

ENVIRONMENTAL EDUCATION

# RESEARCH BULLETIN

ISSUE 5 · JANUARY TO JUNE 2013



## ABOUT THE RESEARCH BULLETIN

The *Environmental Education Research Bulletin* is a project of ChangeScale in partnership with Dr. Nicole Ardoin at Stanford University. The bulletin is designed to inform environmental and sustainability educators about recent relevant research, with a primary emphasis on informal, field, and residential settings, as well as stewardship behavior, conservation, and related topics. Although other environmental educators and those in related fields might also find this bulletin useful, it does not—nor is it intended to—cover all aspects of environmental education. This Research Bulletin, as well as past issues, is available online through the ChangeScale website: [www.changescale.org](http://www.changescale.org). Please send questions and feedback to [eereseearchbulletins@changescale.org](mailto:eereseearchbulletins@changescale.org).

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# INTRODUCTION

Dear Colleagues,

ChangeScale is proud to partner with researchers at Stanford University to create this fifth issue of the *Environmental Education Research Bulletin*. These bulletins aim to bridge the gap between research and practice by summarizing recently reported research that may help educators improve their practice.

The most talented environmental educators we know are conducting place-based programs, collaborating with communities, and using hands-on strategies to make the critical link between environmental awareness, skill building, and informed action. Rarely do these committed professionals have time to keep up on the latest research and its beneficial findings, which may enhance the effectiveness of environmental education programming.

In this issue, we've pulled together relevant journal articles that relate to environmental education practice primarily in informal and field-based settings. We reviewed issues (published between January and June 2013) of the following journals: *The Journal of Environmental Education*, *Environmental Education Research*, *Applied Environmental Education and Communication*, *Australian Journal of Environmental Education*, *Canadian Journal of Environmental Education*, *Journal of Experiential Education*, *International Journal of Science Education*, *Science Education*, *Visitor Studies*, *Journal of Interpretation Research*, *Environmental Research Letters*, and the *Journal of Environmental Psychology*.

Because we are creating this document for you, we're eager to hear your feedback.

Please let us know if there are additional topics or journals you'd like to see covered, or if there's an alternative format that may be helpful. You can send suggestions to [eereseearchbulletins@changescale.org](mailto:eereseearchbulletins@changescale.org). We'll take your

feedback into account at the beginning of each cycle and try to adapt accordingly. And for another take on these kinds of articles, you may also want to check out the research blog available from the North American Association for Environmental Education ([eelinked.naaee.net/n/eeeresearch](http://eelinked.naaee.net/n/eeeresearch)). You may also be interested in the Relating Research to Practice effort of CILS and the Exploratorium, available here: [www.exploratorium.edu/education/relating-research-practice](http://www.exploratorium.edu/education/relating-research-practice).

We wish you all the best in your important efforts to integrate high-quality research into inspiring practice!



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# BEHAVIOR

## WHAT'S THE STORY WITH TEEN ENERGY USE?

Teenagers are often known for their attitudes, and this study explores a particular type of attitude in teens: attitudes toward energy use and energy saving. Environmental researchers know very little about what teens think about energy or how they use it. Previous studies indicate that teenagers consume more electricity than adults, a troubling trend given the environmental impacts of increasing energy consumption worldwide. By listening to the stories of teenage energy users, researchers hoped to gain insight into the next generation of adult consumers to inform effective strategies for reducing consumption.

This study actively engaged teenagers about their attitudes toward energy by providing opportunities for teens to express themselves. These opportunities came in two forms: (1) a diary and storytelling and (2) focus groups based on data from the first stage. Researchers recruited participants between 10 and 19 years old in the United Kingdom.

Sixty teenagers used diaries to record their energy use over seven days. For every diary entry, participants included the time, activity, object in use, and duration of use. Ninety-six participants took part in a 30- to 60-minute story session. Participants documented their energy consumption during a normal weekday or weekend using various writing, drawing, and collaging materials to appeal to multiple creative preferences.

Researchers collected the diaries and stories and extracted themes from the contents. Initial themes included type of energy used, devices used that require energy, and various locations where energy consumption took place. This initial qualitative analysis informed the development of written scenarios used in the focus groups.

These written scenarios described how teenagers use energy. Using these scenarios as prompts, researchers engaged teen participants in focus group discussions around energy, energy consumption, and saving energy. These discussions lasted 25–60 minutes and sought to further explore teens' ideas, perspectives, and attitudes about energy.

Researchers compiled data from the diaries, story sessions, and focus groups. After going through the data and familiarizing themselves



with the content, researchers coded the data into relevant features and then general themes.

The analysis revealed several important themes related to teenage attitudes toward energy.

**Energy use:** Teens associated energy with a variety of activities and appliances. Although older teens focused on household electricity consumption (TVs, computers, phones, kitchen and personal appliances, lights), younger teens considered a broader range of energy uses (water, transport, heat, physical energy, food).

**Location:** Teens cited different locations for energy use, mainly home and school. Older teens focused primarily on the home. Focus groups revealed many teenagers only associate personal energy consumption with devices they turn on or use. Many teens did not feel responsible for energy use at school.

**Sources of information:** Teens identified public media, school, and parents or guardians as sources of energy information. Teens heard energy conservation messages via the media. Most teens learned about energy in school, but many did not understand the relevance to their lives. Parents or guardians presented energy-saving information as a matter of cost, but some mentioned safety and global impacts.

**Impact of energy use:** Teens mentioned impacts of energy use on the environment, future generations, and cost to themselves. Teens linked energy consumption to global warming, ozone depletion, and CO<sub>2</sub> emissions. Many teens expressed concern over depleting energy resources. Teens viewed cost as an important issue but pointed out that cost mostly concerns those responsible for paying bills. Many felt that cost to consumers mattered more than environmental impacts.

**Barriers:** Teens identified lack of knowledge of environmental impacts, lack of motivation to change lifestyle, lack of connection to the issue, lack of financial responsibility, difficulty in breaking habits, unpopularity of “eco-friendliness,” and extra effort as barriers to saving energy.

**Green teens:** Teens expressed mixed attitudes toward the importance of saving energy and whether teenagers care about energy issues. While some expressed concern about the impacts of energy use, others did not. Concern about energy saving could be influenced by other themes, including: how teens consume energy, where they consume it, and what information they receive regarding energy use impacts. Teenagers understood many energy-saving methods, but many felt wary of energy-saving competitions.

**THE BOTTOM LINE:** This study found that engaging teenagers through diaries, storytelling, and focus groups drew on different forms of expression in participants and provided useful details and contextual information. Attitudes toward energy consumption varied across participants: older teens often focused on personal consumption while younger teens included a broader array of consumption types and locations. Most teens understood the link between energy consumption and impacts of energy use, but many teens did not feel personally responsible for lowering energy consumption. These findings can inform future research and education strategies to influence teenage energy habits.

Toth, N., Little, L., Read, J. C., Fitton, D., & Horton, M. (2013). Understanding teen attitudes towards energy consumption. *Journal of Environmental Psychology*, 34, 36–44.

## CHILDREN INFLUENCE PARENTS' ENVIRONMENTAL KNOWLEDGE, BEHAVIOR

Environmental education (EE) has often been touted as a tool for environmental conservation due to its potential to enhance environmentally related knowledge and attitudes and influence conservation-oriented behaviors among participants. Although many see value in EE, there have been active debates about the appropriate—and most effective—audience for EE programs. Should EE interventions address children, who are young and may have a longer influence on the environment, or their

parents, who may be able to take action in the shorter term through currently impactful household behaviors, such as food purchases, or policy actions, such as voting? Such a choice may become obsolete in the face of new research that suggests that parents and children may actually mutually influence each other. While many people readily accept one half of this argument—that parents influence the knowledge, attitudes, and behaviors of their children—studies investigating the other half of this dynamic are rare. This study seeks to fill that gap by investigating whether children’s participation in an environmental education program focused on wetlands influences the knowledge and water conservation behaviors of their parents.

