Green Teacher

EDUCATION FOR PLANET EARTH

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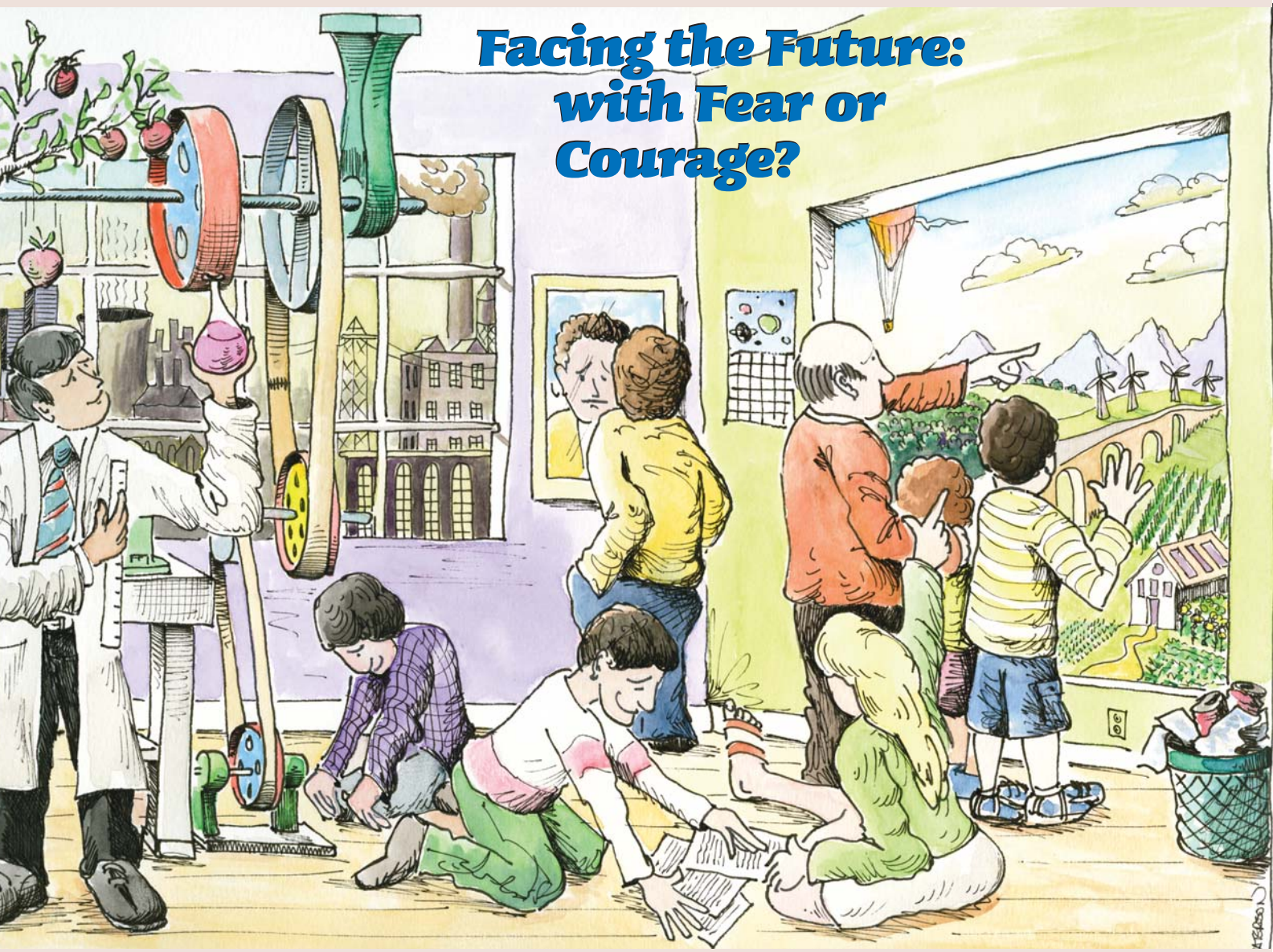

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Editorial

THE summer sun shone round me,
The folded valley lay
In a stream of sun and odour,
That sultry summer day.

The tall trees stood in the sunlight
As still as still could be,
But the deep grass sighed and rustled
And bowed and beckoned me.

("The Summer Sun Shone Round Me" by Robert Louis Stevenson)

IN THE "STREAM OF SUN AND ODOUR" that is Summer here in the Northern Hemisphere, many of us use this time of year to slow down, get away and reflect. In this seasonal spirit, we present four articles to help us reflect on our goals as educators. In the first,

Richard Kool challenges us to think about the images of the future that we convey to young people. To counterbalance the foreboding that inevitably comes with environmental diminishment, he suggests that we talk about, and practice age-old virtues such as respect, hope and courage. In a different vein, Sheila Geisbrecht presents "localism" as a means of reorienting education, thus enabling young people to better know the region in which they live. Rosalyn McKeown and Charles Hopkins make a persuasive case for re-thinking climate change education, noting that all the scientific evidence to date has not brought about the significant legislative and behavior changes that are needed to lessen the impacts of a changing climate. Finally, since behavior change is an important goal of all environmental education programs, four Michigan educators suggest that we use different strategies, based on whether one provides short programs to many groups or one sees the same kids over an extended period of time.

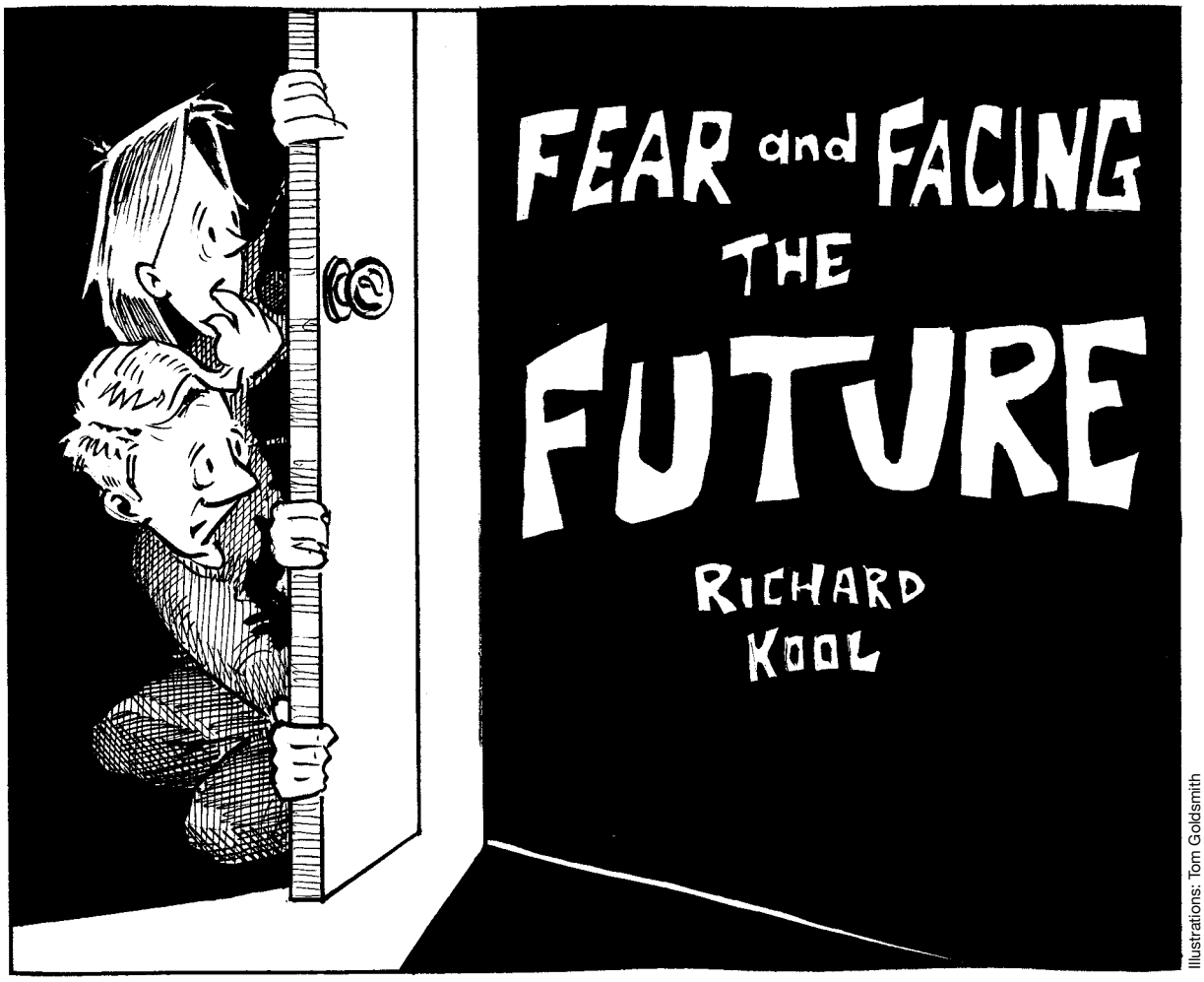
Beyond these analytical pieces, you will find several innovative, practical learning strategies. You will read about projects in South India and southern California which not only teach young people how to grow food efficiently, but also encourage them to think about food systems. Also included are a math activity about the amounts of waste generated in schools, art activities that explore the natural world and an article about using remote cameras in schoolyards to promote thinking about what can be done to make these areas more conducive to wildlife.

In the sultry days of summer, we need both reflective and practical ideas to help us to become more effective educators. And we also need to take the time to listen to the sigh and the rustle of the deep grass.

—Tim Grant

A Special Thanks to Gail Littlejohn

Observant readers will have already noted that only one photo appears at the top of this column. After 19 years of editing Green Teacher, Gail Littlejohn has moved on. I long ago lost track of how many of our 1500 contributors have asked me to convey their highest praise for her elegant and thoughtful rendering of their submissions. It is hard to imagine an editor who has made a greater contribution to environmental education. Needless to say, we owe her an enormous debt of gratitude. She will be missed.



Illustrations: Tom Goldsmith

"THESE ARE THE TIMES that try men's souls," wrote the American patriot Thomas Paine in the dark December of 1776 when it was uncertain whether the American Revolution would succeed. In J.R.R. Tolkein's *The Lord of the Rings*, Frodo expresses the same feeling:

> *Frodo:* I wish the Ring had never come to me. I wish none of this had happened.
>
> *Gandalf:* So do all that come to see such times, but that is not for them to decide. All we have to decide is what to do with the time that is given to us.

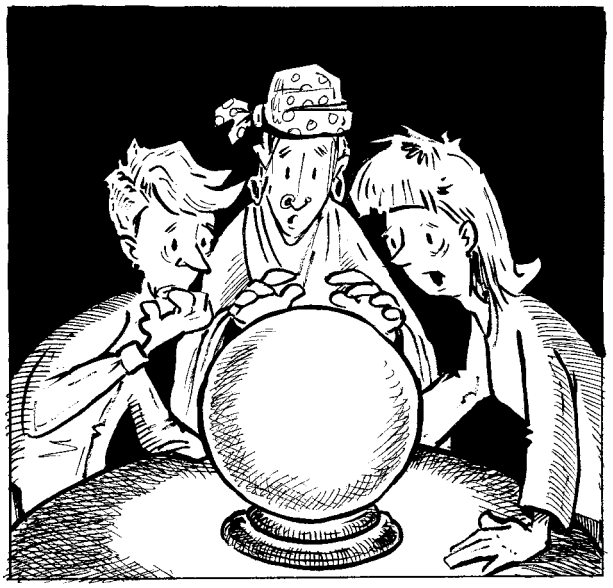
Each generation has to face the challenge of living in an imperfect world not of their making, and to face their fears about the future that will be left to their children. Yet in many ways, the near-future looms significantly in the lives of both students and teachers. We are confronted daily with stories about economic turmoil and the potential for widespread economic chaos, about the possibilities of pandemic disease, about increasingly unpredictable and even catastrophic weather, about species and habitat loss and extinctions. Of course, none of this is certain: we can't know the future. But from one grim prognosis to another, the future appears to be risky, and we as educators need to be able to consider how we talk with our students about the world that they will inhabit.

The past, present and the future

For most of humankind's existence, people have lived in a technologically simpler world governed by traditional values and ways of living— a world in which concepts of economic growth, of technological progress, and of a future radically different from the present were likely not known or much worried about. Whereas we perceive change to be a constant, one can imagine that for most of human history, relative stasis was the norm in a world governed by the rhythms of the earth and the cycles of life, one season following the next, one birth following one death, proceeding across the generations. Indeed, in his recent CBC Massey Lecture, anthropologist Wade Davis noted that during the Paleolithic period, humans' criteria of beauty seemed to be stable for 25,000 years.

Most of us are aware of the future in ways and to a degree that might have been unimaginable in earlier times or different places. We now believe that the future will inevitably be different from our own times, and we are aware of its potency and potentiality, and of our influences over it. We all carry, individually and collectively, an image or vision of the future. In stable, healthy and hopeful times, our individual and collective vision of the future can show us a path forward, one we can take with confidence in the correctness of our direction. Such a vision is "the more or less explicit claim or expression of a future that is idealized

in order to mobilize present potential to move into the direction of this future."[1] (Van der Helm, 2009, p. 100). In contrast, in unstable times of despair and doubt, our vision of the future may be a source of fear.



Perhaps it was Bill McKibben, in his 1989 book *The End of Nature*, who first crystallized an idea surfaced earlier by folks like Rachel Carson and Aldo Leopold: that the future in front of us may be of a diminished and damaged web of life. McKibben pointed out that there was no place left that was 'natural', and that human influence extended every place as even the atmosphere was now a human artifact, changed beyond 'natural' by the impact of human industrial activity. That activity is now also reflected in the scholarly papers written for the scientific journals. Reading those papers can leave one with a sense of loss and diminishment, a sense of increasing risk around climate change, loss of habitat, fisheries disappearing, Antarctic ice sheet disintegration and more. With such disturbing findings, is it any wonder that we – both young and old – might be concerned with the future?

When we as a culture have, by our collective actions, negated the possibility of realizing our individual dreams — and all of us have similar dreams related to the flourishing of our personhoods, families and communities — what do we tell our youth? When our images of the future are increasingly of loss and diminishment, of extinctions, of pollution, of rising sea levels and shrinking glaciers, what and how do we teach our children?

We can imagine a variety of futures. When our desires and expectations for the future are confronted by a present reality that radically differs from that expectation, what can we do? If, in fact, our expectations are nothing more than wishful thinkings which bear little relationship to the future that our present actions seem to be generating, our self-deception can not and will not serve us well. Our vision of the future needs to have the power of hopefulness and not the pathology of deception. There is a power and greatness in a view of the future that is both hopeful and at the same time a vision with motive force.

> *The rise and fall of images of the future precedes or accompanies the rise and fall of cultures. As long as a society's image is positive and flourishing, the flower of culture is in full bloom. Once the image begins to decay and lose its vitality, however, the culture does not long survive. (Polak, 1973, p. 19)*

When we talk about the future with youth, do we offer images of a hopeful future, and by this I mean a future that is both desirable and achievable through collective and individual actions? Or do we present images of despair? Is our image a dystopian vision of the future as hell, or a utopian one, a vision of heaven? Do we feel that we can influence the future for good or ill, or do we believe we are powerless? Is the future already determined, or can we change the course of history through actions needed to make our vision a reality? Do we have a vision that is optimistic, healthy and hopeful, or pessimistic, sick and hopeless? These are questions that we as educators need to ask ourselves and reflect on the cultural zeitgeist as we talk with our students about the present and future.

"The future may well be decided by the images of the future with the greatest power to capture our imaginations and draw us to them, becoming self-fulfilling prophecies" (Olson, 1995, p. 34). Indeed, Fred Polak, author of *The Image of the Future*, felt that "…the potential strength of a culture could be measured by measuring the intensity and energy of its images of the future. These images were seen to act as a barometer indicating the potential rise or fall of a culture" (1973, p. 300). While the influences of a culture's positive vision can become self-fulfilling, so too can the influences of pessimism and despair. When a culture's aspirations die out, as the psalmist tells us, the culture dies: "Where there is no vision, the people perish." (Proverbs 29:18). The philosopher Alfred North Whitehead provided this memorable image of a culture's movement into the future:

> *When man ceases to wander, he will cease to ascend in the scale of being. Physical wandering is still important, but greater still is the power of man's spiritual adventures — adventures of thought, adventures of passionate feeling, adventures of aesthetic experience.... Modern science has imposed on humanity the necessity for wandering. This progressive thought and its progressive technology make the transition through time, from generation to generation, a true migration into uncharted seas of adventure. The very benefit of wandering is that it is dangerous and needs skills to avert evils. We must expect, therefore, that the future will disclose dangers. It is the business of the future to be dangerous"* (1925, p. 208).

Danger and Fear

"So, first of all, let me assert my firm belief that the only thing we have to fear is fear itself—nameless, unreasoning, unjustified terror which paralyzes needed efforts to convert retreat into advance" (Franklin Delano Roosevelt's First Inaugural address, 1933)

If it is, as Whitehead puts it, the business of the future to be dangerous, then we have to come to terms with the fear

that danger may elicit. One way to do that is to try to control the external danger that generates the fear; the other is to control our internal fear. The classic responses of virtually all animals to an external danger are the same: to *fight*, take *flight* or *freeze*. The appropriate response depends on the circumstances. If you believe you can better your opponent, you will stay and fight. If you cannot, and you are swift or clever, you will flee by running away. And if all else fails, you may freeze and hope the danger goes away.

It is clear that the changes in our global environments described by modern science pose real dangers both to us as humans and to the natural systems of which we are a part. Which of these three responses would be reasonable given that global situation? Clearly, *freezing* is out of the question, yet many politicians and decision makers within the global community seem to want to do nothing about the various crises facing us, preferring instead the status quo. The status quo is also supported by 'deniers.' There are 'deniers' for all sorts of issues — climate change, carcinogens, acid rain, clear-cut logging and so on — and all make a pitch for freezing in the status quo. Their modus operandi is, first, to deny that there is a problem at all, then downplay its severity or predict economic ruin if it is addressed, and then propose relying on human ingenuity and technological progress to solve the problem, all the while exploiting scientific uncertainty, using decontextualized scientific reporting and flawed studies by non-scholars or pseudo-scientists, and insulting those scientists and politicians who are pushing for change. (Moser & Dilling, 2004)

Freezing might be a typical societal first response to crisis, but we can freeze individually, too, feeling that the problems we face are too great. When we do look at the large-scale problems in front of us, we can end up feeling helpless, and we can feel hopeless in the face of the situation. Yet the option to freeze, cannot be the message for our youth, nor can we teach a response of hopelessness and helplessness.

Fleeing is a second response to danger. In our current state of economic uncertainty, the Canadian government's response of "economic stimulus packages" seems to be a fleeing from the real issues. Governments are acting as if simply throwing money towards more of the same — continuing to support our outmoded and destructive 19th and 20th- century industries and institutions — will surely make things better. Marshall McLuhan (1967), the great Canadian media theorist, referred to this kind of thinking as moving into the future with our eyes firmly planted on the past:

> *When faced with a totally new situation, we tend always to attach ourselves to the objects, to the flavors of the most recent past. We look at the present through a rear-view mirror. We march backwards into the future…. Spaceship earth is still operated by railway conductors.*

We cannot recommend this kind of response to danger to our youth either. We cannot flee backwards into an unsustainable past and expect that doing more of the same will be an adequate response to the challenges of tomorrow.

The only response that looks straight at the danger and confronts it in an active manner is *fighting*. Fighting takes skill, knowledge, strength and, above all, courage. It can also take collaboration, coordination, conversation and compromise to achieve one's ends. If we are going to fight, it must be against the greatest opponent that all profound revolutions are fought against: our present-day understandings and actions, our assumptions and presuppositions. The great economist John Maynard Keynes wrote "The difficulty lies, not in the new ideas, but in escaping from the old ones, which ramify, for those brought up as most of us have been, into every corner of our minds" (Keynes, 1935). We have to force our eyes away from the rearview mirror and look clearly out through the front window.

Our form of fighting has to involve consciously planned responses to danger and our resulting fear, based on our best knowledge and understanding. Means do influence ends, and the means of our fight will have impacts on the ends achieved. If we are to be successful, our response to the dangers of the future will have to involve resistance to the pressures and systems that force us to adopt unsustainable means of operating. To tell youth that they should freeze in the status quo is of no use. And in truth, where can we flee to?

Facing our fear and the future

So how do we talk to youth about the future? If Whitehead is correct and it is the business of the future to be dangerous, and the science of our times tells us that the future is dangerous, we need to talk about that. And the truth is that the recent future has always been dangerous, especially since the rise of modern science. As Whitehead says, each generation faces its own dangers and needs skills both to disclose and to avert evils. Tolkein put into Gandalf mouth the words about having to decide what to do with the time given to us; one must work towards the fulfillment of a vision, but realize that it's fulfillment may be a long time in coming.

But what are the skills and attitudes we need? From his prison cell, the Lutheran pastor Dietrich Bonhoeffer, later executed by the Nazis for his role in a plot to murder Hitler, wrote in 1944, "We have spent too much time thinking, supposing that if only we weigh every possibility in advance, everything will somehow happen automatically. We have learnt a bit too late in the day that action springs not from thought, but from a readiness for responsibility" (Bonhoeffer & Gruchy, 1991, p. 295). A readiness for responsibility is clearly a key for the skill that we need, youth and elder alike.

We also need the skills of effective action in a variety of

arenas, from individual actions to the expression of collective political will. We will face an uncertain future together. We have to organize, to talk and to push each other, and pushing is an attribute that youth have always done and always done well. Facing the future means that solving the problems that **we** face collectively is not just **my** personal problem, and that only by working together as a **we** can those problems facing us be solved. The problems are large and there are many places where we can put our energies; indeed, the collective **we** have to put our energies into many places at the same time to see the kinds of results that we need to see. Arne Naess, the co-creator of the Deep Ecology Platform, used to say that "the frontier is long," and we all have a place where we can work to break through the barrier to the other side.