The authors conducted their study in the Republic of Seychelles, an island nation in the Indian Ocean with pressing freshwater degradation issues. While environmental education is provided through schools in the country, the authors studied the influence of an in-depth program provided to schoolchildren by Wildlife Club Seychelles (a local nongovernmental organization). The researchers collected quantitative data from students and their parents using self-report questionnaires that involved questions about wetland knowledge, household behaviors, and demographics. In total, they surveyed 161 students and their parents, all of whom were associated with one of 15 selected Wildlife Club Seychelles groups. Of these 15 groups, 7 had studied wetlands within the last year, while the remaining 8 focused on other topics. Using data from the questionnaire, the authors conducted statistical analyses to better understand the associations between children’s participation in wetland education, their wetland knowledge, their parents’ wetland knowledge, and household freshwater conservation behaviors. For the purposes of this study, the authors used two “knowledge” variables—one based on the participants’ ability to describe the river nearest their home and the other based on a composite score representing four questions covering topics such as wetland species and ecosystem services.

The authors present several findings of interest. First, children who participated in a Wildlife Club wetlands program, which involved hands-on learning opportunities,

had higher wetlands knowledge scores than their peers who did not participate in similar wetlands experiences. The length of participation in Wildlife Club Seychelles programs also mattered with regard to student knowledge: students who participated for longer periods of time demonstrated higher wetlands knowledge. These results suggest that the environmental education offered by the Wildlife Clubs is effective at enhancing students’ factual knowledge.

The authors found that the same relationship existed for parents. Parents of students who participated in wetlands education scored higher on the wetland knowledge questionnaire than parents of children without such an experience. The authors also found that parents whose children discussed their environmental education with them had higher wetlands knowledge scores. This suggests evidence of knowledge sharing between children and parents. Yet, even though the results indicate a high likelihood that children are sharing their new wetlands-related knowledge with their parents, the authors found that most parents denied gaining environmental knowledge from their children; this both underscores the risks of relying on self-report alone for such information and also suggests that perhaps the parents may not consciously be aware of the source of their information.

The authors found no significant differences among the student or parent groups on the study’s second wetland knowledge variable—local river awareness. The authors categorize this variable as a type of folk knowledge and argue that the lack of association is logical because (a) most students gain some level of exposure to their local environment and (b) EE programs may be better suited to addressing other types of factual understanding. In other words, the authors argue that EE is better at conveying certain types of knowledge than others.

The authors’ model for estimating the relationship between children’s EE participation and household water behaviors was a poor fit, but they present preliminary hypotheses for future study based on the results. Their results suggest that child participation in wetlands education, increased



knowledge of water systems, and past engagement in conservation activities are all associated with increased household freshwater conservation behavior. The authors interpret these findings as an indication that children may influence the behavior of individuals who are not themselves the targets of EE programs, especially behaviors related to the EE curriculum.

The study results are not able to prove causality in these relationships, but the findings suggest the value in further study to understand the factors and nuances in the relationship among EE, knowledge, and behavior for participants and their immediate family members.

**THE BOTTOM LINE:** This study provides evidence that environmental education programs can effectively convey conservation knowledge to young participants, who, in turn, may influence the knowledge, attitudes, and perhaps even behaviors of their parents. Educators, program coordinators, and policymakers may find this information useful when considering who to target with key conservation messages.

Damerell, P., Howe, C., & Milner-Gulland, E. J. (2013). Child-orientated environmental education influences adult knowledge and household behaviour. *Environmental Research Letters*, 8(1), 1–7.

## CRADLE-TO-CRADLE FRAMEWORK SHIFTS THE CONSUMPTION PARADIGM

Global consumption of materials and energy is one of the greatest contributors to current environmental crises. However, sustainable consumption curricula and corresponding educational research are in their infancy. The author of this paper used recent case studies and EE literature to investigate discrepancies between consumption patterns and attitudes within different socioeconomic contexts. Based on her findings, the author proposes that the Cradle-to-Cradle (C2C) framework could address challenges of teaching sustainable consumption

behavior by shifting the paradigm altogether.

The author used two recent case studies to examine how upper elementary grade students' knowledge of consumption corresponded to their attitudes of consumption and environmental protection, while considering socioeconomic contexts. The case studies used focus groups, interviews, and daily consumption journaling to investigate attitudes and behaviors related to consumption.

Children of upper-income families demonstrated environmental concern regarding consumption and viewed the purchasing of products made with minimal harm to the environment as the solution. This “sustainable consumption” harkens to the movement of eco-friendly, fair-trade, organic, local products.

By contrast, children within a largely migrant and low-income community demonstrated less awareness of the relationship between consumption and the environment, less sense of efficacy (ability to do something about the problem), and less interest. However, their families exhibited more pro-environmental behaviors than the affluent families, such as saving electricity and making minimal food and clothing purchases, with many of these behaviors initially being motivated by concerns around saving money.

Attitudes among these groups differed as well. While children in the more affluent study group expressed guilt related to their consumption and subsequent effect on the environment, children from lower economic backgrounds viewed consumption as a desired outcome linked to a higher social status. Due to these discrepancies in attitudes and perceptions among children of different backgrounds, curriculum on consumption would best be context sensitive.

In the case of wealthier societies, consumer guilt can be a driving force in increased consumption. The purchasing of fair trade, eco-friendly, organic products can lessen

feelings of guilt and give one the sense of “doing good” by consuming the “right” products. This rebound effect—purchasing more to combat issues of consumption—is one of the paradoxes of sustainable consumption. As the more affluent students in the first study reported “sustainable consumption” as the solution for overconsumption, curriculum with critical analysis of paradoxes and contradictions would be necessary in fostering a deep understanding of consumption issues.

As curriculum needs to address both the paradoxes of sustainable consumption, and also sociodemographic discrepancies, the C2C framework offers an opportunity to move beyond the conventional idea of sustainable consumption and shift the consumption paradigm. The C2C framework looks at the whole life cycle of a product, from the initial resource extraction (cradle) to the product’s disposal (the second cradle). It advocates for a waste-free system, where all the elements of the product can be either recycled or reused. The concept mirrors natural systems in which one organism’s waste is another’s food (or fuel), energy sources are renewable, and diversity leads to resilient, ecologically effective systems. Businesses that have already successfully implemented this model for at least one of their products include Ford, Nike, Steelcase, and Herman Miller.

The C2C framework can be infused into current curriculum at any grade level. As consumption studies are interdisciplinary, it can be woven into life and physical science classes as well as into history and economics. The author suggests making the C2C part of a consumption curriculum, which also includes the development of strong communication skills and awareness of political processes. In the United States, for example, big business and government are both the largest consumers and the largest stakeholders of the current consumption system. Subsequently, students will need both the knowledge of consumption as well as the skills to communicate and take action on a broader scale.

**THE BOTTOM LINE:** A consumption paradigm shift moves away from the linear waste production

line and rethinks how to use “waste” as a resource. The C2C curriculum, which aims to foster this shift, has the potential to align with students’ unique sociodemographic needs. C2C provides an alternative and more viable solution than conventional “sustainable consumption.” This paradigm shift provides knowledge of turning waste into valuable goods, encouraging youth of all income backgrounds to become more mindful of use and reuse of materials through creative, environmentally friendly activities such as composting, transforming materials, and reusing existing products.

Kopnina, H. (2013). An exploratory case study of Dutch children’s attitudes toward consumption: Implications for environmental education. *The Journal of Environmental Education*, 44(2), 128–144.

## FOCUSING PRO-CLIMATE BEHAVIOR EDUCATION

There is a vast array of pro-environmental behaviors people can adopt to reduce greenhouse gas (GHG) emissions and mitigate the contribution of human activity to global climate change—from turning off lights, to composting, to biking instead of driving. Few studies have looked at which behaviors are the “low-hanging fruit” in terms of being most likely to be adopted by students after an environmental education experience. In this study, researchers tried to identify pro-environmental behaviors science teachers are most likely to successfully foster—specifically, behaviors that limit students’ contribution to global climate change.

The researchers formulated three research questions to address their overarching questions: (1) What behaviors do students believe will most effectively reduce global warming? (2) What behaviors do students report they are most willing to do? and (3) Is there a connection between students’ perceived effectiveness of behaviors and their willingness to do them? Since the research was conducted in two different countries—England and Australia—the researchers also investigated whether the responses differed between these groups of students from these two countries.

The subjects of this study were secondary students: 785 students from 4 randomly selected public schools in England and 500 students from 3 randomly selected public schools in New South Wales (NSW), Australia. All of the students were given the same questionnaire. Half of the questionnaire items asked about how students' perceived the effectiveness of different behaviors, while the other half of the items assessed students' intentions to adopt those behaviors. The questionnaire asked about 20 different behaviors: 12 of these behaviors were actions that directly reduce global warming, such as turning off lights or eating less meat; 4 were indirect behaviors, such as voting for pro-environmental legislation; and 4 were scientifically incorrect "distractor" behaviors (results from these distractor questions were not reported in the paper).

The researchers developed several indices to analyze the data. Their environmental friendliness (EF) coefficient described how a student's actions compared to his or her perceived usefulness of the behavior. The researchers hypothesized there would be a positive linear relationship between action and belief; in other words, students would be more likely to perform an action they believed to be useful. The EF coefficient measured how much responses differed from that linear norm. A positive value meant a student reported being likely to perform the pro-environmental action even though they perceived the action to be relatively ineffective at reducing climate change. On the other hand, negative EF values were given to students who reported being unlikely to adopt a behavior even though they thought it would significantly help reduce global warming.

Additionally, researchers calculated four indices: (1) potential effectiveness of education, (2) natural willingness to act, (3) natural reluctance to act, and (4) potential usefulness of education. These were based on plots of the responses for each behavior, where the perceived effectiveness of the behavior was on one axis and the willingness to act was on the other. A linear regression was drawn through each resulting plot. The slope of this line was regarded as the *potential effectiveness of education*, because it indicated the extent to which the willingness

to perform an action might be increased by teachers persuading students of the effectiveness of that action. The *natural reluctance* to act indicated the reluctance to take action even though it is perceived to be highly effective. The *natural willingness* to act indicated the willingness to do the action even though it is perceived to have little or no effect on reducing climate change. The fourth measure, *potential usefulness of education*, was developed to further refine the *potential effectiveness of education* index, by taking into account the proportion of the respondents not already intending to take that action. In other words, this final index was based on the idea that education may be better targeted at actions students are not already willing to do rather than actions most students are already doing or intending to do (e.g., if the majority of students already recycle, it may be less useful to teach about recycling).

Results indicated similar beliefs about the usefulness of actions across the two cohorts from England and Australia. These beliefs generally reflected scientific knowledge, although there were some exceptions. For example, more than 50% of students believed that obtaining more energy from renewable resources would reduce global warming, whereas only 15% to 20% believed that reducing meat consumption would reduce global warming (although scientific studies demonstrate that reduced consumption of meat actually would reduce global warming).

In terms of willingness to take action, there were significant differences between the two cohorts. Generally, Australian students expressed greater willingness to take action and demonstrated higher coefficients of environmental friendliness. The authors posit this finding could be related to the Australian formal school curriculum, which includes environmental education projects and activities.

Both groups of students expressed a lower willingness to act than would be predicted from their believed usefulness of those actions. Essentially, students were not as willing to adopt pro-environmental actions as their environmental awareness might suggest. This finding adds to growing evidence in EE research that there isn't a direct or linear relationship between knowledge and behavior. In other

words, more than simply increasing knowledge is needed to change behaviors.

Analyzing the potential usefulness of education index, the researchers found that eating less meat, utilizing renewable energy resources, and transitioning to artificial fertilizer-free (organic) food ranked as the activities with the highest potential for teachers to positively influence through education. These behaviors had high usefulness indices because large percentages of the students either were not taking these actions or remained unaware of their significant environmental benefit. Additionally, indirect actions, such as support for taxation, legislation, and intergovernmental agreements, all show high potential for being effected through education. Using nuclear energy, however, held lower potential for effectiveness, as students tended to be reluctant in their willingness to support this approach. Other actions, such as recycling and switching off electrical appliances, also had low potential usefulness, since most students were already engaging in these behaviors.

**THE BOTTOM LINE:** Certain pro-environmental behaviors that reduce climate change may be more useful and effective for environmental educators to address than others, because they are at the nexus of what youth perceive to be important and effective. Behaviors that may be most useful to address include eating less meat, using renewable energy resources, and transitioning to artificial fertilizer-free (organic) food, since most of the students in this study were not already doing these behaviors and the students were mostly unaware of the significant environmental benefit of these actions. Indirect pro-climate actions, such as participating in the political process and voting for pro-environmental legislation, may also be important to discuss in environmental education initiatives, although these behaviors may not be as relevant or appropriate for students because of the students' age and the policy implications and aspects of the behaviors.

Skamp, K., Boyes, E., & Stanisstreet, M. (2013). Beliefs and willingness to act about global warming: Where to focus science pedagogy? *Science Education*, 97(2), 191–217.

## MEETING PSYCHOLOGICAL NEEDS INCREASES MOTIVATION TO ACT

One of the critical questions that is still challenging and persistent in environmental education (EE) research is why some EE programs are more effective than others at encouraging students' intention to undertake environmentally friendly behaviors. This study investigates one framework—called self-determination theory (SDT)—which explores what motivates people to act. SDT identifies three psychological needs that, when met, increase a person's motivation to act as well as long-term interest in the content. These three elements are competence, relatedness, and autonomy. The researchers used this theory to design and evaluate an EE curriculum in Turkey for preservice science teachers (PSTs).

SDT proposes that specific teaching methods can help people feel competent in their abilities, cared for and related to others, and that they have individual autonomy. Furthermore, SDT argues that meeting these basic psychological needs is critical for people to feel motivated in undertaking environmentally friendly behaviors. Competence, relatedness, and autonomy, thus, were tested through multiple case studies with PSTs.

The research was conducted during 6 weeks of a 13-week environmental science course offered to PSTs in their final year of study in Turkey. Each week of the course was considered a case. Each case involved small group discussions around an environmental problem provided by the authors of the study, as well as assignments the PSTs completed each week. In each, a triangulated approach of individual interviews and reflections, group discussions, and quantitative data were used to develop a baseline understanding of the efficacy of the approach as it related to psychological needs of the teaching methods employed. From the 33 students (22 female, 11 male) in the course, a focus group of 5 PSTs (one from each discussion group) was also formed to allow the researchers to further investigate the efficacy of the course. Each student also presented a capstone project and wrote reflections on the experience, which were used in the data analysis.

The quantitative component of the results indicated increased levels of competence, autonomy, and relatedness during the cases, especially toward the end of the study. Through analysis of the qualitative data for common themes, several positive cognitive and instructional features were identified. Cognitive features included: sense of confidence in action, sense of self-initiation, awareness of personal role in the system, and awareness of environmental actions. Instructional features were: collection construction of ideas, real-life connection, student-guided discussion, and consistent group dynamics.

The most relevant aspects of this study for teachers were the instructional features identified to support students' psychological needs. For example, *collection construction of ideas* speaks to the idea of creating a shared solution to a problem. The study found students were more engaged by supporting each other's ideas and making decisions together and that, ultimately, this process of collaboration helped students develop their confidence and sense of autonomy as well.