We have to talk about the fact that our lives need to be purposeful and have meaning (e.g., Frankl, 1984) because it is that sense of purpose and meaning that will attract us, will pull us, towards the future that we want to see. Throughout human history, one clear purpose of human life, as Aristotle noted more than two thousand years ago, was to live well, to flourish and achieve a state of happiness and satisfaction: but our happiness cannot simply reside in material wealth and prosperity that is only available to a relatively few of the global many. As educators, we can engage with our students to consider the nature of happiness and the impact of mass consumerism on both happiness (e.g., Bok, 2010; Lane, 2000) and on the sustainability of the entire human enterprise. A skill for confronting the future might be the ability to develop a range of purposes for our lives, considering what we can and should do with the time that is given to us. Emma Wood Rous, writing in Green Teacher #69 (2002) had her high school students read Walden, and then write their own version of "What I Live For," following Thoreau's "Where I lived and what I lived for" chapter, thus potentially at least, making the natural idealism of youth explicit.

What are the qualities that will allow us to flourish? When we talk to youth about the future, we have to talk about those qualities that our postmodern world sometimes forgets, but that have been the hallmark of the best of our societies for millennia. Regarding these qualities, Aristotle wrote "The things we have to learn before we can do them, we learn by doing them ... men become builders by building and lyre-players by playing the lyre; so too we become just by doing just acts, temperate by doing temperate acts, brave by doing brave acts" (*Nicomachean Ethics*). These qualities are those such as friendship, courage, self-restraint, wisdom, and a love of justice, along with respect, caring, frugality, awe and hope. These are what the ancients called **virtues** – dispositions and habits that lead to right actions – and it has long been known that the only way to learn them is to do them: one can't learn these through teaching, but only through practice, until they become habit and to **not** do them becomes nearly unthinkable. We need to identify and then practice, over and over, the virtues that will allow us to move with courage into the future. Likely more than anything that can be measured in standardized exams, these are the tools that we will need to face the future.

As teachers, focusing some of our efforts on the analysis of our cultural understanding of where happiness comes from may help to enact the needed education which asks us to consider whether human well-being is necessarily derived from material possessions, wealth or fame. Indeed, the research is becoming increasingly clear that economic prosperity, beyond a certain point, does not cause happiness, but the converse may be more correct: happiness may result in economic prosperity. Since our society seemingly fails to teach us what actually brings about happiness, most of us fail to act in ways that are in fact good for us.

All of this – for example confronting the environmental changes that are now going to happen even were we to stop emitting CO_2, or confronting the lie that we can 'grow' our economy forever and purchase happiness through an endless succession of consumer items – will require courage: courage will be of particular value and an important virtue for youth. We will need courage to create alternative images of the future, images that we want to live in and that can be achieved given the changes that are already unfolding in front of us, and then the courage to map our pathway to that future. Rav Nachman, the 18th century Chassidic rabbi and sage, spoke about courage: "The whole world, and everything in it, is a very narrow bridge. And the important thing is to not be afraid at all." This is a truth for our time. We all have to begin walking on that narrow bridge. Our job as teachers is to learn, together with the youth, the knowledge, skills and beliefs necessary to make the crossing. And to not be afraid.

Dr. Richard Kool is an associate professor at Royal Roads University in Victoria BC. He is interested in the emotional work of environmental education and educators and struggles daily to have the courage to do what needs to be done.

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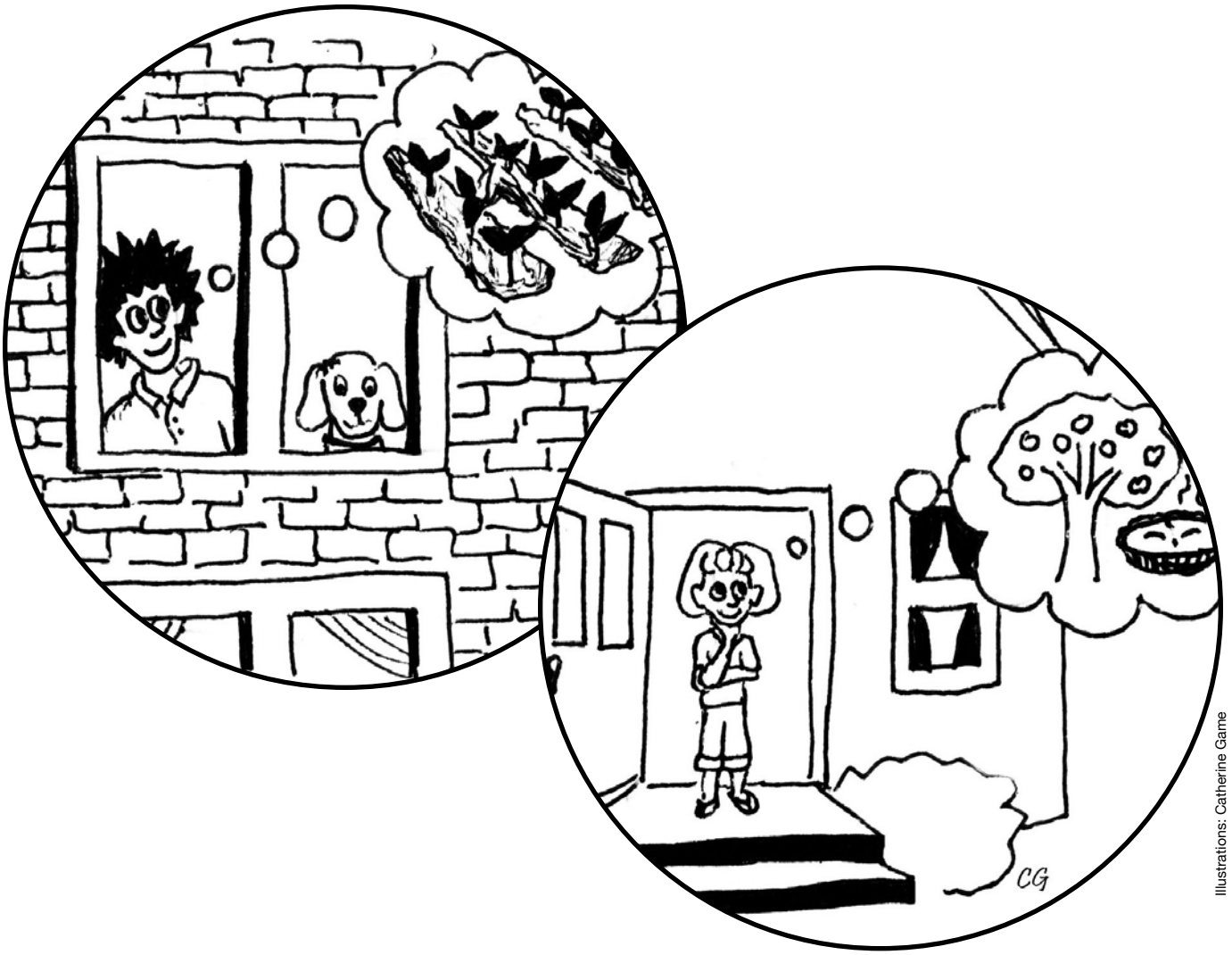


Illustrations: Catherine Game

Growing Behavior Change

Whether your interactions with young people occur over a long or short-term basis, you need to use different strategies if you hope to change their behavior.

By **Catherine Game**, **Andrea Liberatore**, **Ericka Popovich** and **Michaela Zint**

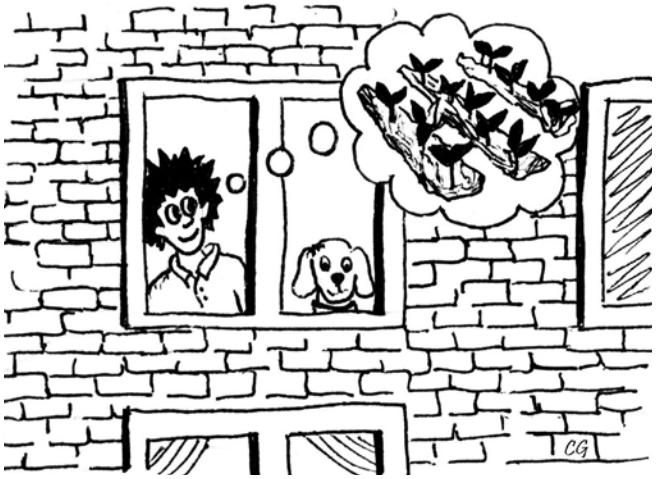
HAVE YOU TRIED TO GET young people to switch off the lights when they leave a room or spend less time on the computer and more time outside, or use a refillable water bottle or eat more vegetables? Encouraging individuals of any age to change their behavior is not an easy task. Yet fostering changes in individuals' behaviors is often an important goal for environmental educators.[1]

Intuitively, many environmental educators believe that by increasing students' knowledge of environmental issues or by raising their concern about the environment, they will be more likely to act in environmentally sustainable ways. It has been about 20 years since this intuitive model was questioned by Hines et al (1987) and subsequently, Hungerford & Volk (1990). Consider the following example: Many individuals struggle to drive less. These individuals know that fossil fuel use and automobile emissions contribute to global climate change, drive wars and tensions in the Middle East, and contribute to health problems like asthma. But does this knowledge translate into driving less or using alternate modes of transportation? Often the answer is no. Something else is needed to propel these individuals into action. But what?

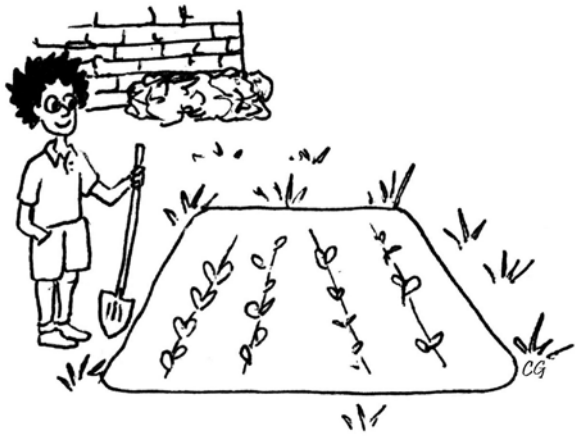
We believe that "growing behavior change" is very similar to growing plants in a garden. In both instances you need the right tools, a supportive environment, and some know-how to get your seeds to grow. Take Frank and Fiona, for example. Both love to garden, but they have different goals for their gardens, different yards with varying types of soil and sunlight as well as different lifestyles. Because of these variations, they have very different approaches to their gardening.

Topsoil: Surface Story

Frank lives in an apartment with a small, sunny yard. He has asked his landlord for permission to grow a garden. Because he will likely move next year, he decides to plant a small patch of vegetables that will be delicious and beautiful, but will not last through the winter.



The Garden: While ambitious, the garden is small and therefore easy to set up. The plants will need only one growing season to produce.

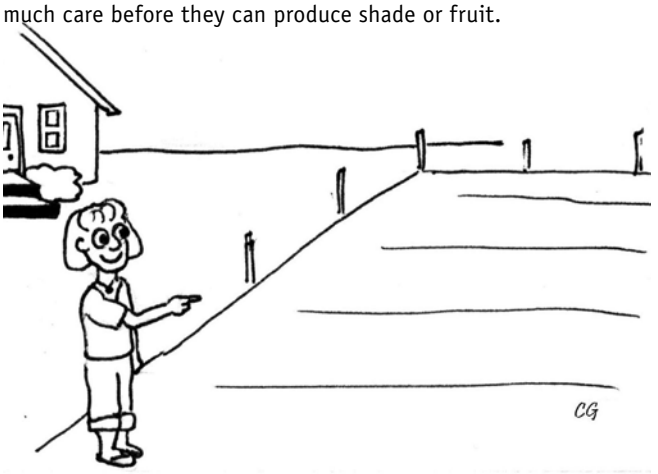


Frank's Approach: Because he is only growing small plants that do not have deep roots, like lettuce, carrots, and tomatoes, Frank only needs to work the topsoil of his garden.

Subsoil: Deep Story

Fiona owns her own home with a large yard and plans to live there a long time. She wants some trees to shade her house, which gets very hot from the summer sun. As someone who loves to make pies, she would also like some fruit trees which can provide for her year after year.

The Garden: Large and planned for the long term, Fiona's garden takes longer to set up. The plants will need many seasons and much care before they can produce shade or fruit.



Fiona's Approach: Trees and shrubs need to be planted deeper in the soil, so Fiona initially invests a lot of time and effort digging deep into the soil to ensure her plants will be able to develop strong roots that grow deep into the ground, giving them strength and stability.

The Results: Frank produces a vegetable garden relatively easily and in a short amount of time, although he will have to start the process over again if he wants to grow vegetables again next year.

The Results: Through her longer-term commitment, and continuing care, Fiona produces trees that provide both shade and fruit, and survive for many years, although it takes several seasons before she sees the results of her hard work.

As you can see from these two gardening stories, different situations require different approaches. The same is true for teaching and for encouraging behavior change in students. Depending on what you want the end result to be, the way you set about achieving your goal may also differ.

Which gardener do you relate to as an environmental educator?

You can relate to Frank if you...

- Have a limited time period in which to teach students
- Seek to produce results in the short-term
- Are less concerned about long-term results
- Work with many different groups of students over a limited timeframe
- Start from the beginning with each new group
- Target student characteristics that are most amenable to change

You can relate to Fiona if you...

- Have a relatively long time period in which to teach students
- Seek to produce results that will last/be durable
- Are less concerned about results in the short-term
- Work with the same group of students over an extended timeframe
- Can build on previous environmental education programs
- Target student characteristics that are deeply embedded and likely to be difficult to change

While some of us may work with twenty students every day for a year in a classroom setting, others engage thousands of students once a year at zoos or botanical gardens. Whatever your educational setting, there are specific strategies you can use to foster environmental behavior change.

The Franks:

If you are a "Frank", you are likely providing short-term, unique, and memorable experiences for students. Perhaps you work at a museum, coordinate exciting annual events or conduct workshops. Like Frank's vegetable garden, your experiences with students may be significantly limited by time. There are certain behavior change strategies that are likely to be particularly appropriate in these situations. Specifically, creating supportive environments for behavior change and fostering different types of knowledge, described below, can be important first steps.

Supportive Environments: The six strategies below help to cultivate a supportive environment for behavior change:

- **Resources** – Be sure to provide the range of materials or access that participants may lack and that prevent them from engaging in the target behaviors.[2] These may include material needs, access to funding for teachers and other leaders you work with, educational resources for future lessons, opportunities for collaboration with other institutions, or even simply the time to learn and practice a behavior in a supportive setting.
- **Attention restoration** – Individuals have a limited ability to concentrate, which is easily used up in this age of electronic equipment and multi-tasking, leaving us feeling burned-out and mentally fatigued. This strategy suggests that it is important to provide opportunities for individuals to restore their capacity to direct attention (i.e. helping participants focus). This occurs through pathways such as spending time in nature, in quiet individual thought, or meditation. When properly restored, individuals are more focused, relaxed and personable.[3]
- **Exploration** – Draw on people's innate desire to be always discovering, testing, and improving their knowledge, skills, and competencies at their own pace.[4] All students learn differently, and this allows individuals to tailor their learning to their own particular style and needs, which leads to greater retention of knowledge. Challenging students to design their own solar energy ovens is one example of a program that allows students to explore at their own pace.

- **Repetition** – Offer multiple opportunities for individuals to learn skills related to the same or similar behaviors to help them remember how to do it in the future.[5] While this is often a challenge for many 'Franks' it is important and can be accomplished through coordination with other institutions and initiatives in the area. Repetition can also be achieved by making sure programs given in non-formal education settings align with school curricula. For example, one might develop a program on water conservation to link with their city's new public campaign on the same topic. This could also align with relevant state education standards, for which lesson plans can be developed and distributed to teachers who further reinforce the concepts in their classrooms.
- **Positive environment** – Positive emotions help broaden the scope of information individuals are able to consider and make it easier for them to build on their existing knowledge.[6] Presenting solutions, in addition to information about the problem, helps to foster a more positive learning environment by making individuals feel comfortable and competent. For example, when discussing climate change, help students learn about local efforts to curb emissions.
- **Feedback** – Information about one's performance provides them with the knowledge needed to make improvements in the future.[7] Individuals may not continue with a behavior if they are unsure if they are performing it correctly, or if they are unaware of how their ability or effort measures up to others. Allowing participants to practice a behavior through a game or mock scenario, such as proper separation of recyclables and non-recyclables, and providing immediate feedback on their performance can be instrumental to their learning to perform that behavior correctly and comfortably.
- **Knowledge** – The two different types of knowledge below are typically needed to support changes in individuals' environmental behaviors:
  - **Issues/Consequence knowledge** (What is the problem?) – This includes information about environmental problems and how an individual's actions influences or impacts those problems.[8, 9] In a unit about recycling, teach students why recycling is important (i.e. landfill problems, energy conservation, etc.)
  - **Procedural knowledge** (What can we do about it?) – This knowledge is based on information describing which behaviors may help to address an environmental problem, how to carry out a desired behavior, and what resources are required.[10] In the same unit, teach student how and what to recycle. Explain where recycling bins are and practice with different types of materials.

The Fionas:

If you are a "Fiona", you probably work in an educational setting where you have long-term interactions with consistent groups of students. You may be a classroom teacher, a scout troop leader, or a mentor. Like Fiona, you can create change over the long term by working on a deeper level with students. Even when targeting this deep level, it is still important to create a supportive learning environment and use the two types of knowledge described earlier. At the same time, however, it will also be important to incorporate additional strategies that can contribute to changing behaviors in the long term. These strategies are described below.

- **Self-efficacy** – This refers to the extent to which individuals feel that they can affect change or contribute to solutions through their actions.[11, 12] Providing students hands-on experience with authentic environmental issues or challenges can affect their sense of self-efficacy. A class can analyze their school's air quality and make recommendations for improvement, or identify and evaluate options for the cleanup of a nearby stream. Whatever the project, students should feel a sense of success upon its completion.
- **Social & personal norms** – People are naturally attuned to the behavior of others and are influenced by what they see other people doing, as this is how we identify the type of behaviors that are expected in a specific context [social norm].[13, 14] People may also attribute their behavior to an internal expectation they have for themselves [personal norm]. Because people are very sensitive to what others around them do – especially friends and loved ones – the altering of social norms can also influence personal norms. One example of a campaign to influence social norms comes from the Greenhills School in Ann Arbor, MI. In trying to encourage students to stop using bottled water, an environmental club made an effort to establish reusable bottles as 'cool'. This involved the sale of specially designed Greenhills School reusable bottles, a school-wide communication campaign about the negative impacts of plastic bottles, and having students demonstrate their use.
- **Meaningfulness** – Feeling personal ownership and a sense of empowerment as a result of engaging in a behavior helps to align that behavior with one's sense of identity and values.[15] Actions that allow students to behave in ways that are consistent with their values can foster behavior change. Environmental educators can help by providing students with ownership over what they do – let them choose which behaviors to participate in, make environmental lessons locally relevant, or connect new information to something they already care about. Maybe a student is not particularly motivated to clean up a riverbed, but after learning that the water in the river is the same water they drink, a meaningful connection can be established.
- **Attitudes** – An individual's personal feelings toward a behavior can influence their willingness to try it.[16] Changing attitudes can also be challenging and may rely upon influencing other characteristics first. Similar to meaningfulness, a supportive environment where a student can learn about a new behavior, become comfortable practicing the behavior, and observe others engaging in this behavior can help influence their attitude toward the behavior. We can influence our students' attitudes toward conservation through providing them with relevant information, stressing its importance with social norms and modeling environmental behaviors.

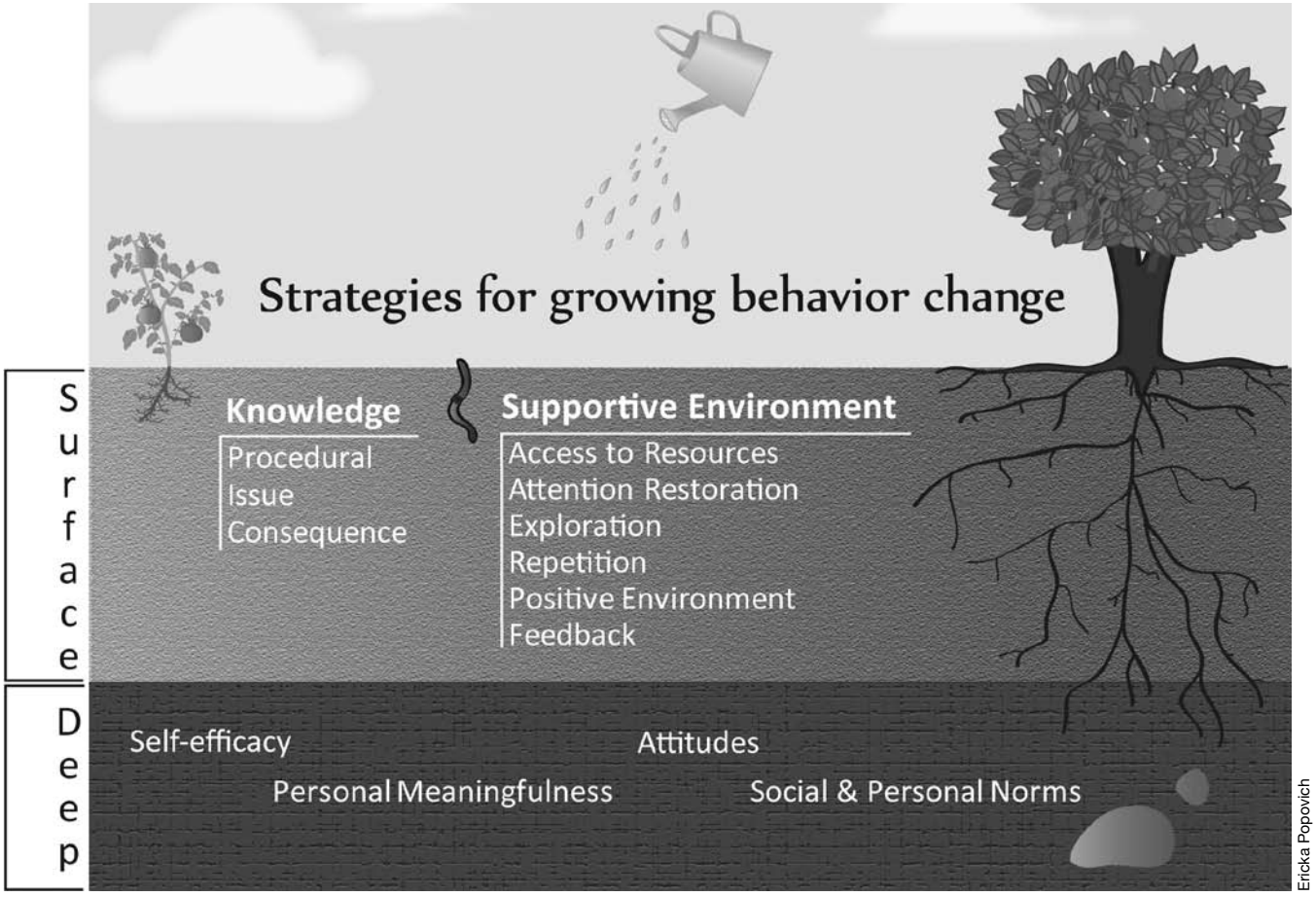
The Educator's Toolshed

Even though Frank and Fiona created completely different gardens, they both needed tools and resources to make their efforts a success – trowels, seeds, water, and more! To grow behavior change, educators can similarly draw on a set of tools and resources. Specific strategies include social/group learning, case studies and stories, goal setting, rewards, and commitment (see image at right).