Another strategy, *real-life connection*, builds on the theory that people are more interested in local solutions. In the cases employed in this study, results showed that local scenarios gave students a sense of self-awareness and competence to work toward a solution.

*Student-guided discussion* was another tool that the preservice teachers employed to support autonomy and relatedness. During cases that were dictated by student discussions, students enjoyed making their own decisions about controversial issues rather than having the instructor tell them what the solution was.

The final strategy that was identified was *consistent group dynamic*, meaning that the students worked with the same group of peers throughout the course. Such dynamics created a sense of trust between students because they could share ideas among "group friends." With more opportunity for students to feel safe, they are more likely to take risks and not fear failure. Several students mentioned that, because they trusted people in their group, they never hesitated to

contribute; if they did contribute an idea that, perhaps, was not practical, they could treat it less seriously.

Taken together, the qualitative and descriptive statistics supported much of the earlier work in this field through three primary findings: (1) people are more likely to become engaged if they feel a sense of connection to each other and to the issue at hand; (2) people are more likely to act if they feel like their behaviors are directly contributing to a positive outcome; and (3) being aware of their personal role is critical to initially becoming engaged. The strategies discussed above are identified as effective tools to provide competence, autonomy, and relatedness.

**THE BOTTOM LINE:** Self-Determination Theory (SDT) suggests that an increase in autonomy, relatedness, and competence will engage students in environmentally friendly behavior that is more effective and sustainable. Teaching strategies, such as student-guided discussions, making connections with real-life and local environmental issues, and positive group dynamics, can help students—such as those in this study—further develop those psychological processes.

Karaarslan, G., Ertepinar, H., & Sungur, S. (2013). Use of self-determination theory to support basic psychological needs of preservice science teachers in an environmental science course. *Environmental Education Research*, 19(3), 342–369.

# EVALUATION

## DEFINING AND ASSESSING ENERGY LITERACY

Energy can be considered the “currency of humanity.” Everything we do relies on energy, and historically, societal advancements—such as the Industrial Revolution and the corresponding increase in human population—parallel energy-related developments. Despite our dependence on energy, particularly in the United States, and a looming energy crisis, various energy studies demonstrate a general lack of energy-related knowledge and awareness among the general U.S. population. A limitation of these studies is that the surveys have focused on specific curricular objectives, such as renewable energy resources or how energy is consumed, making comparisons across studies almost impossible. In light of this limitation, the authors of this paper developed an energy literacy survey, which is intended to be a broad-reaching tool for evaluating public understanding of energy-related issues, assessing energy education programs, and providing a framework for improving students’ energy literacy.

Literacy encompasses much more than knowledge: it also includes evaluating information, applying concepts, communicating ideas, and using these skills to make decisions and take action. To define energy literacy and determine the criteria for measuring energy literacy, the authors reviewed established scientific, technological, and environmental definitions of literacy, as well as curricular materials and educational standards in these fields. They noted parallels between these fields and energy education literature, which highlighted content knowledge, attitudes, and behavior as essential attributes for literacy development. With this in mind, the authors defined energy literacy as “the concepts, skills, and values required to communicate, make choices, and act as an energy-responsible citizen.” The next question was: How are we to measure energy literacy?

Taking each attribute of literacy development—cognitive, affective, and behavioral—the authors parsed them into smaller, descriptive characteristics, and then further into measurable benchmarks. They used educational curricula as well as textbooks, published polls, and surveys; with these materials, they sought approval of their work through a panel of energy and energy-education specialists. The resulting, and agreed-upon, framework includes 16 characteristics and 52 measurable benchmarks to assess cognitive knowledge,



attitudes, and predispositions to behave in accordance with one's energy-related knowledge and attitudes. The cognitive attribute, for example, includes characteristics of energy sources and resources, as well as basic energy concepts. These characteristics are measured through benchmarks such as identifying forms of energy, applying the first and second laws of energy, and identifying units of energy and power.

With these measurable benchmarks as a framework, the authors constructed an 85-item survey with closed-ended, quantitative questions. Careful attention was paid to keep the survey broad and appropriate regardless of age, ability level, and cultural as well as geological contexts; however, the breadth of the survey also poses some limitations. For example, the survey does not identify mastery levels for specific grades, although the survey is intended to be used in classrooms. Despite limitations, the survey provides a useful tool for identifying common misconceptions and gaps in knowledge, evaluating energy educational programs, and improving energy literacy.

**THE BOTTOM LINE:** The growing number of energy education programs provides hope that citizens will develop the awareness, values, and skills needed to advocate for sustainable energy resources and use. However, without a universal tool to evaluate these educational programs, it is challenging to measure program effectiveness or people's energy literacy. The aim of this study was to create a universal instrument, first by defining energy literacy and then by creating a quantitative survey that includes items that can be used to assess a range of programs and age levels.

DeWaters, J., & Powers, S. (2013). Establishing measurement criteria for an energy literacy questionnaire. *The Journal of Environmental Education*, 44(1), 38–55.

# TEACHING METHODS

## TAILORING EE PROGRAMS TO REACH DIVERSE AUDIENCES

Although education research has established a strong connection between a student's cognitive engagement and affective connection to a learning topic, little research has been conducted on how, and whether, environmental education curricula do this effectively across a spectrum of audiences. Do environmental education curricula reach students from diverse backgrounds and, if so, do they do so effectively?

This study's authors sought to investigate the answer to this question by first exploring how teachers in a workshop responded and related to a well-known environmental education curriculum (Project WILD). However, the researchers added an interesting element that reflected the composition of their audience—for the first time in the history of the curriculum, the entire workshop, which took place in the United States, was conducted in Spanish, and Latino cultural elements were incorporated into the activities.

Project WILD's decision is situated in a rich history of scholarship around incorporating issues of diversity into learning spaces. After the Civil Rights movement, scholars developed Critical Race Theory, which theorized that racism is an inherently structural force and, in order to move beyond it, the dominant narrative must be challenged and troubled by creating a rich counter-narrative of minority stories and discourse. By creating this narrative of Latino culture in the training workshops, the scholars hoped that the teachers, and, accordingly, the students, would find the environmental content relevant and engaging.

In the experiment, researchers followed 24 bilingual and culturally Latino and Hispanic preservice teachers as they completed *Proyecto Silvestre* (Project WILD in Spanish) training and participated in a 6-hour workshop in a local natural area. The researchers analyzed the participants' blog entries, commentaries on a group website, and media coverage generated by the all-Spanish training. The data were then analyzed and coded for effects around cognitive and affective learning.





The results indicated that participant teachers were proud of the high status the Spanish language was afforded throughout the training. They also felt joy being able to learn about nature in the context of their own culture. Being able to use Spanish enabled them to more effectively elaborate their feelings toward nature. The researchers concluded this study indicates that if language and culture are more effectively valued within the curriculum, they open up avenues through which students can build affective and cognitive connections with the material.

**THE BOTTOM LINE:** Environmental education programs must consider how to effectively reach a range of audiences. In a diverse world, what cognitively and affectively engages one student may not engage another. By incorporating students' language and cultural backgrounds into activities, environmental educators not only increase the chances of conserving and preserving natural resources and the environment, but they also can preserve and celebrate cultural resources.

Arreguin-Anderson, M. G., & Kennedy, K. D. (2013). Deliberate language planning in environmental education: A CRT/LatCrit perspective. *The Journal of Environmental Education*, 44(1), 1–15.

## ENGAGING URBAN LEARNERS THROUGH FOCUS ON FOOD JUSTICE

Over 80% of people in the United States and half of the world's population live in urban areas, yet current teaching methods in environmental education (EE) are often not focused on learners in urban settings. This paper addresses the ways in which EE is lacking in an urban context and how the food justice movement might help EE become more inclusive and effective for urban learners.

The author elaborates on three ways in which EE is not meeting the needs of learners in urban areas. The first is by largely ignoring urban areas. The author suggests that EE's lack of attention toward urban places traces to its

roots in notions of “nature-as-truth” and “wilderness-as-pristine” and that the current form of EE often reinforces this dichotomy between wild, untouched nature and industrialized urban areas; these dichotomies may exclude youth with urban experiences.

The second shortcoming of urban EE, the author asserts, lies in its common form of classroom science education. This format tends to limit EE to scientific ways of knowing, lecture-based pedagogies, and content that focuses on objective facts. By contrast, EE's philosophy and pedagogy more often call for place-based, outdoor, and experiential learning that do not fit within the rigid formal school system. The author also points out that conventional classroom teaching techniques frequently marginalize learners from more diverse backgrounds.

Finally, the author suggests EE's third challenge in urban contexts is its lack of engagement with issues of race, culture, politics, and economics. This partially relates to EE's lack of involvement with urbanity. The author cites EE's location within an American public education system that is designed to serve the majority and reinforces dominant social structures rather than questioning them as problematic in this regard.

By contrast, the author suggests that the food justice movement may provide tools to combat EE's shortcomings through its singular focus, emphasis on justice, and attention to different scales—from local to global. The author works with this definition of food justice: “Food justice seeks to ensure that the benefits and risks of where, what, and how food is grown, produced, transported, distributed, accessed, and eaten are shared fairly.” Food justice considers the community level as well as the global level, questioning and examining the disparities that occur at each. The local focus allows food justice to correlate with place-based study, while the global aspect keeps the movement holistic and enables it to critique systematic injustice and disparities.

The author suggests that the singular subject of the movement—food—is also significant. Food is universal, relatable, and, of course, necessary for survival. Its study is inherently contextualized and relevant, especially on the local level. Another important aspect of food is its relation to nature without being necessarily tied to wilderness. Urban agriculture and community gardens challenge socioeconomic disparities while simultaneously fostering ecological sustainability in urban areas. They can provide nourishment, promote cultural traditions, protect heritage crop diversity, and empower the economically disadvantaged by resisting the market economy.

The food justice movement is also motivated, at its core, by the notion of justice. Importantly, the movement's deep engagement with issues of race, culture, politics, and economics can help start bringing those much-needed discussions into EE.

**THE BOTTOM LINE:** Food justice can help EE dismantle the wilderness-urban dichotomy, break out of conventional classroom science education settings and pedagogies, and start addressing issues of race, culture, politics, and economics. It provides an entry point for EE into urbanity that enables the study of justice and ecology simultaneously, and in a relevant way. In particular, community gardens can provide a tangible method for EE to interact with urban spaces. The food justice movement is conducive to using methods from place-based and outdoor learning through farmers markets, urban planning, rallies, and informal education; thus, it may be a valuable tool for expanding EE in directions that align with its principles and pedagogy. The food justice movement has the potential to help bridge EE's philosophical and structural gaps that are currently excluding the voices and experiences of urban learners in a way that is inclusive, empowering, and inspiring.

Crosley, K. L. (2013). Advancing the boundaries of urban environmental education through the food justice movement. *Canadian Journal of Environmental Education*, 18, 46–58.

## HANDS-ON LEARNING IN THE SCHOOLYARD

As the school year began, a teacher and doctoral student had a shared vision: to turn a vast, brown landscape of dry grass in the elementary schoolyard into a thriving, productive garden. Together, these two realized that bringing the outside world into the school day could cultivate a sense of environmental stewardship inside their classroom. They wondered: Could a vegetable garden, designed and maintained by elementary students, be an ideal way to bring the outside in?

Although environmental education in lower grade levels is increasing, many students are often only told about—rather than shown—the origination and lives of vegetables and animals, while other students still are not being reached. This article shares how kindergarteners through second graders and their families were empowered in the process of creating a garden as part of a school-wide, interest-based enrichment model. The researchers found that, through the garden experience, students' knowledge of the environment became more nuanced as they collaborated with family members, solved problems, made decisions, and engaged directly with the earth.

During a literature review, the researchers found that many early-elementary-aged students experienced a disassociation between food and its source. Based on this and other evidence, they argue that augmenting environmental education in the primary grades is as important as the teaching of reading, science, and mathematics. These basic “ecoliteracy” components are key building blocks of environmental education. The researchers found that, in elementary schools across the country, teachers and/or community organizations are increasingly introducing school gardens as an avenue toward enhancing ecoliteracy. Connecting students' classroom experiences with their community facilitates a greater understanding of their impact on the world and allows the students to form relationships with each other, family members, their community, and the earth. When ecoliteracy skills are developed, a sense of land

stewardship is established; cultivating a garden allows the children to feel as if they are “interacting with the garden.” To strengthen the connection with the garden and a sense of ownership, research shows that children should plan, construct, and cultivate the garden from the very beginning.

The researchers worked with 16 students in kindergarten through second grade, all in the same elementary school. Approximately 70% of the students were of Latino heritage, 25% were African American, and 5% were European American. Ninety-nine percent of these students received free or reduced lunch. Many of their families were Latino immigrants who had gardening experience either in the United States or in their country of origin.

The researchers entered into the garden project intending to collaborate with students and engage in the process of exploration and discovery. Guided by the teachers, the students planned the garden and shared their ideas for what to grow. Over the course of the project, community partnerships formed. The students brought in experts to help construct a low- or no-cost greenhouse that could withstand difficult weather, and the students learned to grow the seedlings necessary for the garden’s construction. Community support emerged from grants and individual donations, including the national organization Donors Choose and the local countywide beautification board.

The researchers developed activities, which included a focus on literacy, mathematics, and social studies, aligned with the local standards. During the year, the students led families—many times not their own—into the garden space, explaining seasons of growth, necessary equipment, and various types of local vegetables. The researchers emphasize that the students’ depth of knowledge, demonstrated in their vibrant, detailed culminating descriptions, was facilitated through the hands-on experiences provided by tending to their own garden, coupled with the emphasis on family stories and gardening work.

After one year of the gardening program, the formerly barren landscape was now an herb and vegetable garden

full of life. Rather than experiencing an empty outdoor corridor, students and teachers enjoyed the rewards of their hard work in the form of ripe fruits and vegetables. From a learning perspective, instead of complaints about brown grasses, researchers documented faculty and young students asking how to become more involved in growing food.

**THE BOTTOM LINE:** From start to finish, elementary-aged students can be empowered to start their own school garden. By allowing everything about the garden to be student-driven, the youth can become more enthusiastic about and personally engaged in developing and creating the garden and the community itself may also become more committed to making the garden a reality. These garden settings, which draw together young children, families, and other community members, can create connections between school and home experiences; encourage youth and adults to engage in collaborative dialogue; and cultivate a spirit of learning where students, teachers, families, and community members learn side by side.

Kozak, M. S., & McCreight, J. (2013). We grew it! Enrichment through gardening in elementary school. *Applied Environmental Education & Communication*, 12(1), 29–37.

## DEVELOPING UNDERSTANDING THROUGH COLLABORATIVE DISCUSSIONS

Traditional approaches to teaching environmental and sustainability education (ESE) often rely on the knowledge of experts, textbook authors, and teachers, who then engage with students around environmentally related topics with outcomes related to environmental knowledge, attitudes, and skills. However, this delivery of preconceived knowledge does not always leave room for students to develop their own opinions. What’s more, a concern can sometimes arise that students may be presented with a specific ideology. In contrast, a participatory approach, such as student discussion, enables students to develop the competencies

they need to be active thinkers in the democratic processes. This study analyzes the possibilities and constraints of using participatory approaches within ESE.

To understand how participatory approaches allow students to construct knowledge, the authors analyzed video recordings of Swedish upper secondary school students (aged 16–19) engaged in discussion. The purpose of the student discussion was to develop understanding of climate change as an environmental, social, political, and economic issue.