Catherine Game

Grow your own garden…

The strategies, tools, and steps of this garden model for growing behavior change are intended to help you design environmental education programs that achieve your behavioral outcome objectives and to develop active environmental stewards. Keep in mind that no one strategy or tool will work with everyone or every time – often programs that are most successful at changing behavior employ multiple strategies and tools over extended periods of time, and are adapted to their specific location and situation. By combining and applying the concepts described in this article, you will be utilizing research-based methods[17] and thus, be more likely to foster changes in environmental behaviors[18].



Ericka Popovich

Four Steps to Growing Behavior Change

To maximize the ability of your program to change behavior, we recommended following a four step process, as demonstrated through the example of a recycling education program.

1) **Goals:** *Identify which behaviors you want to change.*
   The Emerald Forest Alliance (EFA) would like to initiate a new recycling education program for schools, providing in-class presentations about local recycling facilities. They hold a meeting to determine that the primary goal of the program is to increase student and teacher participation in recycling.
2) **Audience:** *Ask your audience what barriers they face to changing their behavior.*
   To determine which behavior change strategies to apply, the EFA surveys local students and teachers to identify why they are not currently recycling. The surveys reveal a number of reasons why students do not recycle in schools. Students do not know which items are recyclable or where to recycle them. In addition, most students have never seen their friends recycle. The surveys also reveal that most teachers do not believe that their small actions of recycling make a big enough difference to be worth the effort.
3) **Strategies:** *Apply strategies that address the barriers your audience faces.*
   While there are several surface level barriers that seem to be at play with the students (knowing where and how to recycle), the EFA learned from the survey that there were deeper issues as well (lack of social norms for students and self-efficacy for teachers). Thus, instead of implementing a one-time classroom program which would not address the deeper issues and therefore may not be successful in generating long-term behavior change, EFA alters the program design to focus on a few specific schools. With these schools, they can focus more resources on addressing all variables of behavior change. EFA develops a program that has students work in groups to learn how to recycle in their school, thereby promoting a positive social atmosphere for recycling through the use of feedback, exploration, and a positive learning environment. In addition, EFA helps teachers work with the school maintenance staff to measure the amount of materials their classrooms recycle, thus providing feedback to teachers and students on their performance.
4) **Evaluation:** *Determine whether your program changed behavior and how it can be improved.*
   After conducting an evaluation of their program, EFA learns that recycling behavior increased for teachers and students! However, teachers from one school commented that their recycling bins were overflowing and becoming a problem for maintenance staff. To address this, EFA volunteers to provide larger recycling bins that can hold more recyclables.

Catherine Game, **Andrea Liberatore** and **Ericka Popovich** are recent Master's graduates of the University of Michigan's School of Natural Resources and Environment in Ann Arbor. **Dr. Michaela Zint** is the students' faculty advisor. The authors would like to thank Dr. Ray De Young, and fellow students Annie Gregory, Katherine Hollins, Alison Richardson, and Amanda Stone for their contributions.

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Localism as a Guiding Framework for Schools

Julie Tracy

By **Sheila Giesbrecht**

MY MOTHER TELLS THE STORY of life in her idyllic early childhood. They lived on a peach farm and her family life was filled with local pursuits; picking fruit, tending garden and selling produce at the local farmers market. On warm summer evenings, her grandmother and her cousins would come from the next farm over to play in their hayloft. Evening hymn sings, family picnics and community events were all part of my mother's "local" life.

Today, my family's life is radically different than that of my mother. Each morning our family separates. I commute to an office while my children travel to school. We return in the evening with bags of food purchased at the local supermarket. In the evening we sit down to television and watch the lives of others, funnier, more interesting and more glamorous than ourselves. Our lives are framed by the modern values of mobility, consumption, entertainment and choice.

Our societal orientation to the modern values of mobility, consumption, entertainment and choice pose grave environmental and societal challenges, which call us to move towards more sustainable ways of living as a society. Localism is a philosophical idea that may provide a framework to move us in this direction. In this essay, I will attempt to create a picture of what localism is and how a reorienting of education to these ideas can help return us to more sustainable and humane ways of living.

Localism is an idea where individuals and communities prioritize the local over the global. Local food, issues, arts, businesses and projects become important. Individuals oriented towards localism are more likely to choose to buy an apple from the farmer's market, than a bag of apples shipped to a supermarket from a distant source. Individuals oriented towards localism are more likely to attend a community art show than watch the latest Hollywood movie. In a local orientation, ideas, issues, people and communities become important. The source of creativity, life and nourishment for families and communities moves from external places to local places.

Gruenwald (2003) calls localism a form of re-inhabitation. He suggests that localism can be seen as a conceptual framework to guide our understanding of what it means to dwell in our world. Engaging in actions that demand interaction, negotiation and cooperation with those in our local environment call for more complex human capacities than those needed in our modern, technological world. Communities that are engaged with each other – through business enterprise, through discussions of local issues, through collaborative projects – must move from a theoretic to a concrete

engagement with life. To choose Gruenwald's "re-inhabitation", I must choose engagement with my neighbor over virtual worlds, and local issues over absorption with Hollywood drama.

Similarly, the idea of localism serves as an appropriate conceptual model for education. Like our own lives, our schools are fragmented, disjointed and oriented towards mobility and external worlds. My children's experience of schooling is a fragmented experience. Every 45 minutes, they move to a new topic or subject, a new teacher and new ideas. Often these ideas are disconnected and lack relevance and meaning for their lives. In math they learn fractions. In science they learn about mytosis and in environment class they learn about the deforestation of Brazil. A discussion of what it means to be alive and engaged in their own community is missing from the pedagogy and daily experience of education. The traditional lesson planning structure of "objectives → materials → process → evaluation" frames their day and their work. I wonder about my children's experience of school and how a more localized model could shape their lives as more thoughtful citizens of the world.

John Sherk

In thinking on the authors from different disciplines who have called for re-inhabitation of our worlds – environmentalist Edward Abbey, farmer Wendell Berry, theologian Thomas Merton, and architect Christopher Alexander – I am struck by the common themes in their work. While their call to localism looks different, each advocates the importance of home and place, reflection and dialogue and finally action and politicization of our hearts and minds. Each calls for a radical transformation of our selfhood that happens through active engagement with our communities and lives. In this transforming of self, we come to be the sustainable and compassionate citizens of our world, so desperately needed in modern times.

As an educator and a parent I have dreams for my children. I dream of them being sound citizens of the world and of schools that support these dreams. I have dreams of them moving from a fragmented bell-based system of schooling to an integrative, exploratory approach to curriculum and learning.

I imagine my children going to school each morning and exploring their world. Instead of studying the flooding of the Nile River Delta, they would study the flooding patterns of our local river which swells each spring, often flooding homes and fields. They would come to understand the impact of houses sliding into rivers, farmer's topsoil which is washed away and the impact of a newly expanded dike around small outlying communities. Instead of studying the Rain Forest in Brazil, they would study the effect of diminishing river bottom forests. They might take a field trip to the local forest and catalogue the unique frogs and plants growing there. Perhaps they would walk through the suburban sprawl neighboring the river bottom forest ecosystem and determine that pleasant homes for people are more important than this ecosystem. In any case, they would come to know their own issues, people and communities. Abstract ideas of ecosystems, ecologies, community needs and scientific concepts would be made concrete. Simplified ideas of right and wrong, agriculture and environment, and business and people would be made complex. From deep, rich local explorations, my children would be able to better understand the experience of those living on the recently flooded Yangzi River in China or the Rainforests of Brazil.

I imagine my children engaged in authentic reflection and dialogue. Instead of focusing on the memorization of facts, my children would ask "What facts are important? What things do we need to know? What facts are true and what facts are false?" Instead of focusing on achieving standardized curriculum outcomes, my children would co-construct with the teacher and classmates, the knowledge that is relevant for their lives. Perhaps they would explore the impact of flooding on the Cree Nation in Northern Manitoba or explore the impact of pesticides dumped into the local river. Directive curriculum frameworks would be replaced with curriculum frameworks directed by student inquiry, reflection and dialogue.

Finally, I would imagine the school as a site for the evolution of growing hearts and as a site for the transformation of hardened hearts and minds. I imagine my children moving from local explorations, reflection and dialogue towards action and politicization. Instead of "closing the book" on a topic such as environmental degradation or riverbed flooding after a class or semester is over, my children would be moved to action. Perhaps they would advocate for the school lunch lady to use pesticide free tomatoes in salads, so that fewer agricultural pesticides would enter the local river. Perhaps they would draw a picture or write a poem to advocate for the plight of Indigenous peoples affected by deforestation. Perhaps they would invite another school to join them in creating a documentary on the impact of flooding on the local community. The criteria for assessment would become the transformation of minds and spirits towards empathy and kindness, rather than factual memorization of how rivers expand.

In our schools, we look to worlds far away as our source. We rely heavily on curriculum frameworks to guide "what's important". We give the power for knowing what we should know to Central Offices and curriculum writers in state capitals and government offices. As an add-on to

Regina Weir, Green Map System

required curriculum and pedagogy, we explore the local. We take field trips and explore the bush behind the school. We work with other teachers in our school to make engaging interdisciplinary units.

I wonder what would happen if we turned the model inside-out and upside-down. What if we start with the focus "inside"our own world? What if we look to worlds close by as our source, and rely on our communities and students to guide "what's important"? What if we gave the power for selecting what we should know to our classrooms and schools? What if our "add ons" became the required curriculum and central office pedagogy? What if we add facts, and flow charts and curriculum frameworks to supplement what we have already experienced and explored?

A transformative educative pedagogy

The organization of our educational system with standardized tests and centralized curriculum frameworks seems onerous. It is probable that more innovative and engaging methods of educating our young are necessary if we are to create a society that will be able to care for our world. While it is difficult to conceive how our educational system can turn inside-out and upside-down, a localized education may offer insights.

Schumacher (1977) suggests that human problems cannot be solved by rational thinking alone and that the divergent problems of our world call for the higher forces of wisdom, compassion, understanding and love. It seems possible that the organizing framework of localism can serve as a conceptual model to open children's spirits to these transformative principles of mutual love and care.

Sheila Giesbrecht is an educator who is interested in place-based methodologies, urban issues and the educational experiences of student in low-socioeconomic contexts. Sheila currently serves as a government consultant with a focus on the academic success of students in low income environments. She can be reached at sheila.giesbrecht@gov.mb.ca.

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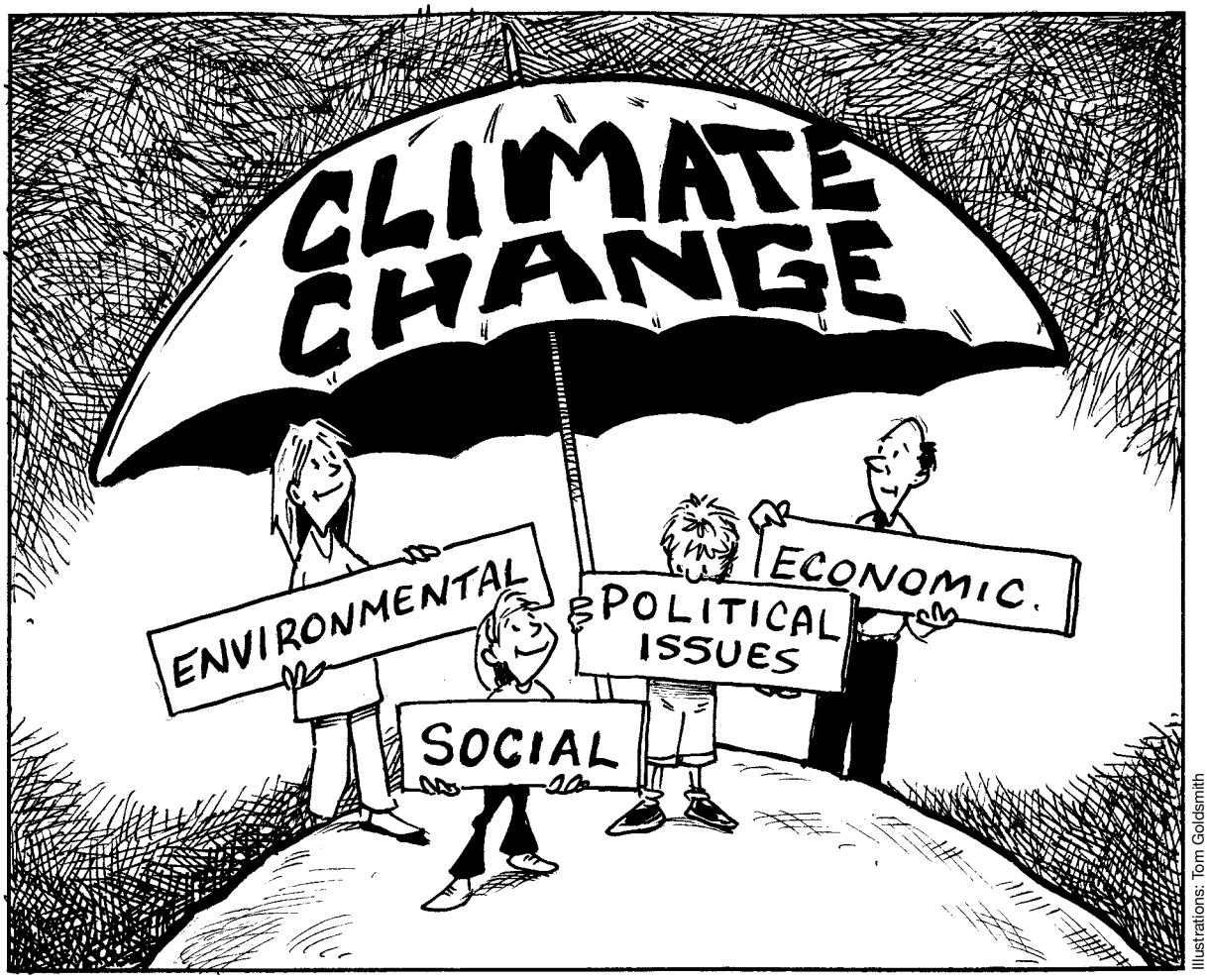
Rethinking Climate Change Education

Everyone wants it, but what is it?



Illustrations: Tom Goldsmith

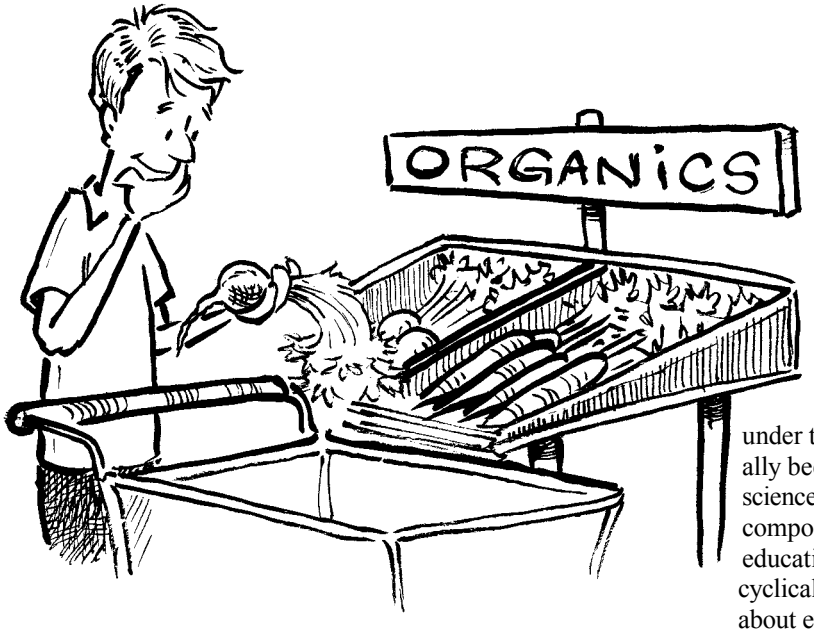
By **Rosalyn McKeown** and **Charles Hopkins**

LAST MONTH, NASA ISSUED A REPORT that predicted 2010 would likely end up as the warmest year on record, due to the combination of global warming and El Nino[1]. Because the vast majority of climate scientists agree that the earth's climate is warming, many organizations and individuals are calling for the implementation of climate change education. Though no one doubts the importance of education in both ameliorating (i.e. lessening) and adapting to this ostensibly man-made phenomenon, there is no agreement of what climate change education is or should be.

In reviewing climate change curriculums and Internet sites, we notice that much of the early work was done by scientists as well as science and geography teachers (CISHDGC, 2002). We applaud their efforts. While science and geography are reasonable starting points, we know climate change, like so many other sustainability issues, has social, economic, environmental, and political roots. As a result, climate change education should also reflect this complexity.

Through systematic scientific investigation, we have known the causes of most environmental problems for several decades. Similarly, the effect of increasing levels of greenhouse gases in the atmosphere has been known for years. However, this science-based knowledge has not brought about policy changes, legislation, or wide-spread behavior changes that are required to adequately address climate change. Solutions to climate change will require engaging the social sciences, in order to develop the societal understandings, cultural keys, and political will that are needed for change to occur.

As we look at the history of education, we see a number of examples where natural science education alone fell short of creating desired changes. For example, sex education that only taught the anatomy of human reproduction did not lower the pregnancy rate. Anti-smoking education that focused solely on naming the toxic and carcinogenic components of tobacco smoke did not reduce smoking. We know from years of experience in environmental education that knowledge and awareness alone do not bring about large-scale societal



change. However, education that includes awareness, knowledge, skills, values, and opportunities for participation does bring about in-depth learning and behavior change. We need to keep this in mind as educational systems around the world define and implement climate-change education.

Climate change: an umbrella paradigm

Climate change is an umbrella paradigm for a host of social, economic, and environmental changes, problems, and issues. Global climate change comes with alterations in the frequency of extreme weather events, agricultural zones, habitat for plants and animals, and geographic ranges for diseases as well as many other consequences. People's livelihoods and patterns of daily life are changing and will continue to change. In some cases this change will be slight and in others substantial. For example, an affluent urban dweller experiencing a rise in temperature and a decrease in rainfall may install air conditioning and pay higher utility costs for electricity and water. To these urbanites climate change may seem like an affordable nuisance. In contrast, farmers who have planted traditional crops for many years may find that drought now shrivels the plants in their fields. They will need to learn how to adapt to this change by selecting low-water crops that are appropriate for the new rainfall and temperature regimes. These farmers will also have to locate new sources of water, not only for their crops but also for their own household use. For them, climate change is life changing.

For both these farmers and their children—who often assist on the farm—it is important that education systems teach more than natural science and mathematics. It needs to embrace teaching people how to adapt and plan for change. The World Health Organization (WHO) defines life skills as "abilities for adaptive and positive behavior that enables individuals to deal effectively with the demands and challenges of everyday life." Everyday life is changing rapidly and will continue to do so, in part because of climate change.

Years ago when the pace of change was slower, one of the goals of education was to help pupils understand the workings of our society and how to be successful in it. However, with technological advances and greater international communication and exchange today, the pace of change has quickened. Teaching how to be successful today without looking to the future is outdated. Enabling young people to predict and cope with change is part of a quality education in the new millennium.

Climate change education: what to teach

Climate change education has two obvious parts: climate and change. The climate part obviously falls under the umbrella of the natural sciences and has traditionally been taught in geography (e.g., climatology) and earth science (e.g., meteorology). Climate includes atmospheric composition and processes. This part of climate change education can be easily updated in formal education through cyclical revisions of the science curriculum that take place about every seven years.

The second part—educating for change—is where the thought-provoking discussions on climate change education need to occur. What does it mean to educate for change? What change is predicted so that we can prepare people to adapt to it? We need to distinguish between educating *about* change—history courses have done that for years—and educating *for* change. We posit that educating for change will help people lessen negative changes, adapt to change, and to promote positive change. Educating for change will require engaging social science and humanities teachers, as well as others.

We think there are six important components to the change portion of climate change education:

- issue analysis,
- community and personal decision-making,
- political processes,
- social justice,
- inter-cultural sensitivity and inter-cultural competence, and
- behavior change

The following are short descriptions of each of these six components. Implementing anyone of these will require far greater description and discussion than space allows.

Issue analysis

Climate change is an umbrella concept that encompasses environmental, social, economic, and political problems and issues facing communities around the world. We think it is important for people to have ways to investigate the things that challenge them and then propose solutions to those challenges. Issue analysis guides people through a process that can be used with any issue. It is a "generic" process that can be applied to a wide range of environmental, social, and economic problems. There are many good methods of issue analysis in the educational literature (Clarke 2000; Ramsey, Hungerford & Volk 1989). See sidebar.

Issue analysis gives individuals and groups the background information they need to understand issues and to

begin to evaluate proposed solutions. Issue analysis skills assist people in untangling the complexity of issues so they can see the roots, consequences, and paths forward. It helps people perceive the values that underlie the opinions of others who support opposing solutions. As such, issue analysis can contribute to informed decision-making processes.

Community and personal decision-making

In a changing world, the ability of individuals, organizations, and communities to select the best course of action amongst many options will be critical. For example, where small-scale farming is the major occupation, changing temperature and rainfall patterns will threaten the food security and source of income for farm families. To choose new crops to grow, they will have to be able to look at many different factors, including nutritional values, soil characteristics, and local markets, etc. Such decision-making is complex. Decisions—both good and bad—will affect the well-being of many people.

Issue analysis and community decision-making are distinctive skill sets. Issue analysis can be the foundational inquiry that helps communities learn about their problem from multiple perspectives and identify options for change. A community decision-making process then uses this information to create an action plan to address those problems.

Political processes

Community decision-making, while a powerful tool for change, has its limitations. For example, in urban areas, if citizens desire changes that involve construction or alteration of major infrastructure (e.g., public transportation and recycling centers), community decision-making alone will not result in those changes being made. Political processes are also involved. In order to change major systems, the public will have to understand the strengths and limitations of the political systems—local, national and international.

Although many students take courses in government and civics, they may still lack the understanding of the political process (e.g., executive orders, legislation, annual budgetary approvals) and grassroots action (e.g., petitions and town meetings) necessary to move solutions forward. All too often those who understand the mechanics of government only from textbooks and classrooms do not have the opportunity to participate in such efforts, so they have no experience or skill interacting with the public within this context.

Social justice

The world is far from being equitable. The gap between the haves and the have-nots is growing, aggravated by the recent global recession as well as climate change. Students arrive at school knowing that things are not right in the world. Many want to know why and would like to do something about it. Issue analysis helps students to understand why, but it takes more than conceptual awareness to undertake effective action. Political action is one means but other avenues for social change exist.

Studying social justice helps pupils put a framework around their feelings of inequity and gives them peaceable paths for action. As with other forms of educating for change, social justice is more than just awareness and knowledge. It also includes analyzing values and providing opportunities to participate, especially through volunteerism.

Inter-cultural sensitivity and competence

If the predictions of planetary change come true, we can expect nearly 150 million environmental refugees over the next 40 years (Conisbee & Simms, 2003). They will be leaving submerged coastlines and regions facing sustained

Issue Analysis

Name of issue: _____

Definition or description of issue: _____

1. What are the main historical and current causes (i.e., physical/biotic, social/cultural, or economic) of the issue?
2. What is the geographic scale, the spatial distribution, and the longevity of the issue?
3. What are the major risks and consequences to the natural environment?
4. What are the major risks and the consequences to human systems?
5. What are the economic implications?
6. What are the major solutions currently being implemented or proposed?
7. What are the obstacles to these solutions?
8. What major social values (e.g., economic, ecological, political, aesthetic) are involved in or infringed on by these solutions?
9. What group(s) of people would be adversely impacted by and bear the cost of these solutions?
10. What is the political status of the problem and solutions?
11. What is a change you can make or have made in your daily life to lessen the issue?
12. Beyond changes in your daily life, what is the next step you could take to address the issue?
13. How is this environmental issue related to other issues?

McKeown-Ice, R., & Dendinger, R. (2008). A Framework for Teaching, Learning, and Assessing Environmental Issues. *Journal of Geography*, 107, 161 – 166.

flooding or drought. Will all of these people relocate in neighboring states and countries? History has repeatedly shown that when people from different cultures are forced together, dissimilarity creates tension that can lead to distrust, which often escalates to hatred and violence. To prevent this escalation, part of climate change education should include preparing some people to leave their communities and preparing others to accept the refugees. This will require a high level of intercultural skills and competence.

Students who go on international exchange programs receive cultural-sensitivity training, as do the people who host them. Similar efforts to raise intercultural competencies will be needed before major migrations occur.

Behavior change

Lessening climate change will require widespread voluntary action by the public. We know that dozens of daily activities contribute to an increase in greenhouse gases in the atmosphere. Daily decisions about what we eat, how we go to work, what we do for recreation, etc., have an impact on the amount of carbon dioxide we contribute to the atmosphere. For the public to reduce CO_2 production in their personal lives, we need to create awareness and, more importantly, a willingness to act.

In the past, education for behavior change has occurred primarily in the field of psychology, and in the preparation of public health workers and other professionals who engage in individual and larger-scale change. However, with relatively large scale changes looming before us, perhaps it is time to teach elements of behavior change to everyone. Behavior change would then become an intentional process to both alter individual habits and actions, and work effectively with others toward a common goal.

A number of tools for social and behavioral change exist. For example, social marketing recognizes and addresses the complexity of changing human behaviors (McKenzie-Mohr & Smith, 1999). Generally, social marketing is a process of: uncovering barriers to and benefits of a particular behavior, building commitment, prompting desirable behavior, modeling and establishing norms, providing incentives to enhance motivation to act, and removing external barriers. We could benefit greatly by extracting lessons from previously successful campaigns to change behavior (e.g., anti-smoking and anti-litter).

Integrating climate and change education

In climate change education, climate and change are both important and interrelated. It is equally important that the change element is informed by the climate element, and the climate element is taught mindful of the social and economic consequences and complexities of change. These two elements—climate and change—cannot be separated, taught independently, and later woven together at an undetermined time or point in the curriculum. We cannot expect students to make linkages between the climate and change elements. The interconnections must be overtly and purposefully taught.

ESD: the best framework

We expect that a great deal of effort will be placed on defining climate change education. We think it is best addressed through the Education for Sustainable Development (ESD) framework. ESD has four thrusts: (1) access to and retention in quality basic education, (2) reorienting existing education programs to address sustainability, (3) increasing public awareness and training, and (4) providing training for employees in all sectors of the economy (i.e., public and private). Although many of the current discussions on climate change education revolve around curricular change within the second "reorienting" thrust, climate change will effect far more than curricular issues within educational systems. For example, climate change affects children's access to and retention in basic education as a result of poverty, migration, disease, and other factors. It will take good governance and policy implementation to deal with these issues within educational systems. In the western world, climate change also will require school boards to consider the carbon footprint of such actions as school construction and renovation, purchasing, transportation, and breakfast and lunch programs.

Like ESD, climate change education should be locally relevant and culturally appropriate. Communities around the world will be facing different expressions of climate change. Each community has its own environmental, social, economic and political contexts. As a result, climate change education will look different in each community. One size will not fit all.

Teachers in every discipline can contribute to climate change education. Students arrive at school with many different skills and interests and it is the teachers' responsi-

bility to engage those different learning styles to teach the mandated content. The same is true of climate change education. Some students will learn through science — observing natural phenomenon, recording and analyzing data, and learning theory. Others will engage through the arts, such as writing, music, painting, and photography. Yet, others will learn through taking action such as awareness campaigns, raising funds, and volunteering their time to address a societal need or a social justice issue. Accordingly, it is important that many approaches are enlisted. We will only reach a small segment of the population if we teach climate change education from a strictly natural science perspective.

Life-long learning

Good climate change education programs will focus on life-long learning and not be limited to primary and secondary education. Public awareness and education programs for citizens of all ages are important, as is training of the current workforce. For most of the world's population, climate change was not included in their school curriculum. Everyone needs to be informed so they can make decisions in their personal and professional lives that will lessen climate change or adapt to it.

Effective climate change education will require coordination of various efforts so that people of all ages, not just pupils in primary and secondary schools, gain the knowledge, skills, and values they need to understand and create solutions for the many issues associated with a changing climate.

Climate change education involves large decisions. What is the scope and sequence? What key messages should the public receive? Which behaviors should be targeted for change—the low-hanging fruit or the highly impactful?

Conclusion

Although we propose two parts—climate and change—and six components for the change portion, we know that climate change education will vary from one geographic region to another depending on local environmental, social, and economic contexts and its impacts on each locality (e.g., drought or flooding). For example, in regions where jobs will change so much that individuals will need new career options, teaching entrepreneurial skills as well as emphasizing creativity and ingenuity is a good strategy.

We are not of the opinion that we have figured out all the answers. Our list of six components of educating for climate change stem from our particular worldviews and the context of our lives and travels. Our aim here is to add to the ongoing dialog. It is our hope that lively discussion ensues about which components of education for change should be in local and national curriculums. We welcome the ideas of other educators and educational policy makers. Perhaps, together we can create quality climate change education programs for all.

Learning is essential to the resolution of climate change issues. Our current textbooks and our existing knowledge base do not contain the answers to the many problems and issues associated with climate change. Our own and the next generation will have to learn their way towards equitable solutions.

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Photographs: The Earth Trust, Tamil Nadu, India

Inspiring Eco-Clubs in South India

By **Vanya Orr** & **Mohan Kumar**

THE NILGIRIS HILL DISTRICT has been described as the lungs of South India, due to its rich biodiversity and dense shola (stunted evergreen) forests. The densely-populated district is part of the Nilgiris Biosphere Reserve and is the main source of water for the rivers of south India. Its temperate climate favours year round cultivation. Over time, tea and coffee plantations have become the dominant crops while in the remaining 25% of agricultural land, very small farms grow vegetables, spices and condiments.

In a nationwide effort to boost food production in the 1960's and 1970's, the Green Revolution introduced chemical agriculture to the Nilgiris. Increasing and indiscriminate use of chemical fertilizers and pesticides reduced soil fertility, leaving degraded agricultural land in its wake. Instead of growing a wide range of crops that in turn supported a varied diet, the Green Revolution encouraged fewer, monoculture crops. In this very poor region, these changes led to a more limited local diet.

With agriculture still in decline, young people continue to leave the land for the cities, and local schools face declining enrolment. For the young people that remain in the Nilgiris area, poverty, a lack of skills and low confidence hold many back.

In 2007 in response to these trends, the non-profit Earth Trust established Eco-Clubs at 2 disadvantaged schools in the region. The success of the Club's extra-curricular activities at these two schools, lead teachers at neighbouring schools to request that the program be expanded. As a result, the program quickly expanded to 16 schools.

With an aim of developing a green consciousness and social responsibility, Eco Clubs promote waste recycling, composting, organic gardening and the efficient use of school land. At the outset, the program introduces group-building outings to natural forests and organic model farms which also helped these 9–11 year old students appreciate the importance of both. These two outings also enabled students to observe first-hand the deterioration in their local environment and to begin to investigate what they can do to stop the deterioration.

The Shola Forest is one of the Nilgiris' most spectacular natural features, consisting of patches of high-altitude (around 2000 meters) stunted evergreen forest separated by undulating grasslands. Since the Shola Forest is 25 kilometres away from the nearest school in a region with few private vehicles, most students have no other chance to visit this special area.

Once permission from the forest department was obtained, these day-long trips for up to 40 Eco Club members were designed to provide exposure to both indigenous Shola

Left: Oyster mushrooms grown in the school. Above: Mixing cow manure, water, cow urine and unrefined sugar, to hasten the decomposition of dry matter in soil.

forests and nearby manmade eucalyptus tree plantations. During the day, students observed the diversity of species in each of these contrasting forests, and learned about the natural, soil-building processes through which a forest matures.

In the following month, each Eco Club visits a model organic farm. Back at school, during the Club's before and after school activities, they gain organic and biodynamic gardening skills, which they use to grow vegetables for their meals at school. They collect traditional seeds and grow older varieties of millets, amaranth and other grains. For children from desperately poor, often remote villages, it has been a passionate and mind expanding program.

One key to the success of the two outings is the way they link local forest eco-systems to a school organic garden. By observing nature, and then undertaking a variety of recycling and composting activities back at school, both students and teachers began to understand the principles and the benefits of organic farming. Confidence and self-esteem of Eco Club students has markedly improved, and an interest in environmental issues has percolated into local communities and government.

With their new understanding of how natural systems work, Eco Club students have started organic gardens at each of their schools. For the first six months, they focus on improving the health of the soil. Then the students moved on to organic gardening, experimenting with mixed cropping, crop rotation, composting, preparing growth promoters, and harvesting seeds.

Almost immediately, these gardens became lighthouses for the rural populations around them. With once a month parent-teacher association meetings, parents began to notice the organic gardens and the activities of the Eco Club at their children's school. This encouraged many parents to create their own organic "kitchen gardens" at home. For example, at Thenali School, this lead to the creation of at least 22 organic home gardens.

Eco-Club participants are strongly encouraged to share their knowledge with others. It is fantastic to see how the self-confidence of these disadvantaged students has been enhanced by their new "life skills" and to see the enthusiasm and knowledge that they have gained. These children have become models for their peers, acting more responsibly and transferring eco-friendly practices to their villages. The schools also benefited from the program. Many visitors, including those from overseas, were attracted to the school gardens, which did a lot to further increase the self-esteem of children and teachers. The organic gardens also won praise from higher officials, the local community and neighbouring schools. Eco-Clubs make a difference in creating new life skills, and model for peer groups, social responsibility, and self esteem to both teachers and students.

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Teaching Sustainability with Two Buckets

Environmental Charter High School

By **Sara Laimon**

MODERN AGRIBUSINESS HAS accustomed us to buy almost any fruit or vegetable whenever we want. Finding bananas from Ecuador in the middle of winter is as natural as finding fresh seafood in the middle of the country. The closest that many young people get to the origins of the food on their dinner table is at the local grocery store. Being so far removed from agricultural operations, it is hard for them to truly appreciate the complex web of processes and relationships that brings food to their table.

By contrast, a sustainable food system encourages local production and distribution, and ensures that nutritious food is affordable and accessible to all. Further, it is a humane and just system that protects farmers and other workers, consumers and communities. Our food system is complex, woven with many interrelated parts, and best understood through systems thinking. It is much easier for students to visualize and appreciate food systems when they have opportunities to study an actual system.

At Environmental Charter High School, we knew we needed a project that would help our students develop a more realistic view of the food system while teaching important concepts of sustainability, permaculture, and systems thinking. The project we developed is a system using two buckets to grow food. It has provided us with a practical, hands-on learning opportunity that gets our students outside. While our container gardens are much smaller than that of a traditional school food garden, they are large enough to provide an effective context for learning.

In this article, I will describe how to build this self-watering container system and suggest some related activities and experiments you can use with your students. While we worked with high school students, this system can easily be adapted for use with lower grades.

In our system, two buckets are stacked together. The inner top bucket holds the soil and the plant, while the outer bottom bucket holds the water. The water is delivered to the plant through a wicking system that draws the water up to the plant roots only when needed. Much less water is needed than for a traditional garden—and very little is lost to evaporation. (Water is added to the bottom bucket occurs every 1-2 weeks through a tube.) With no weeding, it requires little effort to maintain. It can be built quickly and economically with cheap or recycled materials. It is portable, does not take up a lot of space, and can be re-used year after year. And many people have found that container systems produce more vegetables than can be grown in comparable-sized spaces in traditional gardens.

Many types of vegetables, herbs or flowers can be grown in our bucket containers, but tomatoes grow especially well. Your own choices will be dependent on your personal preferences, the season, your local climate and the length of time you can devote to this project. Whenever possible, allow students to choose what to plant, so that they will have more ownership over their project. Growing a salad or pizza garden with these container systems can be fun. Obtain specific planting and harvesting time information for your area and avoid plants that are root intensive or like watermelons, don't lend themselves to container gardening. And to increase efficiency, we recommend planting seedlings rather than seeds.

Activities

Biology/Life Sciences: Initiate a class discussion about what makes up a community. Suggest that the different plants in their containers represent a community, in much the same way that the class is a community. Each individual plant needs different amounts of water, organic nutrients, sun, and time to develop. To have a healthy community in a container garden you need a diversity of plants that are fed with proper nutrients, water and sun. (The more bio-diverse an ecosystem is, the healthier it tends to be). The same concept holds true within your classroom.

Ask them to consider the growing conditions in their bucket containers or local food gardens or farms. If the food grown in these local settings does not have the proper amount of nutrients, water, or sun or it is pumped full of chemicals, will they produce food? If not, where will your food come from? (Food will have to be trucked in from outside the community.) What are the consequences? (Reduced productivity of the farmland causes social, psychological, and economic hardship for farmers, and the increased cost of food causes economic hardship for the community, whose money is no longer staying within and supporting that community.) Now zoom out to view the bigger picture. What can we do as a world population to make our food resources more sustainable? How can we keep our resources diverse and productive over time? What are the benefits of sustainable gardening and sustainable agriculture? What are the social, economic, and environmental consequences on a world level if we don't move to sustainable agriculture?

Sciences

A: The goal of the permaculture revolution was to create stable agricultural systems. (The term *permaculture* came from "permanent agriculture", but has since been expanded to mean "permanent culture.") Among its key principles are the following: observe and interact with your surroundings; all energy can be captured; feedback is important (listen to your system); use your resources wisely; there is

Science Experiments

Challenge	Self-watering containers can be used to demonstrate the consequences of growing food in unsustainable way. In this experiment, groups of students will grow the same food plant, but in different conditions. One group will grow their plant in the best conditions of healthy soil and good water quality. A second group will test the effects of soil salinization. A third will test the effects of depleted soil nutrients. A fourth will test effects of global warming. A final group will test a worst-case scenario that combines all these conditions. All other variables (i.e. the amount of sun and water, etc.) should remain the same. Once you have completed the experiment and noted the differences, have your class come up with ideas for making their self-watering container system more sustainable. For example, unused plant material can be composted for re-use. A rain barrel or water catchment system could be devised using the school's gutters to provide a source of water for plants.	
MODEL CONDITION	**PROCEDURE**	**RESULTS**
Ideal	Follow the basic instructions for self-watering container and water regularly	Every plant has a different growth cycle, but during their growing period, compare the results from each plant. Variables to measure include: plant height, physical appearance, presence of pests, fungus or other diseases, number of shoots or branches, number of vegetables produced per plant, and/or mean vegetable size (weigh all of the vegetables produced by one plant and divide by total number produced). Choose a result that is appropriate for your vegetable or plant. For example, if you are growing tomatoes, you could compare the number of days until harvest, the total number of tomatoes produced per plant, and the average weight of tomatoes grown from each plant. All of these factors will be influenced by the differences in the growing environments. Discuss why the results differ between each plant. What are the consequences?
Salinization	Add 0.5 to 1 teaspoon of salt to each cup of water that you add to the water reservoir	
Decreased Nutrients	Use a potting soil without any nutrients added and do not use fertilizer when planting	
Global Warming	Put three dowels or sticks into the soil and cover the top of the container with plastic wrap (sticks should "tent" the plastic wrap over the top)	
Worst-Case Scenario	Combination of the three conditions: salinization, decreased nutrients, and global warming	

Making a Self-Watering Container System

Items needed:

- Two recycled, food-grade five-gallon buckets for every 4 students in a class (You can often find free buckets at local restaurants or bakeries or via online services such as Craigslist. Do not use paint containers.)
- One 16-ounce recycled yogurt container or plastic cup
- One 17-inch bamboo stick or a similar length hollow tube or pipe about 1/2 inch in diameter
- One bag of organic potting mix
- One cup of dry organic fertilizer
- Drill with 1/4-inch drill bit
- Keyhole saw and/or a utility knife

Procedure:

1. In the next few steps, you will find instructions for drilling or cutting the following holes in the bottom of one of the five-gallon buckets: one large hole for the 16-ounce container to sit in (which will act as the wicking chamber); one medium hole for the bamboo stick or tube (which will deliver water to the bottom reservoir bucket); and approximately twenty small holes for drainage.
2. To determine how large of a hole to cut for the wicking chamber to sit in, you will need to find out the height of the water reservoir. To do this, put one of the five-gallon buckets into the other in front of a light source. On the outside of the outer bucket, mark the location of the bottom of the inside bucket, then measure the distance from the bottom of the outside bucket to this mark. Measure this same distance on your yogurt container or plastic cup, and measure the diameter of that container at this spot. Add 1/8 of an inch to this measurement and that will be the diameter of the large hole.
3. Turn the inside (i.e. unmarked) five-gallon bucket upside down, and draw a circle in the center on the bottom of the bucket, with the diameter determined in step 2. Drill a series of 1/4-inch holes around the perimeter of this circle. Use a keyhole saw or utility knife to cut the hole out.
4. Measure the diameter of your bamboo stick or tube. Add 1/8 of an inch to this measurement to give you the diameter of the medium hole. This hole should be near the outside edge of the inside bucket (the one you just cut the large hole in). Cut the hole the same way as above.
5. Drill approximately twenty 1/4-inch holes in the remaining area of the bottom of this bucket. These will be drainage holes that will allow water to seep out of the soil (i.e. in addition to the 1/4 inch hole).
6. Up and down the sides of the yogurt container, drill 14-18 evenly-spaced 1/2" or 3/4" holes. Take care not to cut open the side of the container, or put any holes in the bottom. Once it is inserted into the bottom of the inner bucket and filled with potting mix, the yogurt container will act as the wicking chamber for the water.
7. Next, drill an overflow hole into outer bucket (the five-gallon bucket without any holes) so that the inner bucket will not be sitting in water. Drill a 1/4-inch hole approximately 1/4 of an inch below the mark you made in step 2.
8. Place the five-gallon bucket that is full of holes into the bucket with the overflow hole.
9. Cut one end of your bamboo stick or tube at an angle and place the angled end into the medium hole at the bottom of the inside bucket and down into the water reservoir area of the outside bucket. The top of the stick or tube should be 2-3 inches above the top edge of the buckets. The angled end prevents the tube from clogging.
10. Fill your yogurt container or cup with potting mix and place it into the large hole so that the bottom of the container is in the water reservoir area. The top of the container may stick up into the inside bucket but this is fine.
11. Fill the inside five-gallon bucket with potting mix, compressing the mix along the way.
12. Transplant your seedlings or plant your seeds in the center.
13. Make a shallow, circular channel in the soil around the perimeter of the plant. Sprinkle a cup of dry, organic fertilizer into this trench.
14. Pour water through the bamboo stick or tube into the reservoir chamber of the bottom bucket (you may want to use a funnel to make this process easier) until water begins to flow through the overflow hole.
15. Place your self-watering container somewhere sunny (even if it is on pavement) and watch your plant grow!

no waste in nature (nor should there be in our systems); use small, doable solutions; biodiversity is good; and everything should serve more than one purpose.