In analyzing these videos the authors drew on John Dewey's theory of action, in which meaning-making, or the development of knowledge, is a socially constructed process. Part of Dewey's theory is that meaning-making changes and adapts in response to varying actions. Building on this philosophy, the authors identified, categorized, and counted six different knowledge-acquiring actions, which allowed students to collectively construct their knowledge of climate change. These actions include:

1. Confirming or reinstating another person's idea
2. Affirming and agreeing with another person's idea
3. Fulfilling or completing another's unfinished idea
4. Asking clarifying questions of another person's idea
5. Asking questions to encourage another participant to reconsider their idea
6. Making statements which question and counter another person's ideas

The students involved in the discussion used these actions as they uncovered the tensions and conflicting interests in finding solutions—specifically, an international agreement—for climate change. From their critical, iterative, and open-ended discussion, students determined that the challenge of developing a climate change solution is huge—and beyond their ability to have a direct impact—and lands within the political and economic redistribution of power.

Although students were able to discuss these complex controversies and deduce the crux of the problem, they

did not discuss their personal ideological differences within the group. These varying perspectives would have diversified and broadened the discussion. This hesitancy to share one's personal viewpoint is one of the risks of participatory approaches, as seen in this research study and others. The trend demonstrates students' discomfort in sharing ideas that differ from the groups' ideas, but the conformity carries the risk of falling into established power relations, such as only considering dominant perspectives. It may be possible to overcome or lessen this risk by emphasizing the importance of providing equal speaking time for each student and fostering a culture focused on the diversity of ideas as opposed to consensus.

**THE BOTTOM LINE:** To prepare students to participate in democratic processes about complex environmental issues, ESE should strive to move beyond learning experiences that foster a culture where there is an expected “right answer.” One way to do this is with a participatory approach, which emphasizes informed open-ended discussions and varying opinions. In this way, students are allowed to weigh ideas and values and to make sense of complex issues. Students may be unfamiliar with this way of interacting with their peers and developing knowledge, but teachers can provide support and scaffolding. Using the six knowledge-acquiring actions described in this study, teachers can suggest sentence starters, such as “Could you elaborate on . . .” (a clarifying action) or “That is a valid point, but . . .” (a counter-argument action) to help facilitate student communication. Teachers can also create graphic organizers or visual concept maps for students to organize their thoughts and for teachers to monitor students' progress. Additionally, teachers can provide research and an unbiased array of information to support informed discussions.

Öhman, J., & Öhman, M. (2013). Participatory approach in practice: An analysis of student discussions about climate change. *Environmental Education Research*, 19(3), 324–341.

## USING METAPHORS TO TEACH CLIMATE CHANGE

Like many scientific concepts, climate change and the carbon cycle are both processes that humans can't sense directly—they are too large, too gradual, or simply invisible. In order to understand them, it is necessary and natural for humans to use metaphors to relate these concepts to our sensed experience of the world. For example, a common metaphor in climate change science is that of the greenhouse effect, where people imagine an easily visualized physical object (the greenhouse) and their physical experience of being inside of it (warm); then they are asked to apply this metaphorical imagining to the entire atmosphere. However, taking this metaphor a step further, while climate scientists and a common person might both be using the same metaphor of the greenhouse, the common person may not have the correct understanding of the mechanism that is causing global warming. The authors address this and several other issues in this article.

The main goal of this research was to develop effective strategies for teaching about the greenhouse effect and the carbon cycle. To develop these strategies, the authors first investigated the metaphors that climate scientists and high school students use to understand these concepts. Better understanding the existing metaphors enabled the researchers to develop hands-on teaching strategies that allowed the students to discover the problems with their incorrect concepts and also to discover the correct conceptual model, based on the climate scientists' understanding.

To understand the scientists' understanding of these concepts, the authors examined scientific textbooks and the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC 2007). To gather data about commonly held beliefs and understandings of the causes and processes of climate change, the authors reanalyzed 24 empirical studies on everyday concepts of global warming. The authors also conducted a study with 35 18-year-old students in German schools (16 female,

19 male). None of the students had any prior climate change instruction. Before the teaching intervention, the authors interviewed the students about their concepts of greenhouse gases or the role of atmospheric CO<sub>2</sub> in the carbon cycle. These interviews were transcribed and, along with all the other data, were examined to identify the most common metaphors used by both scientists and nonscientists to explain the greenhouse effect and the carbon cycle.

Based on the results of this first phase of the study, the authors set up and evaluated 10 different teaching experiments with the same high school students. Each experiment lasted approximately 65–90 minutes and was conducted with small groups of two or three students. Students reflected on the experiential learning and their new or changed conception of the greenhouse effect or the carbon cycle (depending on the teaching experiment in which they were involved). Researchers recorded all interviews and videotaped all teaching experiments.

With regard to the greenhouse effect, the researchers were surprised to find scientists and nonscientists/students used the same basic metaphor to conceptualize the process—a container with a balance of stuff coming in (light from the sun) and stuff going out (light or heat). The researchers call this the “container-flow model.” The earth forms the bottom of this container, and the atmosphere is the content; light or heat is the “flow” that needs to be balanced. However, the specifics about the top boundary of the container and the processes happening within it were different. Specifically, the authors identified two everyday misconceptions about the greenhouse effect: (1) it is caused by a hole in the ozone layer, and the hole is created by CO<sub>2</sub>; and (2) it is caused by a layer of greenhouse gases at the top of the atmosphere, which lets light in but does not let light out. By contrast, the scientists view CO<sub>2</sub> as part of the *content* of the container or atmosphere (not an ozone-destroying compound, or only the top layer of the atmosphere). Secondly, the scientists understand that CO<sub>2</sub> is permeable to light rays, but *impermeable to heat rays*, which is why it shifts the “radiative equilibrium,” or warms the earth.

To “restructure the container” to match the scientific understanding, the researchers identified two questions for students: (1) Consider the top border of the container: is it an ozone layer, a CO<sub>2</sub> layer, or just assumed? and (2) Consider the role of CO<sub>2</sub>: does it form the top border of the container or is it the content? Does it destroy the border or trap heat?

Using these questions as a guide, the researchers designed different hands-on teaching exercises. One of the exercises used a strong light bulb to heat two glass containers with open tops and black bottoms. One container was filled with air and the other with CO<sub>2</sub>. The students measured the temperature inside both containers, which was hotter in the container with CO<sub>2</sub>. In interpreting the phenomenon, the students were able to correct misperceptions about the role of the ozone layer and also start to understand the heat-trapping properties of CO<sub>2</sub>.

A second exercise used a light bulb shining through one plastic bag filled with air and one filled with CO<sub>2</sub>, measuring the brightness and temperature behind each. The brightness behind both bags was the same, but the temperature behind the bag with CO<sub>2</sub> was lower. This allowed students to correctly deduce that CO<sub>2</sub> is permeable to light rays but not heat rays. The authors found that the combination of these two teaching methods allowed the students to correct their misconceptions of the greenhouse effect and discover the correct concept.

The researchers repeated these processes with the concept of the global carbon cycle. In this case, the authors found scientists use the metaphor of a balance or scale, where carbon going into the atmosphere is balanced (or imbalanced) relative to carbon being sequestered back into the earth or oceans. The students did not use this metaphor, and held one of two primary misconceptions: (1) that there is a difference between natural and manmade CO<sub>2</sub>; or (2) that all CO<sub>2</sub> is created by humans (that is, a “normal” atmosphere doesn’t contain CO<sub>2</sub>). In addition to correcting these misconceptions, the authors wanted to explain climate change based on the idea of imbalanced carbon flows (more carbon being released

than sequestered). One of the methods the authors used to accomplish this involved creating a model of the carbon cycle that used plastic containers to represent different carbon stores (for example, fossil carbon, atmosphere, ocean, or vegetation) and plastic balls to represent carbon (a container-flow model). The students were given a story that involved carbon cycling and asked to model the movement of carbon in the story using the containers and balls. Other activities helped them understand that manmade and natural CO<sub>2</sub> are the same and that CO<sub>2</sub> is a natural component of the atmosphere.

**THE BOTTOM LINE:** Using metaphors—such as containers or balance scales—is essential for understanding scientific concepts such as the greenhouse effect or the carbon cycle. Students’ conceptions are often incongruous with scientific conceptions, but they rely on similar metaphors. Establishing a teaching environment where students present their misconceptions, experience a concrete manifestation of the correct metaphor, and then reflect on this experience allows students to develop a more scientifically correct understanding of climate change.

Niebert, K., & Gropengiesser, H. (2013). Understanding and communicating climate change in metaphors. *Environmental Education Research*, 19(3), 282–302.

## MODEL FOR TEACHING ABOUT ECOSYSTEMS

Understanding how ecosystems function is a critical element of environmental education. However, learning about ecosystems can be difficult because of the complexity of the relationships between the different ecosystem components. Past research has shown conceptual representations that enable students to organize these relationships may help them develop the necessary reasoning skills to understand complex systems. These conceptual representations may also allow students to bring these skills to other contexts.

This study was part of an ongoing investigation into the collaborative learning processes and outcomes where

classroom-scale aquariums were used to teach ecology. The authors used a conceptual representation model called Structure, Behavior, and Function (SBF) and combined the model with computer-based learning tools to help middle-school students understand the complex biological system inside an aquarium. Specifically, the authors tested the hypothesis that instruction that includes the embedded SBF representation, through guided questions and computer simulation, would lead to more coherent, complex, and expert-like descriptions of the behavioral and functional levels represented in a complex ecological system. The authors provided data from two middle-school classrooms in which students were engaged in a one-week classroom intervention where the SBF framework, alongside computer simulations and worksheets, was used to promote learning about a closed aquarium ecosystem.

The study participants included 138 seventh- and eighth-grade students from two public middle schools in the northeastern United States. The teachers volunteered to pilot the intervention in their science classrooms. The researchers used surveys to conduct pre- and post-test measures to assess knowledge gain and the students' understanding about the complexity of the aquarium systems.

The authors wanted to understand whether the SBF framework could provide the students with language that helped articulate their ideas and whether they could transfer their ideas from one context to another. In the SBF model, structures are the parts of the system; the behaviors are the ways in which the parts operate; and function refers to the outcome or result of the action of the parts. The identification of structures (such as fish, coral, and algae) encourages students to dig into the system and find structures that are not necessarily visible or obvious. Through describing the behavior and function of each structure, students are encouraged to think about how, and to what end, that structure is engaged in systems-level phenomena, establishing a broader frame of reference.

The researchers employed a computer simulation called the RepTools toolkit. This toolkit includes (a) an information source in which images and hyperlinks are embedded into a hypermedia program (the program highlights key structures, behaviors, and function) and (b) two computer simulation modeling tools—one focusing on the macro elements of the aquarium and the other focusing on the micro elements.

The researchers found the students were able to see more than one link between the mechanisms and the parts of the systems, as the intervention (the tools) provided through the program helped to make the mental framework explicit. Students demonstrated significant knowledge gains with regard to structures, behaviors, and functions inside the aquarium after the program; they also had an improved understanding of the complexity of the aquarium system. The overall trend following the intervention was toward higher quality and more coherent explanations of system-level phenomena.

The findings have implications for teaching about complex systems such as ecosystems. When students are encouraged to generate explanations through problem scenarios with specific attention given to underlying mechanisms, they can draw new connections focusing on the functions of ecosystem processes. The use of a conceptual representation such as SBF provides educators with a clear framework for both teaching and assessment.

The complex nature of aquarium systems can enable educators to provide a context for investigating ecosystem ideas, as well as to promote scientific inquiry skills. Because of their size and relatively low cost, aquariums can easily be integrated into classroom instruction. Moreover, because students and teachers are generally familiar with aquariums, they can be model ecosystems for initial interaction. Further, establishing and maintaining an aquarium system provides opportunities for teaching and learning, because it requires an understanding of how biological and physical components within an ecosystem interact. The nature of these interactions also provides an ideal context in which students can apply SBF reasoning.

**THE BOTTOM LINE:** Classroom-scale aquariums can be effective teaching tools for exemplifying complex ecological systems. When partnered with an effective framework—such as the Structure, Behavior, and Function (SBF) model—and coupled with worksheets, computer simulations, and teacher guidance, students can develop deeper, more nuanced critical-thinking skills about complex ecological phenomena. Conceptual representations that enable students to organize the complexity of the relationships among the different parts that comprise an ecosystem—an aquarium ecosystem, in this case—may help students develop the necessary reasoning skills to understand complex systems and to transfer ideas from one context to another.

Jordan, R. C., Hmelo-Silver, C., Liu, L., & Gray, S. A. (2013). Fostering reasoning about complex systems: Using the aquarium to teach systems thinking. *Applied Environmental Education & Communication*, 12(1), 55–64.

## USING ART TO TEACH AND EVALUATE CLIMATE CHANGE EDUCATION FOR YOUTH

Despite the potential of climate change education programs to inspire the younger generation to change current behaviors and embrace possibilities for mitigation, the education community remains torn over addressing climate change, and related behaviors, with youth in younger grades. This study set out to address the feasibility and appropriateness of teaching about climate change at a young age—in particular, third through fifth grades. The authors used student artwork both as a teaching and an evaluation tool; they also reported on the effectiveness of these methods.

In this paper, the authors discuss three main categories of concern related to teaching climate change to students in grades five or lower. First, educators may hesitate to educate young children about politically controversial topics. Second, many schools lack a protocol to introduce climate change lessons into their current curriculum. And third,

the education community lacks consensus about when it is developmentally appropriate to include climate change in formal educational settings. Many educators fear the lessons are not aligned with young children’s intellectual maturity and emotional readiness, introducing fear or anxiety regarding climate change rather than introducing appropriate skills, empowerment, and ownership toward mitigation efforts.

This study used an art elicitation approach as the primary data collection tool. Student artwork is a helpful tool for assessment in environmental education as it allows students to communicate ideas that they might otherwise have difficulty expressing verbally. The artwork also provides teachers (and researchers) the opportunity to identify strengths, weaknesses, and emotions underlying student learning.

The researchers created a climate change module for third- and fourth-grade students in Nova Scotia, Canada. The module, which addressed climate change causes, impacts, and mitigation and adaptation techniques, was piloted in two Nova Scotia schools. To control for potential variations in teaching methods, the same teacher led all lessons over three two-hour periods. Thirty-eight students completed the module; 85% of the students participating were in grade 4, and 15% were in a mixed-grades classroom of grades 3 and 4. Before and after the intervention, students were prompted to paint what they thought about when they heard the words *climate change*. Students were also prompted to provide a short “artist statement” alongside their watercolors.

After analyzing all student artwork, the researchers created categories of visual features and thematic concepts they could discern in the artwork. They used the artist statements to cross-check the intentions and features the students meant to draw, as well as to add features that may have been difficult to depict, such as greenhouse gases. Features were specific images, such as cars, houses, smoke, and the like, and were only counted once for each painting/artist statement. Thematic concepts included “pollution,” “climate change impacts,” and “weather,”



among others. Once these were discerned, the researchers plotted the features relative to conceptual themes in each piece of artwork to determine how frequently they corresponded, both before and after the intervention. As an example, one of the results of this analysis was that before the intervention, no students drew or mentioned the features rain, wind, or floods; after the intervention, several students drew these features, and these features always corresponded with the theme “extreme weather.”