These principles apply equally to large agricultural lands and systems as small our self-watering containers. Have your students apply permaculture principles before planting, during the growing period and after harvesting. When using recycled materials to make their self-watering containers, make sure that everything serves more than one purpose. What other permaculture principles can be applied before planting? Have your students come up with creative answers.

B: While the plant is growing, students should "listen to" their system—observing and interacting with their plants. Are the plants getting enough water? Students will have to monitor the water levels and make adjustments accordingly. There are intricate connections between the sun, the plant, the soil, insects, and humans. What are they? When you alter one, how does that affect your plant? What other permaculture principles are in place? For example, the energy from the sun is captured by the plant. Are you using your resources wisely, such as putting more into the system than you are getting out of it?

Systems Thinking

A: All systems have inputs and outputs, and all systems need the support of other systems in order to operate. Our self-watering container system is an example of an open system: it demands inputs from other systems to sustain itself, but it also provides outputs. The plant – the fruit of our labor – provides us with oxygen to breathe and food to eat. What other outputs does our plant produce? Are these outputs now inputs for other systems? How do all of these inputs and outputs interrelate?

B: All systems in our world nest within other systems. Take, for example, the buckets that we used for our self-watering container system. These buckets were originally used for a different system: the transportation and storage of food. What other systems brought your buckets to you? Typically these would include the transportation system, the agricultural system, the monetary system, and so on. As one can see, even just obtaining the two buckets involves a lot of systems. Have your students list all of the inputs the self-watering container system requires. There are the physical items needed to build the self-watering container (buckets, soil, fertilizer, etc.) plus the natural resources that the plant needs to live and grow (water, nutrients, carbon dioxide, sunlight). A concept map or flow chart is a great way to visualize all of the inputs our system needs.

Ethics The ethical component of permaculture is the idea that we should utilize Earth's resources in ways that are both wise and equitable. We should change the way we live in order to support each other. Not only does this protect the Earth, but it also develops stronger societies. Discuss with your class how you can use your self-watering container projects to help others. You could give your produce to families in need. You could host a farmer's market to sell your produce and use the money raised for different projects. The possibilities are endless and the rewards are priceless. Sharing the harvest with others is an especially satisfying part of this project and is a perfect demonstration of permaculture ethics.

After harvest, have your students design their own self-watering container system and decide what they would do differently the next time, based on feedback from their system (and with long-term sustainability in mind). What input/output changes to their system would they make? How could they make their system more efficient (i.e. Where did they get their inputs? How can they decrease waste?)? Consider the other, larger, systems that contribute to our system. How many different levels can they come up with? For example, "Have students think about how and where the buckets were made, what they were made from, who harvested the materials that made them, etc.

Have your students make recommendations that will be used by other students doing this project in successive years. For example, one permaculture principle is to produce no waste. Composting plant waste to return the nutrients to the soil is a sustainable way to provide needed soil nutrients. Reflecting another principle—using your resources wisely—students may also want to build a water catchment system that collects and uses water from the gutters of the school.

In addition to those discussed above, the self-watering container system offers several other potential connections to sustainability concepts and practices, such as the benefits of local, organic foods and the slow food movement. Some schools have also used their harvests for fundraising and philanthropy.

Using the self-watering containers to introduce the concepts of sustainability, permaculture, and systems thinking yields long-term benefits. Once students are empowered with this experience and knowledge, they will likely develop a world view that helps them to make better choices with the planet in mind. Our ultimate goal is that these future leaders will become more globally-aware advocates for sustainability.

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Photographs: Dawn Malosh, Outside Art

Connecting to Nature through Art

Strategies for engaging elementary students

By **Dawn Malosh**

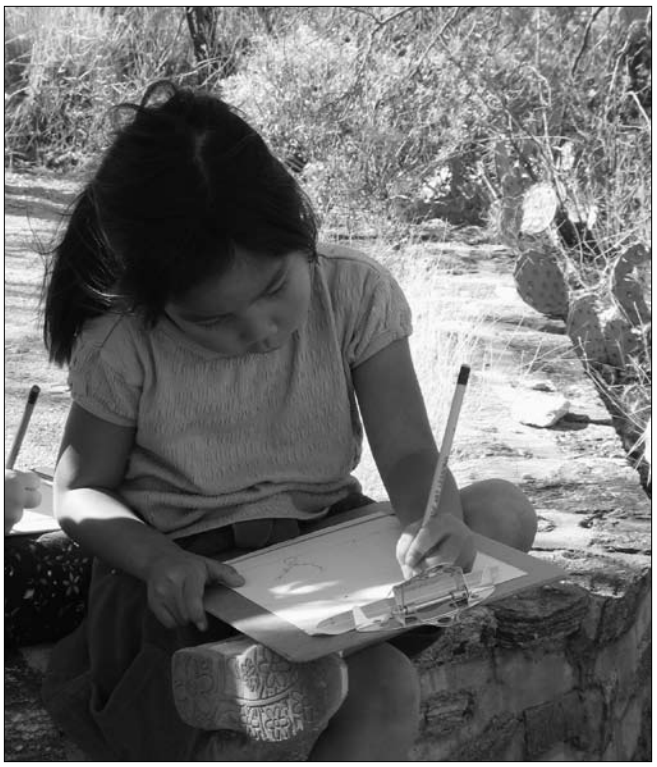
DESPITE EVIDENCE THAT outside activities improve the health, focus, productivity, creativity and sense of well-being of children, most spend too many hours indoors with little exposure to sunlight and nature. Many children today can readily identify corporate brand names while barely recognizing the animals and plant life in their local region. If we expect this generation of children to serve as responsible eco-literate stewards of the environment, they are going to need meaningful early connections to nature.

Art activities serve as affective and effective tools to further enrich, enhance and enlighten the nature experience for students. Art creation itself allows for higher-level cognitive, affective and psycho-motor domain attainments from Blooms taxonomy of learning. The study of nature through art allows the "student-artist" to experience, observe, value, analyze, synthesize and express his/her understanding of, and relationship to, nature and the environment. The examination of nature through artistic processes has been a constant in the development of artists and scientists throughout culture and history. From the time of the ancient painters of the Lascaux caves, to the artists of the Renaissance and to modern day artists, nature has inspired people to create in order to understand, and praise its wonders. As the great painter Francisco Goya explained, "I have had three masters, Nature, Velasquez, and Rembrandt." We can help young people to learn from this great master too, by inviting them to consciously experience and express their perceptions of its vast and wondrous classroom.

For those who are a bit unsure about doing art activities outside, the following suggestions are intended to help you get started. While geared toward the elementary level, they can be adjusted to other grades and developmental levels.

Finding Nature for Inspiration. Many schools have natural landscapes and parks near them that can be used for the activities provided in this article. For the schools that have limited natural terrain, blacktop playgrounds and small campuses, here are a few suggestions that may help provide fodder for artistic activities.

1. Take children to a nearby park, garden, natural museum or forest.
2. Use resources that bring nature to you. Many local agencies offer free educational outreach that will bring animals, plants and environmental education to your school.
3. Make use of what you have! There is nature present in many unexpected places. Many plants, insects and other animals have made homes right next to humans. Send the children on a nature hunt, and everyone might be pleasantly surprised.



4. Plant a garden, hang bird feeders or dig a pond. Once you invite one form of life to the school's ecosystem, others will follow. Plan thoroughly and make sure you research the ecological and environmental ramifications of these activities before executing them.
5. Many student families have unique pets that could be brought into the classroom for study. Make sure they are safe around children and ask students, parents and administrators about this possibility.
6. Find parents who have jobs involving nature. Invite them to describe some of the aspects of their job, or give a slide show.

Making a Nature Journal

If each student has their own nature journal, it will be easier to establish a regular routine for outdoor art activities, much like the "bell work" time that occurs in many classrooms. If transitory student enrollment makes it difficult to for all your students to have a journal, any of the journaling exercises listed here could be achieved by using plain white — preferably recycled post-consumer — copy paper, pencils, any dry coloring medium and a clip-board.

Materials: 8 ½" x 11" post-consumer recycled copy paper and card stock, hole-punchers or stapler, yarn or twine, scissors, crayon, colored pencils, markers or watercolor or tempera paint.

Students can make a simple nature journal by binding twenty or so blank pages together with a cover made from cardstock, poster or tag board. For younger students, consider using a three-hole punch and binding the holes with twine, fasteners, string or yarn. Other fasteners could include used twist-ties, old telephone wire, and even strips of plastic from plastic bags. If time is an issue, simply stapling a packet of paper along the side would suffice.

Have students use things from nature to "draw" their name on the front cover. For example, the letter "L" could be made out of blades of grass. If students are stumped for ideas, have them write their names in a creative way, and then look at each letter to see if it resembles anything in nature. Failing either approach, encourage students to put their favorite things in nature on their letters, reminding them that any way they can include nature in their name is acceptable.

On the back cover, have them draw a memory of a favorite experience they have had in nature. To trigger their memories, you may need to ask questions, such as have you ever played in the snow? Have you ever stomped through fallen leaves? Have you ever gone swimming or built a sandcastle at the beach?

If the front and back covers are made from poster or tag board, have them draw their ideas in pencil and then paint them with poster, tempera, watercolor paints or any available dry color media. If the covers are painted, let them dry before assembling the interior pages.

These cover-making activities will help your students establish a positive attitude towards nature and begin the journey of making connections between themselves and nature.

Outside Drawing Activities

Children should be outside working individually when nature journaling. Again, if they do not have nature journals, any of the exercises listed here could be achieved using plain white recycled, post-consumer copy paper, pencils and a clip-board. Teachers may want to provide specific teacher-led assignments like the ones listed here.

The Hunt for Life

Introduction: If you have never incorporated art into your usual class activities, this is a good introduction that will open your students' eyes to the life around them.

Tell students they are to pretend that they are astronauts searching for life on another planet. Ask what is life? Discuss the possible signs of life before embarking on this adventure. Consider asking them: Do all living things move? Do they eat and breathe? Even though we all seem to know what is meant by saying something is "alive", it's not very easy to describe what "life" is.

To be helpful, tell students that the study of life is called "biology" and the people who study it are called biologists. Even biologists have a tough time describing what life is. However, after many years of studying living things — from the mold on bread to monkeys in the rainforest — they have determined that all living things need energy. They all grow and reproduce, and they respond to their surroundings.

To help children invest their imaginations in this activity, have the whole class act out a rocket lift-off and a landing onto an imaginary planet.

Materials: Nature journals or recycled copy paper for drawing, standard-sized clip-boards (as a support to the journals if they are flimsy), #2 pencils, erasers, crayons or colored pencils. (Any available dry coloring media will work.)

Instructions: Give each student a clip-board, recycled copy paper or their nature journal and a #2 pencil. Tell them to search for life by quietly observing trees, flowers, shrubs and herbs. They could also look under rocks or in crevices in buildings, cement walkways and parking lots. Tell them to be patient and look carefully. Remind them that many animals will hide or run away from humans, especially when people are loud or moving quickly. Direct them to draw, take notes and record as much information as they can about the insects, birds, plants and other life that they see. Encourage them to draw each item as large as possible and to be as detailed in their notes as possible. This is the only opportunity that these astronauts will have to study this planet!

Variation 1: Ask students to look for and record signs of life instead of life itself, especially if the animals in the environment of the school take a hiatus because there are noisy children about. Some examples of signs of life might include a spider web, a chewed leaf, animal tracks, a feather, a snake's skin, a beetle's shell, a burrow in the ground, and a nest.

Variation 2: After students record what they actually see, tell them that they can draw an imaginary life-form. Suggest that they consider the lines, shape, color and patterns of the life form as well as its habitat. Ask students to consider what the life-form needs in its environment and home to survive.

Conclusion: Have the students share their drawings and findings in small groups. Ask them if they knew there were so many things living right by their school. What surprised them? What was the most interesting life-form they found? What was the weirdest? What was the most beautiful? Did they notice any specific lines, shapes colors or patterns in the life-form when they drew it? Do they have any guesses why those lines, etc. were there? What was the life-form doing? What does their observed life-form need to live? What does its habitat have that allows it to live?

Illustrated nature journaling exercises

Here are some additional exercises and suggestions for follow-up environmental education activities:

1. Draw two different plants growing next to each other. Show the differences in shape, size, color and texture. Try to overlap them to show their differences. Follow-up:

Preparing Children for an Outdoor Classroom.

Outside learning environments may be very unfamiliar to children at your school. Unless they have previous experience with outside science experiments or experiential lessons, children may associate the outdoors with unstructured playtime. Whether this is true or not for your students, it is important to establish expectations before venturing outdoors. Here are a few guidelines:

1. Unless working on a special group assignment, have the children work quietly and individually, at least 10 feet away from one another if possible. When observing animals, silence and stillness are essential. Children should be reminded that many birds and other animals will not come near noise or movement.
2. Children must always remain within your eyesight. Remind the children that if they can't see you, then you can't see them. For younger children, you may want to set boundary lines or colorful markers to clarify the perimeter of your outdoor classroom.
3. Let the children know it is okay to sit on the ground, or stand while working. Remind them to look first, so they don't sit on an ant mound or rash-causing plant! If there is time, have children make their own special seat-cushions to sit on during outdoor activities.
4. Be prepared for the weather. If it is hot, be sure to have plenty of water on hand. Limit the amount of time that students are in direct sunlight or have them wear sunscreen and hats. If there is a chance or rain, have students wear hooded rain jackets, or carry plastic tarps.
5. Keep medical records and a first aid kit with allergy pills and an EpiPen with you at all times. Make sure you know which students have allergies, and what they are allergic to. For example, if some students are allergic to ants, search the ground thoroughly before sitting on it. And, students allergic to certain pollens should be kept clear of those. Ask your school nurse about any potential problems with taking your students outside.
6. Avoid areas with poisonous or dangerous animals. Always search the ground before choosing an area to work, and remind children to always watch where they are walking and sitting. Without scaring the children, inform them to slowly back away from snakes, venomous, poisonous or biting creatures. Encourage children to respect, not fear these creatures, and give them space. When animals sting or attack, they are merely trying to protect themselves and possibly their offspring. Nevertheless, in order to be prepared for unwanted surprises, brush-up on the latest first-aid and avoidance recommendations for your area.
7. To compensate for the time they spend in front of fast-moving imagery on media screens, children may need sensorial guidance. To promote visual, auditory, olfactory, and kinesthetic awareness, use guiding statements like "notice the outline, shapes, patterns and textures in the object". Encourage children to touch, (if it is safe) smell, and quietly listen to nature and natural objects. It will help them experience nature more completely and express their experience better.
8. Establish rules and perhaps a pledge to revere and protect all life, as well as the homes and habitat of wildlife. Remind children that the life-forms that they will encounter have an important purpose, and are special and valuable. Point out the homes of animals including insects.

Try to find the names of the plants in a plant identification book or online resource.

2. Write and illustrate a short story about an activity you observed in nature. Try to show the action and movement that you observed. Do research to find out if there is a scientific name for the activity. Follow-up: Research if other animals or plants do the same activity. For example when a squirrel collects and stores nuts, it is called hoarding. Wood mice are also known for hoarding.
3. Draw a cartoon about the interaction between animals or other life-forms that you observed while watching nature. Follow-up: Research the relationships between those different species.
4. Draw a careful detailed picture of any flower that you see. Show the lines, shapes, colors and textures that you notice. Study and then draw a diagram of the reproductive parts of a flower. Study how flowers develop seeds or nuts.
5. On the same page, draw 3 different leaves that you have found. Show how they are different in size, shape, texture, pattern and color. Follow-up: Research leaf types and how their size and shape help a plant to grow and develop.
6. Draw a tree, showing the shape of its branches and leaves and the texture of its bark. Show the colors too. If there is anything else living in or on the tree, draw that too. Follow-up: Research animal habitats and which animals use trees as habitats.
7. Find a magnifying glass and study an insect up-close. Draw it to a big enough scale that it almost touches the edges of the page. Show in detail its shapes, textures, patterns and colors. Follow-up: Research the anatomy and activities of insects.
8. Draw a bird, including the shape, color and textures of its body, head, beak, legs and wings. Follow-up: Find the name of the bird that you drew. Look in a species guide or ask an older person to help you. Learn the most common types of birds around your home and school.
9. Draw a mammal that lives in, on or near your school or home. Study it as close as you can without disturbing it. Draw its lines, shapes, colors and textures. Show its habitat too. Follow-up: Research the common mammals in your neighborhood. Learn where they live and what they eat.
10. Find out if there is an environmental issue or problem in your town, city, county, state or province. Create a poster-sized advertisement promoting a solution to the problem. Follow-up: Have students share their posters and discuss in small groups the issues they were addressing.

Benefits

Illustrated nature journaling activities are designed to provide guided art activities and lessons that help children of all levels and capabilities to connect to nature. They also address current deficiencies in visual art and environmental learning within elementary education.

Here are the most common curriculum standards achieved through using nature journals and undertaking the drawing activities provided in this article. Students will demonstrate a higher understanding of art through the application of artistic techniques, art structures and art elements synthesized with their own perceptions of the natural world. Students will gain, from their own inquisition and discovery, an understanding of the functions, interactions and structures of the natural world through observation, application of knowledge and artistic compilation. Students will make valuable observations and conclusions as to the importance and functions of nature and art. Please check your national or regional art education association for specific competencies, benchmarks, and content requirements that correlate with drawing nature.

Have students use the blank pages to the left of the drawing pages for writing ideas, questions, notes and/or their observations of nature. They could also add diagrams about their drawings, answer teacher questions, list things they want to research and/or write plans for knowledge quests based on their nature observations.

The drawing lessons provided in this article are also designed to open the door to student-centered inquiries. Allow students to continue their research and initiate their own projects and reports on nature topics as a means of encouraging student-directed discovery of environmental science topics. By doing so, you will be taking advantage of the excitement created by discovery-based, illustrated journaling. Students will be highly motivated when they are researching the mysteries of nature that they themselves have discovered.

As the great Renaissance artist, Leonardo da Vinci once said, "Although nature commences with reason and ends in experience it is necessary for us to do the opposite: that is to commence with experience and from this to proceed to investigate the reason." The creation of art during outside observation will heighten the nature experience and improve the understanding of nature for your students. Outside activities, such as drawing, demand a focus that will heighten their senses, curiosity and learning about nature. Nature journaling and other art activities will also encourage higher-level thinking in your students by requiring valuing, analyzing, synthesizing and expressing their understanding of nature through the process of art creation. So, just as the great da Vinci did with his apprentices five hundred years ago, venture outside with your students and encourage them to experience nature through art, and as Leonardo da Vinci, "investigate the reason."

Dawn Malosh is the Founding Director of Outside Art Lessons, a program that integrates art standards with discovery based environmental education across Maryland's Eastern Shore. Over the years, she has served as an art department head, an art specialist at multiple environmental, nature and conservation learning centers, an educational guide at the world-renowned Biosphere 2 and a presenter at various national conferences. For more information, visit www.outsideartlessons.com.

The Mathematics of Trash

Measuring classroom wastes over time helps elementary students grasp the magnitude of our waste problem on a meaningful level

By **Kate Nelson**

Illustrations: Tom Goldsmith

ACROSS THE INDUSTRIALIZED WORLD, the amount of solid waste sent to landfills each year is hard to fathom. Did you know that the United States cranks out about 250 million tons (approximately 225 million metric tons) of residential and commercial waste per year?[1] That's approximately 500 million cubic yards. In Canada, 30 million tons per year are generated[2], while Australians generate approximately 35 million tons[3]. While students understand that these are big numbers, it can be hard for them—and many adults—to really grasp the magnitude of these volumes. After all, when was the last time you saw 250 million tons of anything in one place?

The following lesson uses mathematics to help students grasp the waste problem on a more familiar and meaningful level. These activities are appropriate for 3rd through 5th grade students studying graphing and multiplication, but they can easily be adjusted up or down.

Materials:
Bathroom scale, graph paper, calculators, classroom trash

Time: 10 minutes/day for five days, plus 45 minutes for calculations and discussion and 30 minutes for a classroom trash audit

Background knowledge for teacher:

- Information for the calculations, i.e. number of classes in the school, elementary schools in the district, number of days in the school year
- General understanding of landfills (http://science.howstuffworks.com/landfill6.htm is a good place to start)
- General understanding of your school's and/or community's recycling program

Goal: Students will understand that while one person's garbage may seem inconsequential, it adds up to an enormous number when taken as a whole. They will also understand that most of this garbage goes to landfills, and landfills have environmental consequences.

Procedure: To begin, have the class weigh all the waste in the classroom trashcan at the end of each day for one week. Since it can be tricky to balance a bag directly on the scale, one solution is to have a student weigh her or himself holding the bag, and then again without the bag. Then subtract the latter from the former.

Graph the trash weights for each day and find an average. You will most likely get a number that is just a few pounds or kilograms. Now the multiplication can begin. First, ask the class to multiply their average daily trash weight by the number of classes in the school building. Ask them, "If our class makes "X" pounds/kilograms of trash on average each day, would it be reasonable to assume that other classes at our school make about that much?" This may initiate some lively conversation about which grade generates the most waste, but more importantly it will give the students an idea of how much trash their school is generating each day.

Next, the class needs to figure out about how much waste is generated by the entire school (not including lunchroom waste) each school year. (Be sure you have the number of days in the school year at hand.) Multiply the amount of waste that the class previously calculated for all of the school's classrooms by the number of days in the school year, and now you should have a nice, large number that will likely surprise the students.

If you would like to continue, ask the class, "Could we assume that most elementary schools in our school district

make this much trash in a year?" A quick visit to the district's web site should provide the number of elementary schools to multiply by. Calculators may be necessary at this time.

Hypothetical Example:
Classroom trash average = 1 lb/kilo. per day

1 lb./kilo of trash x 18 classes in the school building = 18 lbs/kilos. of trash from the school's classrooms each day. (Students may need a reminder that this does not include lunchroom trash.)

18 lbs/kilos of trash x 180 school days per year = 3,240 lbs/kilos of trash from the school's classrooms each school year.

3,240 lbs/kilos x 15 elementary schools in the school district = 48,600 lbs/kilos of trash produced by the elementary schools in the district each year. To figure the approximate volume of this weight, assume 1,000 lbs/per cubic yard of trash, or 496 kilograms per cubic meter (according to Solid Waste Association of North America estimate of municipal waste weight while in trash trucks).

You can continue to make the trash calculations are far as you and your students want to go. For example, you could now multiply by the number of school districts in your state or province, the number of states/provinces in your country, and so on. The students may challenge that the trash weight is getting more approximate the larger you go, but the point is to find a generalization that shows how all of our little chip bags, broken pencils, and paper scraps can add up to quite a lot.

Closure: Now that the class has a handle on how quickly waste can add up, this is a good time to discuss landfills with students. Point out that some waste generated by a country is recycled and composted, and some is burned, but the vast—54% in the U.S.[4], 78% in Canada[5], and 54% in Australia[6] —majority is laid to rest in a landfill.

Here are some basic concepts to help students understand the consequences of landfills: 1. Landfills come in different shapes and sizes, but they are usually about the size of 10 football fields. 2. Once waste is dumped in landfills, it is never used again. Landfills are not compost piles, nor is anything removed for recycling. 3. Landfills fill up eventually and are then closed.

Ask kids, "Why aren't landfills a sustainable solution to dealing with waste? In other words, in hundreds of years, what will our country be like if we keep putting our discards in landfills?" Lead kids to discuss not just the problem of the space taken up by landfills, but the issue of burying our natural resources forever. "If we bury paper in the landfill, how will we make new paper?" It may be necessary to have a quick review of what resources we do use from the earth for manufacturing, including petroleum, wood, ore and sand.

A meaningful conclusion to this lesson would be to take a close look at specifically what is in the classroom trash can; this is called a waste audit. Brainstorm ways to keep the items found in the trash can out of the waste stream. "Where can we dispose of things besides the trash can? Is there a way to avoid some of this trash in the first place? Can any of these items be used again?"

Knowing kids, they'll come up with more solutions to the trash dilemma than adults could ever hope to.

Creating a No-Trash Classroom

Reduce:
- Disposable plates, cups and cutlery from classroom parties result in mounds of garbage. Encourage kids to bring their own plate, fork and cup from home. Keep a set of cloth napkins on hand (as long as you're willing to wash them!)
- To reduce the tendency of students to use paper towels as if the roll is never-ending, have cloth rags and sponges on hand for erasing transparencies, washing desks, and mopping up spills.

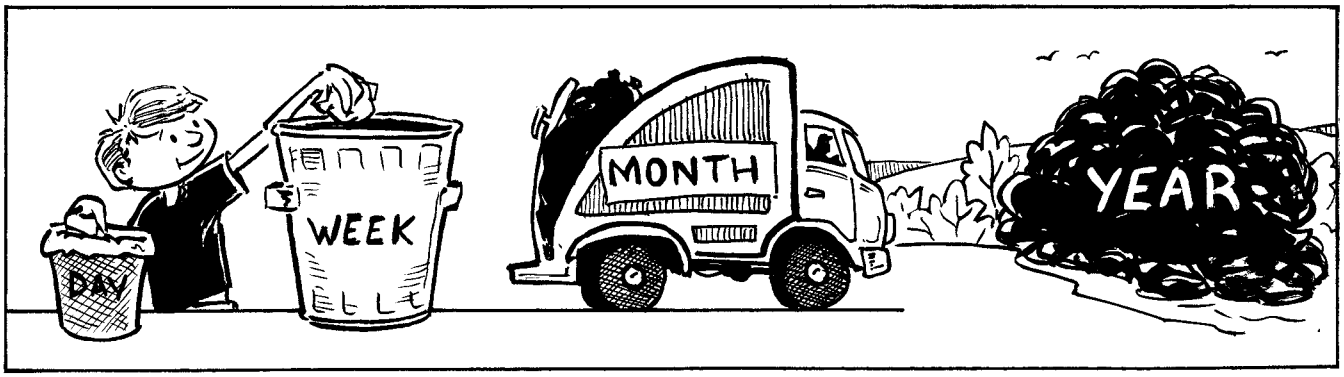
Reuse:
- Drink and snack containers are common school trash, but with a little encouragement they can be easily avoided. Consider random prize drawings for students who bring drinks and snacks from home in reusable containers. Graph daily how many students are using durable containers.
- Paper is a hot commodity in any school, so get the most out of it. One-sided copies can be left in a designated area for scratch paper. Construction paper scraps can be saved and used again for craft projects.

Recycle:
- Many classroom discards, like notebook paper, copy paper (white or pastels), and tissue boxes are commonly accepted by recycling programs; check your school's recycling guideline for specifics. If your school lacks a recycling program, all that's needed is an improvised collection bin and a team of willing parents to take the recycling to the local drop-off center.
- Even if your school does have a recycling program, it may be worth investigating whether there are additional recyclables accepted by your community's program. You may find that while juice boxes are not on the school's collection list, the recycling center would gladly accept them.

Rot:
- Give orange peels and bread crusts a second chance. School gardens are gaining popularity, and a good dose of decomposed food waste will keep those plants happy. If a garden or compost pile isn't an option for your school, consider joining the many adventurous teachers who are composting in the classroom using worm bins. Your students will love it and it doesn't take much work to keep worms happy and healthy – find instructions at http://www.watershedactivities.com/projects/winter/wormbin.html.

Extensions: For fun, use division to come up with interesting weight comparisons.

Example: If the school generates 3,000 lbs (1364 kilograms) of waste a year, this equals the weight of approximately how many fifth grade students? At 80 lbs/ 37.5 kilos



per student, the equivalent of about 38 fifth graders are thrown away each year!

Use fractions to discover possible solutions. For example, if we could recycle 1/3 of the trash that is being thrown away by our school each year, how much would that reduce it by? (3,000 lbs/1364 kilos x 1/3 = 1,000 lbs/454 kilos, so it would reduce the trash by 1,000 lbs/454 kilos) If we could compost another _ of our trash, how much more could we reduce it by? (2,000 lbs/909 kilos left after recycling x _ = 500 lbs/ kilos, so composting would reduce the waste by another 500 lbs/kilos).

Recycle the problem. If your classroom already has a recycling bin in use, weigh the contents of the classroom recycling bin for one week and complete the calculations as before. This time increasing weight will be a good thing, as the class will be hypothetically calculating the amount of recycling generated by the school each day, year, and so on.

Kate Nelson loves to talk trash, and is an environmental educator for Eco-Cycle in Boulder, Colorado.

Notes

1 US EPA <http://www.epa.gov/osw/basic-solid.htm>

2 Statistics Canada, Human Activity and the Environment, Annual Statistics 2005, http://www.statcan.gc.ca/pub/16-201-x/16-201-x2005000-eng.pdf

3 Productivity Commission, Waste Management Inquiry Report, 2006, http://www.pc.gov.au/projects/inquiry/waste/docs/finalreport

4 US EPA < http://www.epa.gov/osw/basic-solid.htm>

5 Statistics Canada, Waste Management Industry Survey 2006, http://www.statcan.gc.ca/pub/16f0023x/2006001/5212375-eng.htm

6 Australian Bureau of Statistics, *Solid Waste in Australia*, Australia's Environment: Issues and Trends, 2006 http://www.abs.gov.au/ausstats/abs@.nsf/Previousproducts/4613.0Feature%20Article252006?opendocument&tabname=Summary&prodno=4613.0&issue=2006&num=&view=

A Window into the Wild

Using Remote Cameras to Analyze Schoolyard Biodiversity

Taking Action Opportunities

By **Dawn R. Tanner**

"Wow, forests aren't as scary as they look in movies!"
—Wes, 5th grade

"If a Gray fox eats me, my mom will be really upset with you!"
—Dakota, 5th grade

FOR YEARS, RESEARCH SCIENTISTS, wildlife managers, and conservation organizations around the world have used remote cameras to document the presence of species such as jaguars, rhinos, snow leopards and tigers. This enabled them to develop species inventories, explore questions about animal behavior, and estimate population density of target species[1-3]. Closer to home, scientists in Minnesota use remote cameras to monitor Canada lynx[7]. In Montana, these cameras are used to discover new wolverine habitats[8]. Even deer hunters now use them to find good hunting locations.

In recent years, Minnesota Project Wild has helped schools use remote cameras to monitor the presence of wildlife in their schoolyards, as a stepping stone towards learning about habitat fragmentation and wildlife management. Typically, ten weeks' of photographic "captures" are compared with those taken in a nearby protected area that is known to provide prime wildlife habitat. This allows students to compare wildlife in relatively pristine habitats to more human-dominated landscapes.

Three Minnesota organizations developed lessons for grade 5–6 students that were field-tested at Afton-Lakeland Elementary in Lakeland, Minnesota, a small town 25 miles from Minneapolis-St.Paul. Edged with mixed deciduous trees and conifers, the 10 acre schoolyard is on the periphery of a housing development. Cameras mounted on schoolyard trees there have captured surprising pictures of Red and Gray fox, White-tailed deer, and Virginia opossum in addition to the expected Red squirrels, Gray squirrels, and Eastern cottontails. Students then compared those images with ones taken at nearby Afton State Park.

An additional 19 Minnesota schools, urban and suburban, now use the program. Some boast extensive wildlife habitat that includes outdoor classrooms and school forests. Others have only small patches of scrubby vegetation, but even those support a surprising array of species. During the day, they may only be visited by squirrels and children, but at night, deer, raccoons, native rodent species and even beavers and foxes may visit those small patches of vegetation.

During the day, remote cameras use visible light to produce color images. At night, an invisible infrared beam collects black-and-white images, whenever its sensor is triggered by an animal's body heat and/or motion. Unlike earlier and inexpensive versions, good quality remote cameras do

not use a bright flash that will startle animals.

This article provides a structure for using remote cameras as an innovative schoolyard science tool with fifth grade students. It begins with a lesson on documenting "animal sign" (i.e. animal tracks, scat, fur and feathers, etc.) and choosing remote camera sites. It continues with a tutorial on how to set up and monitor a schoolyard camera and analyze the data retrieved from the schoolyard. It concludes with a process for developing and implementing proposals to improve wildlife habitat in the schoolyard.

While many analyses of camera findings can be conducted, the basic steps remain the same. Students search the schoolyard and carefully document animal sign. Then they choose locations for 1 or 2 remote cameras, monitor them for 10 weeks, analyze their findings to determine the amount of animal activity, and compare those findings to those from a protected area. Finally, students propose and implement a habitat-improvement project for the schoolyard.

Young people do not realize there are so many interesting things that they can learn about animals in their own schoolyard and neighborhood. In Minnesota, many students are surprised to learn that animals such as Virginia opossum, White-tailed deer, and Gray fox are active in their schoolyards. One student on the way out to check a camera asked me, "Where do all of these animals go when we're here playing at recess?"

Using remote cameras helps teachers to increase technology learning in their classrooms and brings students outside to create meaningful connections. They are a powerful tool to increase student understanding of local biodiversity and to connect them more intimately with their schoolyard environment. Whenever we head outside to check our cameras, we pick up trash, identify animal sign, and talk about wildlife habitat and what it means in our schoolyard. Students soon pick their favorite species, learn more about their habitat requirements, and become passionate about greening their schoolyard. Through this experiential, highly interactive experience, students come to understand more about their local landscape, their role in caring for the wildlife in that landscape, and their broader role in society. Experiencing the outdoors through this schoolyard science activity during 5th grade has the ability to set students on a path of continued biological exploration.

"I want the cameras to stay!"—Keith, 5th grade

Lesson: Schoolyard CSI: Documenting Animal Sign

Time: two 50-minute class periods

"I have a little patch of forest by my house that I never go in. I'm going to spend some time exploring this weekend and see how much animal sign I can find."—Alexa, 5th grade

"I think our school supports wildlife because I see a lot of trails, scat, and feathers here."—Jacob, 5th grade

After spending too much time indoors, most young people cannot identify outdoor sites where animal activity is high. This lesson guides students through a process of discovery of the animals likely to be found in their region and how to recognize signs of those animals in the schoolyard. The schoolyard worksheet (Figure 1) includes a high resolution, image of the schoolyard (Google Earth provides them freely for use in schools) and a tally sheet used by students to record the animal signs that they find. In the first class period, students make predictions about which animals are likely to be found in the schoolyard compared to a nearby protected area. In the second class period, they search their schoolyard for animal sign and then decide as a class on the location for cameras. (If more than one class of students is involved, allow students from each to make decisions about the locations of one camera during the 10 week monitoring period.)

Objectives

- Consider species present in a local wildlife habitat area
- Document animal sign in the schoolyard
- Analyze the schoolyard for areas of animal use
- Nominate locations for camera placement

Materials

- Protected-area mammal species list (Ask a park manager from the protected area nearest your school for a list).
- Slideshow of pictures of mammal species found in the protected-area. Include the common and scientific names on each photo. To obtain photos from government sites that you can freely use for educational purposes, do an internet search using the common name and ".gov" in the search line.
- Schoolyard evidence worksheet (Figure 1).
- Clipboards for the schoolyard worksheet to be taken outside by students working in pairs.
- Field journal for individual notes and recording clues.

Setting the Scene

Explain to students that scientists around the world are now using remote cameras to study far-away species such as jaguars, rhinos, as well as wildlife closer to home. They can also be used to monitor animals in schoolyards. Describe how remote cameras work (see above) and let students know that they have an opportunity to select the locations of up to 2 cameras. Since it is ideal to have each camera placed in 3 different locations during the 10 week monitoring period, students will decide every 3–4 weeks if and where they should be moved. Over those 10 weeks, the two cameras will collect a total of 140 trapnights' worth of images. (i.e. One trapnight equals one camera per night).

Using the mammal species list, ask students to predict which mammals will be captured by class cameras and those might use the schoolyard as habitat. Mark each mammal species on the board as: + (mammals we think use the schoolyard as habitat) vs. ✓ (mammals we think will be captured by our cameras) (See Figure 5 below.) Tell the students to consider the species that they predict will use the schoolyard as habitat as they identify and nominate camera locations.

Explain that "animal sign" consists of visible marks

Figure 1: Afton-Lakeland Elementary Schoolyard

Google Earth

How many times do you see each of these animal signs? (Keep a tally as you explore outside.)

Tracks?_____ Animal trails? _____

Scat? _____ Fur or feathers? _____

Homes (burrows, nests,...)?_____

Live animals or carcasses? _____

Signs of feeding, grazing, or browsing? _____

Where do you see these animal signs?

left in an animal's habitat which indicate their presence and activity. It includes tracks, trails, scat, homes such as burrows or nests, fur or feathers, food caches, marks from grazing and browsing, animal carcasses, and live animal sightings. Make a list with your students what types of animal sign might be found in the schoolyard. To help visual learners prepare for the exploration outside, PowerPoint slides are especially useful.)

Searching for Animal Signs

Before taking the students outside, check the schoolyard for animal sign yourself. Field guides that cover tracks and scat in your geographic area will be helpful in your exploration[10].

Working in pairs with a pen or pencil, a schoolyard animal sign worksheet (i.e. Figure 1) and a clipboard, ask students to note each type of animal sign they find, and where they found them. They should also mark a large X on their worksheet where they think a remote camera should be mounted. After returning to the classroom, collect students' worksheets, compile a list of nominated sites and have the class vote for the first camera locations. Afterwards, give students 10 minutes to record in their field journals, their individual predictions as to which area (i.e. the schoolyard or the protected area) will have more species of animals "captured" by remote cameras, and what evidence they found in the schoolyard that supports their predictions.

To conclude, have students elect two representatives to visit and inform other school classes about the purpose of the trail cameras in the schoolyard. Apart from increasing the representative's ownership of the project, their visits will reduce the likelihood of vandalism and get other students excited about camera captures. Some will subsequently find the cameras and get their pictures taken.

Figure 5: Species Score Card

Species Documented in Protected Area	# of species found in protected area	# of species predicted in schoolyard	# of species found in schoolyard
Coyote (Canis latrans)			
Gray fox (Urocyon cinereoargenteus)		P	P
Red fox (Vulpes vulpes)	P	P	
Black bear (Ursus americanus)			
Raccoon (Procyon lotor)	P	P	
T = total number of species possible =	PA = species found in protected area=	P = predicted species found in schoolyard =	SY = total species found in schoolyard =

Questions for Students after Filling Out the Above Chart:

1. What percentage of species documented in the protected area have been captured by remote cameras so far?
2. What percentage of species documented in the protected area did we predict could be found in our schoolyard?
3. What percentage of species predicted to be found in the schoolyard have been captured by remote cameras so far?
4. Based on our predictions, where do you think we should move the remote camera to capture species that we think use our schoolyard as habitat but have not been captured yet with our cameras?
5. Which species predicted to use our schoolyard as habitat are unlikely to be captured with our cameras because of the way they may use our schoolyard habitat? (Example: bats are very difficult to capture with cameras because of their rapid aerial movements, fossorial mammals such as gophers are difficult to capture above ground, and rare mammals may be unlikely to capture especially during a single, short monitoring period.)

Lesson: Improving Schoolyard Wildlife Habitat

Time: one 50-minute class period

"I have always wanted to see a Gray fox. Now I've seen one with our cameras. I had no idea they could live in our schoolyard."—Abbi, 5th grade

"Our school habitat is about 30% trees. We can make a natural habitat area for different species by removing buckthorn and planting trees and prairie plants for the animals to eat, every year have an animal protection week, and clean up trash even more."—Amy and April, 5th grade

Objectives

- Use knowledge of schoolyard and protected-area biodiversity to propose a project for the schoolyard
- Work in small groups to develop ideas
- Present small-group project to the class
- Select student representatives to meet with the principal and/or PTA

Materials

- A laptop computer with internet access for each student working group.
- Resources to stimulate student ideas. See references # 12-15 below. In particular, the book *Woodworking for Wildlife* is an excellent resource with patterns and detailed directions on how to build structures for a range of species. Seed catalogs containing plant species native to an area, are also helpful resources.
- Examples of projects that students might consider include: creating a native-plant garden in the schoolyard, building an interpretive trail in or near the schoolyard, conducting a schoolyard clean-up, planting native vegetation, and building nesting boxes [12-15].

Setting the Scene

Using the knowledge gained from the camera captures, each group of students proposes a project to improve schoolyard habitat. The class votes to select the group proposal they like best. Then they select representatives to present their project to the principal, the PTA and/or the school board. Students

should be encouraged to think big, while being realistic about what can be accomplished in as little as a couple of weeks or as much as one growing season. This provides an opportunity for students to problem solve and develop decision-making skills.

Procedure

Students work in groups of 3-4 to develop a proposal for the schoolyard. To help students stay on task as they develop their project proposals, write a timeline on the board itemizing the steps that need to be accomplished within 50 minutes.

When students compare the species "captured" in their schoolyard versus those in a nearby protected area, they will notice some species present in one site but not the other. Ask them what characteristics of the protected area supported the species seen in the remote-camera photographs. Which native grasses, forbs, trees, and shrubs provide food and cover for wildlife? These plant species might be especially attractive additions to the schoolyard.

The cameras also capture photographs of birds. Since students tend to be excited about increasing the number of homes for wildlife in the schoolyard, consider the species of birds observed in the cameras. A schoolyard project building and putting up nest boxes to increase habitat for specific bird species might be another excellent project option.

- For 10 minutes, group members should discuss possible projects. One member should write down all the group's ideas, so it will be easier to choose one at the end. If the group has problems reaching a consensus, ask them to take a vote. The teacher may provide a tie-breaker if needed.
- Write an outline of the project (15 minutes): The outline should include dates and length of the project; a schedule of steps for the completion of the project; the number of volunteers, including adults needed for each date (if multiple days are required); the amount of money required; and how the money will be raised. I have been surprised at how well 5th-grade students are able to conduct this part of the exercise.
- Each group briefly describes their idea to the class (15 minutes).
- The class votes both on which project to present to the principal and/or school board or PTA.

Dawn Tanner is a PhD candidate in the Conservation Biology Program at the University of Minnesota. Working in collaboration with the Minnesota Department of Natural Resources (MN Project WILD), Cedar Creek Ecosystem Science Reserve, Afton-Lakeland Elementary, and Afton State Park, she created the Taking Action Opportunities (TAO) curriculum that makes use of remote cameras for environmental education. To learn more about the curriculum, visit http://www.dnr.state.mn.us/projectwild/tao/index.html.

She would like to thank the students, teachers and PTA at Afton-Lakeland Elementary for their inspiration and support, along with the partner organizations mentioned above, plus Gander Mountain, Stillwater Area Schools, Bell Museum of Natural History, and Minnesota Trappers. Chris Wemmer provided advice about working with remote cameras and through his blog, I met teachers across the country, and got a better idea of the questions they had as they prepared to install cameras in their schoolyards.

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Tutorial: Setting the (Camera) Trap

In groups of four, students sign up to check and reset the cameras on a weekly basis. Each student should have an opportunity to work with the camera and set up "lures" at least once. Cameras should be monitored in the schoolyard for 10 weeks or ~140 "trapnights".

"If we say we haven't gone out to check cameras yet, can we go out again?"—Riley, 5th grade

"I can't believe this is the place where we watch the opossum with our camera. Are these really opossum trails?"—Corri, 5th grade

Objectives

- Select camera sites using the locations of animal sign to indicate best placement
- Practice using remote camera technology
- Mark camera location with handheld GPS unit if available
- Discuss where and why to place lures on animal trails

Materials Needed

*Keep camera supplies in a backpack that goes outside each time

- two remote cameras
- two camera lock boxes for your brand of camera (Purchased where cameras are sold, they can be advertised as bear boxes, so to protect the camera from bears.)
- four 1.2-meter aircraft cables to attach camera boxes to trees (One cable will usually be sufficient to set up one camera. Use a cable clamp to connect two cables if more than one is needed to secure the box.) Purchase these at building supply stores.
- four cable clamps
- one roll camouflage duct tape
- one padlock with 2 keys (Keep spare key in a separate location in case one gets lost)
- spare batteries
- two memory cards (Having a spare will allow you to swap cards in the field. Check images when you have returned to your classroom computer)
- wildlife lure (See below)
- wrench and socket for tightening nuts on cable clamps
- two camera identification tags (Use a camouflaged clip license holder and laminate printed page with ID to avoid having text become illegible in rain or snow)
- one GPS unit (if available)
- one pocket knife for clearing light vegetation

What kind of camera to use?

There are many brands of remote cameras available, and they keep getting more affordable. I have tested many cameras and found Moultrie infrared cameras to be an excellent choice for schoolyard use. Remote cameras start at about $50 and range up to about $599. Moultrie's I40 model costs $215. This camera performs well in a range of settings, its menus are simple to use and their laser aim function helps to minimize lost captures due to a camera being set incorrectly. With a battery life of 150 days, this camera's power is not quickly drained as with other brands I tested. See if there any grants for new technology are available to help with this purchase.

Dawn Tanner

To get used to using the new camera, set it up in your home first. For a few days, monitor "well-used trails" frequented by humans and pets. Make sure that the camera is capturing images consistently, is aimed correctly, and image quality is set for your desired output. This trouble-shooting step will save you time and avoid lost captures outside. Once you have become comfortable using your camera and know that it is functioning properly, practice using it in the schoolyard before introducing it to your students.

Minimizing theft

Theft has not been a big problem at Afton-Lakeland Elementary School, where we have been monitoring with cameras for three seasons, or the dozen other schools that used them this past school year. Because of this, we tried putting cameras out in the open on well-worn trails in one schoolyard and lost our first camera to theft. In response, we moved the cameras back to where they were more difficult to spot by people walking in the schoolyard. We also started using heavier cable to mount camera boxes to trees, and now bring cameras inside over the weekend. Following these changes, we have not had other problems. Depending on your schoolyard location; you may want to adopt strategies like these to minimize theft.

How to set up cameras?

When you install your camera, look for place where animals are likely to travel, such as trails in long grass, areas close to water and highly visible deer trails. Position the camera at a 45-degree angle to the trail, 2 meters from the intended photo area. Most trail cameras can detect motion out to 9 meters, but the flash often will not reach that far. Night pictures taken under 0.5 meters will white out the content

of the photograph. Cable the lock box or camera to a tree about 0.3 meters off the ground. To avoid false triggers due to motion, choose trees with a large enough trunk to prevent movement caused by wind. By aiming your test beam at your lure site on the ground, this will enable the photo capture animals, small and large. If possible, have your camera facing north, so as to be less susceptible to false triggers caused by shadows and direct sunlight. However, it is sometimes worth trying a site that does not have optimal orientation, if its other characteristics are favorable.

Remove some waving grasses, small saplings, and overhanging branches from the immediate sensing area of the camera to avoid false triggers. Try to minimize the amount of clearing you do so as to limit habitat disruption. If you opt to clear very little, the tradeoff will be having to delete false triggers before you share the latest pictures with students.

Check the battery level every time you monitor your camera. Turn the camera on and confirm settings. Use camouflage duct tape to further secure the site if needed. Place the camera in live mode, wait for the time out period to expire and the camera to trigger and capture the first picture. Set up your lures while the camera is in live mode so you can confirm that it is working before you leave the site. Close the lock box over the camera, and lock it with the padlock.

Lures?

Made from animal glands or secretions, smelly oils, and urine, lures are designed to attract animals to a particular site. As you prepare to set up your cameras, consider if you want to attract animals to your site and/or rely on finding active animal trails. You will have the most success by doing both. Currently, baits and lures used in small amounts are allowed in Minnesota, as long as no hunting is conducted at the site. Check your state or provincial regulations and contact local wildlife conservation officers before setting up your camera site. If you are not allowed to use lures, optimize your chances of success by locating cameras near active animal trails.

Lures are available from hunting and trapping companies. Students get pretty excited about using lures, so it's important to explain that they have a responsibility to use a minimum amount, so as not to change the feeding habits of wildlife. Generally, the amount is used for a lure is between the size of a dime and a quarter.

I consulted many trappers, each of whom have a favorite lure, but many recommend applying a combination of small predator attractants, such as Hiawatha and Violator 7, to a small piece of lambs' wool. If you suspect the schoolyard presence of certain species, ask the supply source for their recommendations for lures designed to attract those species. Apply your lures to lambs' wool and add a paste of corn, powdered acorn, or other grain. This will give you an opportunity to attract a range of species without habituating wildlife to a new food resource. If you find that grain remains at the site when you next return to check your camera, reduce the amount of grain used. The scent from the lure will be quite potent initially, but the smell will fade as it is exposed to the elements. Optimal attraction will occur in the first couple of days. If you attract a species that you would prefer to avoid bringing into the schoolyard, discontinue using that particular attractant and move the camera to a new location.

How do we retrieve and analyze images?

Retrieve images once a week throughout the monitoring period. If you remove the cameras for weekends, you can check each Friday and return the camera to its site on Monday. Upon arriving, walk in front of the camera and trigger the camera. The resulting picture will verify that the camera is working and serve as a reference for the date and time. Turn off the camera, and replace the memory card with the empty spare one. To reset the camera, clean the lens and motion sensor if needed, turn the camera on, confirm settings, and refresh lures. Place the camera on live mode, then secure and lock it.

Review captured images before sharing them with students. Delete false triggers due to movement or light and all but one picture of each bird species to serve as a voucher. Record all mammal captures, and every week, show students the "best-captures", and compare those to best-captures recorded previously at the protected area.

Develop Excel spreadsheets to record data each week of the captures during the previous week. Before voting on whether to move the cameras, analyze captures to date by species and by time of day broken into 4 categories: sunrise-noon, noon-4 pm, 4 pm-sunset, night. Compile a list of species that were captured and compare this list to the list of species predicted to be captured. (See Figure 5.) Allow students to nominate and vote on new camera sites. When the final week of data collection is complete, update graphs of frequency and time of day captures.

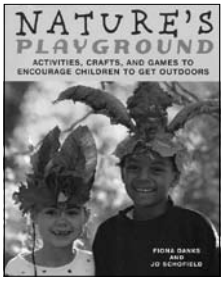
Consider variables that you may want to address in class and as you retrieve images. Develop your spreadsheet to accommodate these variables and continue entering data each week. This will avoid a data-entry marathon at the end of your 10-week monitoring period. As you build analyses from year to year, think about additional variables that you may want to analyze.

Enrichments for more advanced students. Provide guidance but allow them to set up and move cameras themselves. Help students build graphs by themselves (instead of focusing discussion on already completed graphs).

Taking Action Opportunities

Resources

Reviewers: Jessica Culverhouse, Kristen Ferguson, Tim Grant, Jonathan Hayes, Gail Jardine, Elizabeth Johnson, Jennifer Kobylecky, Gail Littlejohn, Phyllis McKenzie, Barbara McMillan, Terry Tomasek



Nature's Playground

With *Nature's Playground: Activities, Crafts, and Games to Encourage Children to Get Outdoors*, UK environmental educator Fiona Danks aims to encourage "adults and children to appreciate and enjoy wild places together and, above all, to have fun in the freedom of the great outdoors." She offers useful general tips for selecting a destination and making preparations, but the heart of the book is over 50 activities designated for spring, summer, autumn, winter, all year round and after dark. Many are explorations or nature crafts that require no materials other than natural objects (e.g., straw dolls, ice mobiles, mud sculptures), and all seem designed to encourage imagination and aesthetic and sensory appreciation of the colors, textures, sounds and smells of nature. Jo Schofield's beautiful photographs of children playing, exploring and creating in nature are perfect complements to the text. The book is rounded out with an index, resource list and advice on outdoor conduct and safety (North American readers will note that the advice to walk quietly is inappropriate in areas with bears and cougars, and in some areas night walks cannot be assumed to be safe). Overall, this is a wonderful book — full of activities that teachers can easily incorporate into their science, art, health and physical education programs and that parents and other adults can enjoy doing with children. *– (GJ/GL)*

Chicago Review Press, 2005, ISBN 978-1-55652-723-4, 192 pp., US$16.95/C$21.95 from Independent Publishers Group, (800) 888-4741, <www.ipgbook.com>.

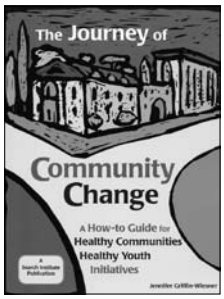
The Sustainable High Schools Kit

The Sustainable High Schools Kit provides a framework to engage students, staff and other stakeholders in assessing and improving the health and well-being of their school community. From setting up a Sustainability Advisory Committee to assessing the use of chemical-free cleaning products, this free downloadable kit goes well beyond programs that simply have students perform school energy or waste audits. Beginning with their vision of a sustainable high school, students design and perform assessments to determine the current health of their school using ecological indicators in 10 topic areas, including Health and Well-Being, Knowledge, Governance, Energy and Land. Students then work with members of their advisory committee to develop a plan for achieving their vision over time, set benchmarks and report progress to the larger school community. *The Sustainable High Schools Kit* engages students in critical thinking while dealing with real world situations as they embark on a journey to make their high school community sustainable and healthy. Developed in British Columbia, the materials are easily adaptable throughout Canada and the United States. *– (PM)*

Sierra Club BC, 2008, 74 pp., available as a free three-part download from <www.sustainablehighschools.ca>.

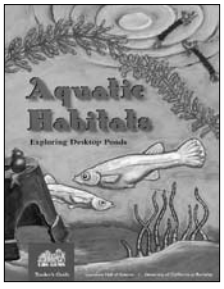
Journey of Community Change

Since 1989, the nonprofit Search Institute has been surveying young people in grades 6-12 about their behavior, beliefs and experiences of school, family and community. From this research, they have identified 40 "developmental assets" that help young people become healthy, caring and responsible adults — from caring neighborhoods and positive peer influences to creative activities and a sense of purpose. *The institute's The Journey of Community Change: A How-to Guide for Healthy Communities–Healthy Youth Initiatives*, by Jennifer Griffin-Wiesner, is a guidebook filled with positive strategies, systems and essential questions to help evolve initiatives that improve communities for youth. It places heavy emphasis on, and provides structures for, engaging youth in all aspects of a developmental asset-building initiative, including visioning, planning, implementing, evaluating and celebrating.



Along with case studies of long-running initiatives and checklists such as "Identifying Community Asset-Building Strengths and Challenges," the guide provides suggestions and cautions for developing an initiator group, creating vision statements, using focus groups, handling negative publicity and encouraging adults to work with other peoples' kids. *The Journey of Community Change* will be beneficial for leaders and organizations involved in many kinds of youth-oriented initiatives in their communities. *– (PM)*

Search Institute, 2005, ISBN 1-57482-861-4 (pb), 146 pp., US$39.95 from Search Institute, (800) 888-7828, <www.search-institute.org>.



Aquatic Habitats

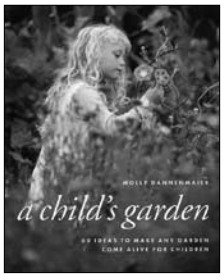
For students, it can be an awe-inspiring experience to assemble a desktop pond and investigate aquatic food webs, adaptations, life cycles and ecological concepts. However, delivering this learning experience can be daunting for many teachers. Katherine Barrett and Carolyn Willard's *Aquatic Habitats: Exploring Desktop Ponds* guides teachers with detailed instructions for turning simple aquariums into complex model ecosystems. From

the early planning stages to the development of the habitats and outdoor explorations, this is a thorough guide. Activities progress from creating the habitat to introducing and observing organisms: worms and snails first, followed by fish and mosquito larvae. Included are materials lists (with suggested alternatives), sourcing information (U.S. only), detailed lesson plans, worksheets and cross-curricular connecting activities. *Aquatic Habitats* is intended as a flexible teachers' guide for grades 2–6, but would need to be simplified for younger students. – *(JH)*

Lawrence Hall of Science, 1998, ISBN 0-924886-01-3, 136 pp., US$23 from Lawrence Hall of Science/University of California at Berkeley, (510) 642-7771, <http://lawrencehallofscience.org/gems/GEMaquatic.html>.

A Child's Garden

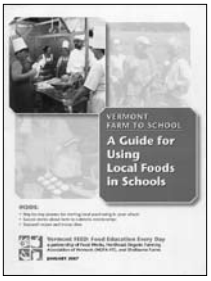
Reminding us of the vital connection between children and the natural world, author Molly Dannenmaier describes how to create complex garden environments that nurture and excite kids. Natural play structures, digging sites and vegetable bowers that double as playhouses are among the many examples she presents in *A Child's Garden: 60 Ideas to Make Any Garden Come Alive for Children*. Successful gardens are featured throughout the book, and Dannenmaier identifies the elements within each that attract children, such as wild creatures, secret refuges, dirt and having room for movement. Lavishly illustrated with striking photographs, this book will undoubtedly inspire parents, educators and gardeners to include special places for children in their gardens. – *(JH)*

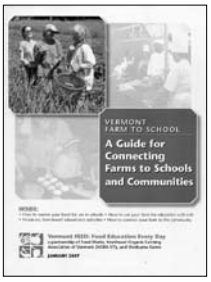


Timber Press, 2008, ISBN 13-978-0-88192-843-3, 176 pp., US$19.95 from Timber Press, (800) 327-5680, <www.timberpress.com>, C$26.95 from Thomas Allen & Son, (800) 387-4333.

Vermont Farm to School kit

Changing to a healthier, more sustainable food system at school just got easier. Vermont FEED has released three uniquely practical resources to guide the rest of us in doing what they do: connecting farms, schools and communities. In *A Guide for Using Local Foods in Schools*, teachers, administrators and cafeteria staff will find ideas for incorporating local foods into school lunches, case studies of successes and challenges and tips for working with the farmers and gaining support from the community. Student-friendly recipes are also included. *A Guide for Connecting Farms to Schools and Communities* helps farmers think about using their farms as learning environments. It offers suggestions for contacting schools, hosting class visits and interacting with students of different ages. A collection of thoughtful lesson plans is included to ensure that class visits are interactive and educational experiences. The 23-minute DVD titled *Grow Up Fresh* shares many stories about connecting farms to schools. We meet teachers who plant and harvest vegetables and develop recipes with their classes, and hold school-wide taste tests. We meet children who are excited about being involved in their food choices. We also gain insight into the benefits to farmers, the changes possible in cafeterias and the possibility of producing healthy food that students will enjoy. – *(JH)*





Vermont FEED, 2007, 110-page guide books US$15 each, DVD US$10, from Shelburne Farms, 1611 Harbor Road, Shelburne, VT 05482, (802) 985-0333, <www.shelburnefarms.com>. The two guides can also be downloaded free from <www.vtfeed.org>.

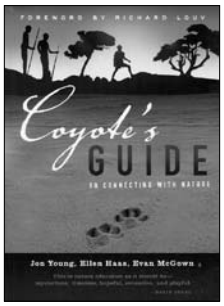
The Story of Stuff

Annie Leonard's 20 minute *Story of Stuff* video has racked up over 7 million views on the internet since 2007. Its popularity is not surprising. Leonard offers a no-nonsense explanation of the complex supply chain of the everyday the stuff we buy, showing how everything ultimately comes from the earth. As our demand for stuff increases, we are quickly depleting the natural resources needed for the production of these goods, but we're also undermining the prospects of a healthy life for all. Illustrated with animations that are both whimsical and scathing at the same time, this is a compelling, educational and thoroughly watchable short film that would make a great addition to a unit on sustainability at the high school level. You can download the video for free or order a hard copy for $10, which includes free international shipping. The website also includes an annotated script citing sources for the statistics referenced in the film, as well as a comprehensive bibliography. – *(JK)*

Tides Foundation & Funders Workgroup for Sustainable Production and Consumption, no ISBN, 20-minute DVD, US$10 via check/money order addressed to "Tides Center – Story of Stuff" at: The Story of Stuff, 1442A Walnut Street, #272, Berkeley, CA 94709 USA, <www.storyofstuff.com>.

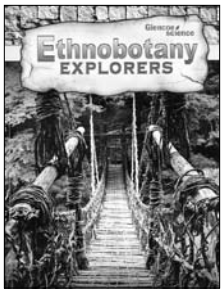
Coyote's Guide to Connecting with Nature

Co-written by Jon Young, Ellen Haas and Evan McGown, *Coyote's Guide to Connecting with Nature* is a remarkable mentor's manual and activity guide. In the first half, the authors provide mentoring strategies built on ancient practices that help expand young people's awareness and foster a deeper relationship with the world around them. The focus is on meeting learners where they are, at the "edge of what they can personally appreciate and relate to in a memorable way." These are places where the learner may be physically uncomfortable, or lack information or experience. A variety of strategies is provided for mentors to coach learners to stretch their edges, creating new levels of comfort and building awareness and knowledge. In the second half of the book, the authors present dozens of activities and games that show how to bring this learning to life. For example, Sit Spots takes advantage of children's natural interest in playing hide-and-seek by asking them to lie still in a leaf pile for a long period, trying not to be found. As they wait



quietly, children may become fascinated with ants, spiders or leaves, while also developing their ability to be still for longer periods of time. Besides instructions, each activity includes reflections for mentors and alternatives and extensions. Drawing on the work of many important authors and educators in the field, *Coyote's Guide* also offers strategies and activities for creating deep connections with nature in yourself and the people you mentor. – *(PM/TG)*

OWLink Media, 2010, ISBN 978-1 57994-025-6 (pb), 548 pp., US$34.95 plus $5 s&h from OWLink Media, 210 SE Cedar Hill Lane, Shelton, WA 98584, <www.Owlink-Media.com>.



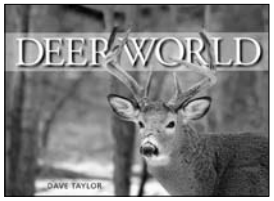
Ethnobotany Explorers

Ethnobotany Explorers combines a fascinating 3 to 4-week curriculum with a documentary-like DVD designed for high school students that explores the interactions of humans and plants around the world. The curriculum highlights important topics such as plant-based cures for disease, preserving traditional knowledge and protecting rainforest species. In one of eight engaging lessons, a research simulation helps students understand the roles of indigenous cultures and scientists in plant research and conservation. Another provides the materials for students to carry out a local ethnobotanical research project. In addition, there are directions for creating a classroom herbarium. All lessons are very complete, and make good use of the documentary segments on the DVD, well written student readings and extensive support documents. This curriculum could be used for formal or informal learning environments including after-school clues, camps, youth groups and nature centers. – *(TT)*

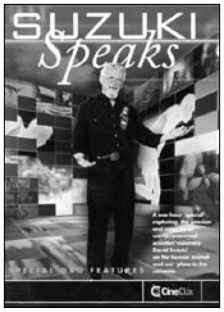
Macmillan/McGraw-Hill Glencoe, 2008, ISBN 978-0-07-891486-7 (pb), 267 pp., US$26.64 from McGraw Hill, <www.glencoe.com>.

Deer World

Seeing wildlife in their natural habitat can be very beautiful, as demonstrated by Dave Taylor in *Deer World*, his book of photographs of a year in the life of Northern American deer. For each day in a calendar year, he includes a colour photograph of a member of the deer family or of another animal that shares the same habitat. *Deer World* is more than a stunning keepsake collection of seasonal photographs. Through informative captions found throughout the book, we learn a great deal about deer and their wide-ranging habitats in Ontario, Florida, Alberta and Texas. Particularly helpful when teaching about habitats, food chains and animal adaptations, *Deer World* would appeal to those from 8 to 18 years of age. – *(KF)*



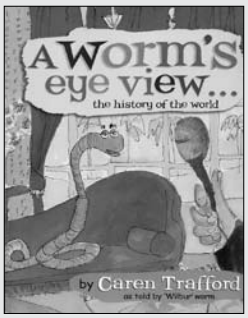
Boston Mills Press, 2008, ISBN 978-1-55046-501-3, 399 pp., C/US$39.95 from Firefly Books, (800) 387-6192, <www.fireflybooks.com>.



Suzuki Speaks

While David Suzuki is known for his TV show *The Nature of Things*, his many books and his Foundation, television is truly the medium where he shines. In this documentary, Suzuki explores concepts of interconnectedness, the origin of the universe and the need for human responsibility to care for the natural world. The strength of the documentary lies in clever visual interpretations that help make complex concepts accessible and interesting for all ages. Creative special effects place him in visually compelling settings— within a TV screen embedded unexpectedly on top of a cityscape, next to a shot of wild "Black Friday" shoppers and even in the hands of someone about to toss the TV tube in the garbage. The film makes an effective plea for people to rediscover their links to the natural world by illustrating just how connected

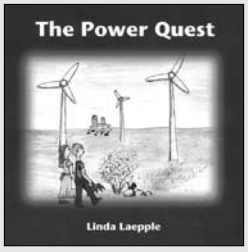
Books for Young Readers



A Worm's Eye View: The History of the World

According to Wilbursaurus Junior, the informed narrator of Caren Trafford's book — and a worm himself, worms have been eating their way through animal dung and other organic waste since the age of the dinosaur. In so doing, they convert waste into a mixture of benevolent bacteria that in pellet form fertilizes the soil and enables plants to grow. As Wilbursaurus relates the history of worms on Earth, readers learn about their life cycle, how both Cleopatra and Darwin recognized the importance of worms and the impact of the chemical agriculture on worm populations and the fertility of soil. Humorously-illustrated and educational, *A Worm's Eye View: The History of the World* is certain to appeal to many 6-12 year old readers and should be in the library of every school. It concludes with directions for building a small-scale worm farm – *(BM)*

Etram Pty Ltd., 2001, ISBN 0-646-41588-3, 36pp., US$20.00 from the Water Environment Federation, (800) 666-0206, <www.wef.org>.



The Power Quest

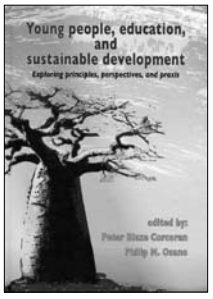
When the power goes out in Linda Laepple's picture book *The Power Quest*, children wonder aloud where it comes from. Determined to answer their question, the older children go on an adventure to learn about different types of electrical power genera-

to and dependent upon it we all are. The DVD also includes a 5 minute summary suitable for short classroom viewing and a 1992 speech Suzuki made to the United Nations. – *(JK)*

Avanti Pictures, 2004, no ISBN, 45-minute DVD, C$34.95 from Avanti Pictures, 5526 Marine Ave., Powell River, BC, V8A 2L9, (604) 609-0339, <www.avantipics.com>.

Education and Sustainable Development

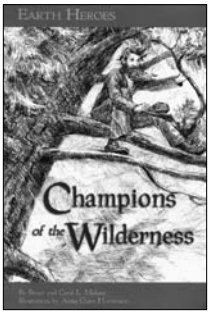
The aim of the United Nations Decade of Education for Sustainable Development from 2005-2014 is to integrate the values, principles and practices of sustainable development into all aspects of education and learning. Edited by Peter Blaze Corcoran and Philip M. Osano, *Young People, Education, and Sustainable Development: Exploring Principles, Perspectives, and Praxis* presents a combination of scholarly reflections on the value and ways of educating for sustainable development and current programs found in such diverse contexts as tribal-oriented South Pacific islands, resource rich Latin America and war-torn countries such as Nepal. Whether the pressing issue is peace-building, HIV/AIDS prevention, coral reef restoration, or conscious and conscientious consumption, each country's relationship to sustainable development is expressed through initiatives and curricula developed for and by young people. This volume makes clear that every nation is pursuing and educating for sustainable development from a unique political, social, cultural and environmental space. Essential reading for anyone teaching or learning for sustainability, *Young People, Education, and Sustainable Development* will bring a greater awareness of the many paths to be followed in creating an ecological sound, economically prosperous and socially just future for all. – *(PM)*



Wageningen Academic Publishers, 2009, ISBN 978-90-8686-093-7 (hc), 416 pp., US$82 from Wageningen Academic Publishers, telephone: (+31) 317 47 65 14, <www.WageningenAcademic.com/bookshop>, <sales@wageningenacademic.com>.

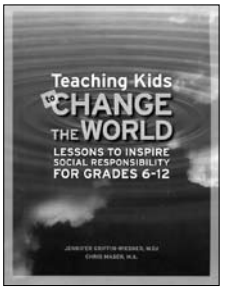
Earth Heroes: Champions of the Wilderness

Written for young readers, *Champions of the Wilderness* chronicles the lives of eight conservation heroes who have made significant contributions to the way humans interact with and protect wild places today. In their preface, authors Bruce and Carol Malnor promise that you will feel less like you are reading a history book and more like you are meeting friends. They stay true to that promise, highlighting not only the achievements, but the personalities of conservation greats such as John Muir, Aldo Leopold, David Suzuki and Wangari Maathai. At the end of each chapter is a useful "Timeline of Historical Events" which juxtaposes the major environmental and pop culture milestones that occurred at the same time as significant moments in the life of each hero.



For ages 10-14, with 40 illustrations and 40 photographs. – *(JK)*

Dawn Publications, 2009, ISBN 978-1-58469-116-7, 144 pp., US$11.95 from Dawn Publications, (800) 545-7475, <www.dawnpub.com>, C$14.95 from Monarch Books of Canada, (800) 404-7404.



Teaching Kids to Change the World

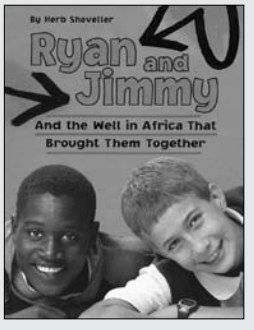
Subtitled "Lessons to Inspire Social Responsibility for Grades 6-12", Jennifer Griffin-Wiesner and Chris Maser's *Teaching Kids to Change the World* provides 26 lessons organized around eight principles of social and environmental responsibility. Each lesson presents a real-life scenario of a problem that occurs amidst unfamiliar settings, countries and cultural practices. The lessons are quite effective in encouraging

tion including hydro, bio-gas, nuclear and wind power. When they return home, a younger sibling explains that she learned that you can make power in your own yard with solar energy. Appropriate for early elementary grades, *The Power Quest* uses a simple story, engaging illustrations of power generation processes and easy-to-understand language to teach about sources of power, saving energy and reducing pollution. – *(KF)*

Self Published, 2007, ISBN 978-0-9783595-0-8, 21 pp., C$6.50/US$6.11 from Volumes, <www.volumesdirect.com>.

Ryan and Jimmy: And the Well in Africa that Brought Them Together

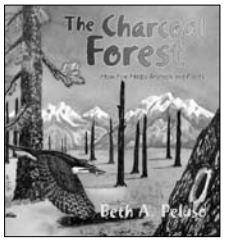
Herb Shoveller's *Ryan and Jimmy: And the Well in Africa that Brought Them Together* brings to light a remarkable, true story. Ryan Hreljac, a Grade 1 student in 1998, learned about the lack of safe drinking water in poorer communities. He decided to do chores to earn the $70 he was told it would cost to build a well that could supply an African village with clean water. In 1999, at a much greater cost and with assistance from many others, Ryan's first well was built in northern Uganda. By 2005, Ryan's Well Foundation raised enough money to build 194 wells in Africa and South America. As the subtitle of the book suggests, the book also focuses on Ryan's trip to Uganda where he meets his pen pal Akana Jimmy, and how they eventually become brothers. Thoughtfully written and illustrated, this is a perfect book for helping 8-12 year old readers understand what it means to think like a global citizen. – *(BM)*



Kids Can Press Ltd., 2006, ISBN 978-1-55337-967-6 (hc), 56pp., US$16.95/C$18.95 from Kids Can Press, (800) 265-0884, <www.kidscanpress.com>.

young people to think about the long-term impacts of their actions and the benefits of sustainability. To deepen understanding and application, each lesson also includes follow-up discussion questions, and suggestions for class activities and service projects. This interdisciplinary resource could be used in formal or informal settings. In particular, Language Arts teachers might use this resource as prompts for writing assignments. – *(TG/TT)*

Search Institute Press, 2008, ISBN 1-57482-877-0 (pb), 102 pp., US$19.95/C$21.95 from Independent Publishers Group, (800) 888-4741, <www.ipgbook.com>.



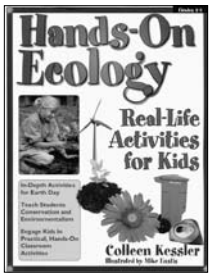
The Charcoal Forest

When most of us hear about forest fires, we cringe as we think about the devastation, but Beth Peluso shows us that nature is alive and well after a Rocky Mountain forest fire. In her picture book *The Charcoal Forest: How Fire Helps Animals and Plants*, she introduces us to twenty species that thrive in burnt areas. Amidst full page illustrations of each species, young readers are encouraged to spot a hidden black-backed woodpecker, which also needs forest fires to thrive. An engaging and informative text, *The Charcoal Forest* is appropriate for independent reading in grades 4-6, but would be enjoyed by those younger and older too. – *(KF)*

Mountain Press, 2007, ISBN 978-087842532-7, 56 pp., US$12 from Mountain Press Publishing Company, <www.mountain-press.com>.

Hands-On Ecology

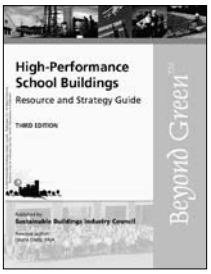
Drawing on children's natural fascination and curiosity about the world around them, Colleen Kessler's *Hands-On Ecology: Real-Life Activities for Kids* invites learners in grades 3-5 to be active observers, recorders and processors of information about the natural world around them. Thirty-eight well-organized activities address conservation topics such as human impacts on the environment and creating a wildlife garden, and natural science topics such as soils, carbon cycling and water quality. Each chapter provides background information which will be particularly helpful to newer teachers and youth leaders. Most activities include reproducible student pages, and some of which are data collection sheets which will familiarize students with the scientific practice of data collection and analysis. – *(TT)*



Prufrock Press, 2007, ISBN 978-1-59363-201-4 (pb), 157 pp., US$19.95/C$25.95 from Prufrock Press, (800) 998-2208, <www.prufrock.com>.

High Performance School Buildings: Resource and Strategy Guide

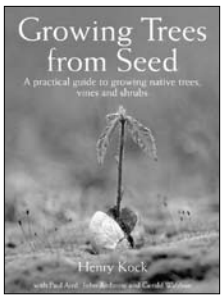
Reflecting the green building movement's tremendous momentum over the last five years, this downloadable guide is an excellent resource for navigating the process of planning and constructing an environmentally-friendly facility. The guide provides an introduction — not an in-depth treatment — of many important topics such as daylighting, environmentally-preferable building materials and superior indoor air quality. Case studies of the construction of four green schools are included. While focused on school buildings, the advice is general enough to be applicable for any commercial building—nature centers, non-profit organizations and even corporations will find the simple checklists and definitions in this guidebook quite useful. – *(JK)*



Sustainable Buildings Industry Council, 2008, ISBN 0-9762073-9-7, 112 pp. PDF, US$55 from Sustainable Buildings Industry Council, <www.sbicouncil.org>.

Growing Trees From Seed

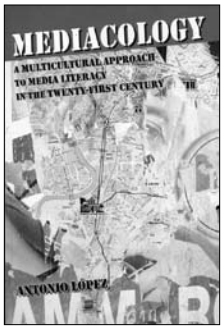
According to the late Henry Kock, "to think like a seed, we must first listen to the seed's story as written by the land and water where the seed formed, and the wind, water and animals that distribute it". We learn this and much more in this comprehensive book from the renowned horticulturalist, naturalist and conservationist. Kock explains how to collect, clean, store and germinate seeds, and also how to set-up a small nursery, divide your plantings, choose a proper planting site, and transplant outdoors. He provides an extensive guide of woody plants in which descriptions of each plant provide the information needed to identify a species and understand its ecology. Accompanying each of these descriptions are beautiful botanical pencil drawings. Horticulturalists will treasure Kock's seed treatments, and the seed dispersal calendar in the appendix. Educators will use this book to establish restoration projects with young people. Although focused on the Great Lakes bioregion, much of the information is appropriate for other regions as well. More than a "how to" book, we also learn the many reasons "why" to restore the landscape. – *(JH)*



Firefly Books, 2008, ISBN 978-1-55407-363-4, 280 pp., C/US$45 from Firefly Books, (800) 387-5085, <www.fireflybooks.com>.

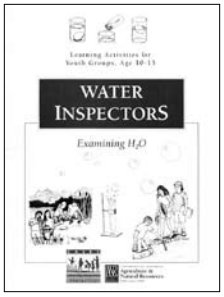
Mediacology

Antonio Lopez coins the word "Mediacology" among many other inventive terms in this book to describe and advocate for a necessary shift in the way educators help their students understand and respond to new and traditional media in the 21st century. Lopez's principal recommendation is to not only deconstruct media in the classroom, but to also allow students the opportunity to reconstruct and recreate their own media contributions, empowering them to actively engage in media rather than demonizing it as a corporate invention. Like healthy ecosystems, Lopez asserts that healthy media should have many small and interdependent parts that are in proper balance with one another. Through an exhaustively copious literature review and imaginative allegories, Lopez explores media comprehension through traditional Native American cultural beliefs, comparisons of right



brain vs. left brain thinking approaches, and even an in-depth analysis of the popular television show LOST. This is a very dense volume, and many readers may find the language and academic writing style a bit hard to digest. The core ideas in the book are expressed most clearly and accessibly in the later chapters, so if readers can persevere through the end, they will be rewarded with challenging perspectives on creatively rethinking media education methods through the prism of sustainability and permaculture. – *(JK)*

Peter Lang Publishing, 2008, ISBN 978-0-8204-9707-5 (pb), 178 pp., US$32.95 from Peter Lang Publishing, 275 Seventh Ave., 28th Floor, New York, NY, 10001, <www.peterlangusa.com>.



Water Inspectors

If you are a classroom teacher looking for hands-on, inquiry-based, water-related activities, *Water Inspectors: Examining H_2O* is the resource for you. Best suited for students in grades 4-8, the easy-to-follow activities address topics such as water density, salinity, hardness, temperature and aquatic life. Each activity is designed in laboratory format and includes data sheets for students. In this practical volume, most activities make use of everyday household materials such as glue, paper, soap, or food coloring, and can be altered for various sized groups ranging from one student to groups of 4-6. The book includes a total of nine labs and is also available in Spanish. – *(EJ)*

University of California Division of Agriculture and Natural Resources, 2001, Publication 21609 (pb), no ISBN, 46 pp., US$8.50 from University of California Agriculture and Natural Resources Communication Services, (800) 994-8849, <http://anrcatalog.ucdavis.edu>.

Crapshoot

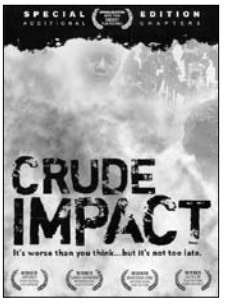
Subtitled "The Gamble with Our Wastes" Jeff McKay's documentary offers a clear and powerful message. Whether we are indifferent or ill-informed, the billions of liters of water and waste that are flushed into sewers each day are putting public safety at risk. McKay interviews engineers,

concerned citizens, and activists who maintain that the continued use of sewer systems to dispose of household and industrial waste will have disastrous consequences. The flushed concoction of chemicals, solvents, heavy metals, food and human waste is resurfacing in the food chain of every living organism on Earth. Filmed in five countries, including Canada and the United States, McKay shows examples of untreated waste being dumped into oceans, and partially treated waste being dumped into waterways or collected as sludge and spread on farmland as fertilizer. A few alternatives to the present system of sewer disposal are suggested. Recommended for ages 14 and above, and highly recommended to teachers and youth leaders. – *(BM)*

National Film Board of Canada, 2003, 53-minute DVD, C$19.95 (home use)/$59.95 (institutional use), (800) 267-7710, <www.nfb.ca/store>.

Crude Impact

Crude Impact is an award-winning documentary showing how oil extraction affects individuals, indigenous peoples, nations and the planet. We

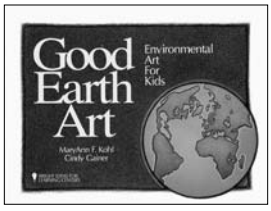


hear from people directly affected by oil industry pollution, but also from one scientist who believes that fossil fuels are here to stay. The film shows the impact of oil on the foreign policies of many nations, and the environmental damage it has caused. With peak oil — the point at which oil production begins to irreversibly decline — as a backdrop, additional interviews reveal the urgent need for positive change. Four solutions are proposed to limit our need for oil: bringing population into balance with the planet's resources and other species through educating and empowering women; reducing energy consumption; promoting organic farming; and making our voices heard with politicians. Supported by a website that includes further interview content and stories of hope as well as ways to get involved, this documentary is a must-see for all high school-aged youth and adults. – *(PM)*

Vista Clara Films, 2006, no ISBN, 200-minute DVD, US$24.49 (1-20 copies)/US$12.25 (20+ copies), from Vista Clara Films, <www.crudeimpact.com>.

Good Earth Art

Good Earth Art is a wonderful resource for teachers wishing to incorporate art and nature into the curriculum or for parents looking for nature themed art projects for their children. Written by

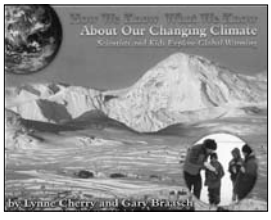


MaryAnn Kohl and Cindy Gainer, this book includes over 200 hands-on activities that can be completed indoors or out. Recommended for children ages 4-8, most activities use recycled materials like egg cartons, paper or items easily collected outdoors such as leaves, twigs or sand. Activities are divided into categories such as drawing and painting, sculpture and mobiles, and weaving and crafts. A resource guide at the back tells readers where to find free materials and lists of environmental organizations for further information. From Dried Bean Pictures to Six Pack Ring Weaving, the projects in this resource are a great way to introduce nature or art to young students. Teens and adults will enjoy many of them too. – *(EJ)*

Bright Ring Publishing, 1991, ISBN 0-935607-01-3 (pb), 223 pp., US$18.95 from Independent Publishers Group, (800) 888-4741, <www.ipgbook.com>.

How We Know Our Climate is Changing

With colorful and interesting graphics, charts, photographs and concise, scientific explanations, *How We Know What We Know About Our Changing Climate* is an excellent resource. Written by Lynne Cherry and Gary Braasch, the book helps students and educators to better understand climate change and its scientific evidence. It illustrates



and explains research on the effects of climate change on various ecosystems while also telling the inspirational stories of young people who are doing their part to slow climate change and reduce their carbon footprints. This resource is written at an upper elementary through middle school reading level. A separate Teacher's Guide by Carol Malnor suggests classroom activities that help students practice graphing, critical thinking and laboratory skills while learning about the principles of climate science. – *(JC)*

Dawn Publications, 2008, ISBN 978-1-58469-103-7 (hc), 66 pp., US$18.95 from Dawn Publications, <www.dawnpub.com>; C$23.95 from Monarch Books of Canada, (800) 404-7404.; Teacher's Guide ISBN 978-1-58469-105-1 (pb), US$8.95 from Dawn Publications, <www.dawnpub.com>; C$10.95 from Monarch Books of Canada, (800) 404-7404.

Born with a Bang
From Lava to Life
Mammals Who Morph

Perfect for students in grades 2-6, Jennifer Morgan's paperback trilogy focuses on the creation of the Universe, Earth, and humankind. *In Born with a Bang*, The Universe talks of her own creation and change of form. The book *From Lava to Life* discusses planet Earth and its inhabitants up to the dinosaur period, and *Mammals who Morph* captures the evolution of mammals, ending with human beings. Dana Lynne Andersen's illustrations in these publications are very colorful, creative and appropriate to the storyline. Narrated by Madame Universe, the series discusses evolution from a surreal, fairytale perspective. The author provides an account of major evolutionary happenings in an easy to understand chronological report. Release the regimented views of yesterday's scientists and take hold of the expressionistic rendition of tomorrow's storytellers: our children. This series is best suited for storytime or for addressing sensitive creation and evolution issues. – *(EJ)*

Dawn Publications, 2002, *Born with a Bang*, ISBN 1-58469-032-1 (pb), *From Lava to Life*, ISBN 1-58469-042-9 (pb), *Mammals Who Morph*, ISBN 1-58469-085-2 (pb), , 48 pp. each, US$9.95 from Dawn Publications, (800) 545-7475, <www.dawnpub.com>; C$12.50 from Monarch Books of Canada, 5000 Dufferin St, Toronto, ON M3H 5T5, (800) 404-7404

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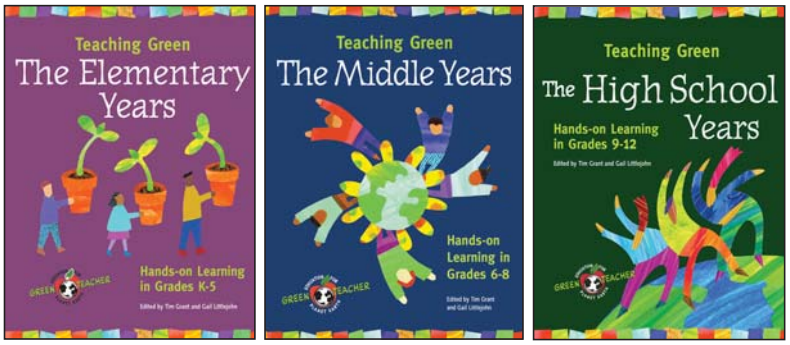
BOOKS from Green Teacher

Teaching Green

Hands-on Learning in Grades K–5, 6–8 and 9–12 240 pages, 8 1/2" x 11"



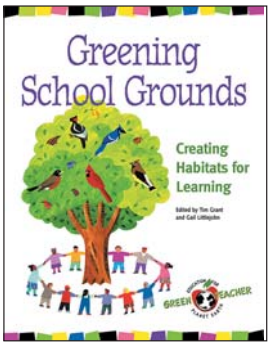
The ***Teaching Green*** books are complete "green" teaching resources for anyone working with young people in Grades K–5, 6–8 or 9–12, whether inside or outside of schools. Each book contains over 50 of the best teaching strategies and activities contributed to ***Green Teacher*** magazine during the 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

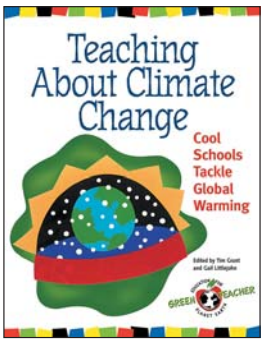
Cool Schools Tackle Global Warming

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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