The authors reported other strong signs of overall effectiveness of the module. In the pre-intervention artwork, many misconceptions of climate change were depicted. In particular, students depicted littering, general pollution, and ozone depletion as primary causes of climate change. Many of these misconceptions were amended in the post-intervention artwork; students continued to paint smoke and air pollution, but discussed greenhouse gases in their artist statements (the researchers believe greenhouse gases were difficult for students to portray in their art, often resembling smoke or particles in the sky). Overall, the entire classroom showed increased understanding of climate change causes and effects. Although only a few students depicted mitigation strategies in their art, the topic was discussed very briefly at the end of the teaching module and had made no appearance in the pre-intervention artwork.

Furthermore, the researchers stated that worry about students in this age group being overly frightened or disturbed by exposure to climate change concepts appeared to be unfounded. Most artwork created by the students in the study was of a neutral or positive tone.

**THE BOTTOM LINE:** This study suggests that it is possible for climate change education to be conducted in a manner that is age appropriate for students in middle to upper elementary school, particularly if approached from an art-elicitation angle. The students began the module with general climate change misconceptions, which were almost all amended by the end of the intervention. Art elicitation before and after the intervention proved to be useful in

analyzing students’ understanding of climate change, as well as the effectiveness of the teaching module. The artwork, which consisted of watercolors, along with a short “artist statement,” allowed the researchers to better understand the intention and understanding of the students, especially with regard to concepts such as greenhouse gases, which can be difficult to draw. Soliciting student artwork may be equally useful for teachers looking to evaluate their students’ understanding of a scientific concept.

Baker, J., Loxton, J., & Sherren, K. (2013). Using art elicitation to deliver and evaluate a grade 4 climate change instructional module. *Applied Environmental Education & Communication*, 12(2), 130–142.

## TAKING RISKS WITH SOMBER ENVIRONMENTAL EXHIBITS AT ZOOS

*“I’ve stepped in the middle of seven sad forests. I’ve been out in front of a dozen dead oceans . . .” – from Bob Dylan’s song “A Hard Rain’s A-Gonna Fall”*

Zoos have become increasingly interested in promoting environmental awareness and conservation-oriented attitudes and behaviors; at the same time, these sites have the opportunity to impact more than 150 million visitors annually. However, zoo visitors usually come for entertainment and family leisure time, which could potentially be at odds with learning disturbing, challenging, or depressing information related to conservation and the environment. Since zoos are businesses, they need to be careful not to drive away their customers and, as such, need to balance their visitors’ interests in entertainment with their desire to educate about pressing environmental challenges. In this paper, research staff at a zoo investigated visitor response to a stark, controversial photographic exhibit called Hard Rain. The exhibit dealt with themes such as climate change, threats to wildlife, and human degradation of nature.

The research took place at the most-visited zoo in the United Kingdom, the Chester Zoo. The authors, who were responsible for putting the exhibit on display, had three objectives. Their first aim was to acknowledge the responsibility of zoos in providing environmental education. Second, they wanted to test the tolerance and receptivity of the visitors to the emotive and gloomy images and messaging in the exhibit. Third, they were interested in testing and developing research methods to effectively evaluate visitor behavior and response to such exhibits.

The Hard Rain exhibition is a collection of photographs, each placed above a line of the Bob Dylan song “A Hard Rain’s A-Gonna Fall.” The exhibit was displayed in a horizontal fashion along an outdoor walkway, and visitors could start at either end. Hard Rain was not designed specifically for zoos; it has been displayed at museums, universities, city centers, and the United Nations building in New York City. According to the paper, the authors estimate that Hard Rain has been seen by more than 15 million people worldwide. (The images can be seen at [www.hardrainproject.com](http://www.hardrainproject.com).) In response to concerns from some zoo staff, warning signs were placed at either end of the exhibit, cautioning viewers about the images’ graphic content.

The authors used two data-collection methods: written feedback from viewers and unobtrusive visitor observations. The authors placed a board at one end of the exhibit to solicit written feedback from visitors; prompting questions included: “What do you think? Have your say here . . .” Visitors were invited to write responses on Post-It notes and add them to the board. The same four “staged” Post-It notes were always left on the board, written by different zoo staff, to prompt visitor participation. The goal of the written feedback was to gather more considered responses as well as the direct thoughts of the viewers. To observe visitors’ more immediate, real-time responses, researchers (discreetly dressed in plain clothes) carried out unobtrusive visitor observations. The researchers measured the amount of time a given subject spent at the exhibition using a stopwatch. They also gauged the subject’s engagement

level on a scale from -3 to +3, representing a range from “active repulsion” to “engrossed response.” In total, 227 Post-It comments were collected and 238 visitors were observed from May to September 2008, the busiest season at the zoo.

The researchers analyzed the Post-It note responses by categorizing them as follows: positive, negative, positive and negative, personal reflection, comments focused on children, environmental comments, responses to other visitor comments, empathetic, and unrelated comments. Each comment was assigned to only one category in order to assist analysis, which they note in their paper was sometimes challenging as comments could be seen as overlapping. The researchers also separated the comments as best they could into those written by adults and those written by children, based on the quality of the handwriting.

The researchers found that, on balance, there were many more positive than negative responses. Comments categorized as “empathetic,” “other environmental comment,” “personal reflection,” and “positive toward exhibition,” together, accounted for over 60% of the responses. Only 16% of the responses were strictly negative, 7% were both positive and negative, and 6% of responses were focused on the children. A small percentage of the comments were unrelated or responding to other visitors’ responses.

The overall positive response of visitors to the exhibit was supported by the results of the visitor observations. The researchers were particularly delighted to find that the median time spent at the exhibit by the observed visitors (49 seconds) was comparable to the amount of time visitors spend with some of the more exciting live animal exhibits at the zoo, such as the indoor giraffe exhibit (53 seconds). In terms of engagement, no visitors in the recorded sample fell into the -2 or -3 engagement levels, meaning that no one was recorded as being actively repulsed or having a very negative response to the images. Only 4.6% of visitors were noted to have a negative

response (-1 level); 37.8% of visitors were recorded with a neutral response; and 57.6% were recorded to have a positive response, from +1 (positive) to +3 (engrossed).

**THE BOTTOM LINE:** Zoos have been, perhaps, overly cautious about presenting educational themes that are primarily focused on conservation rather than being animal centric and, in particular, bring visitors face-to-face with “hard truths” and challenging messages. Findings from this study suggest that pressing environmental issues might not only be presented successfully at zoos, but that visitors might actually find them engaging. Moreover, they may be helping fulfill part of the moral obligation of zoos to teach about human impact on the environment. Positive findings from this study, in terms of visitor engagement, should give zoo educational and exhibit staff the confidence to pursue such conservation messages.

Esson, M., & Moss, A. (2013). The risk of delivering disturbing messages to zoo family audiences. *The Journal of Environmental Education*, 44(2), 79–96.

# SENSE OF PLACE

## PLACE-BASED LEARNING CONNECTS EXPERIENCE, OUTDOORS, AND SUSTAINABILITY

As the focus on promoting sustainability through environmental education has increased, so has the scrutiny on outdoor education programs, which may not always lead to increased sustainable behaviors. In fact, this paper's author suggests that some outdoor education programs may have an adverse effect on attitudes and perceptions of sustainability by making nature seem remote, pristine, and disconnected from students' day-to-day lives. Drawing on an extensive body of research and interviews with educators, the author makes a case for the potential of place-based education to connect experiential learning and sustainability education. He also argues that place-based learning is a remedy for some of the problems that outdoor education programs face in fostering sustainable behavior.

As part of his research, the author partnered with eight educators in New Zealand—six secondary teachers and two preservice teachers. These teachers participated in three phases of research: first, they critiqued their current school-based outdoor education program; second, they engaged in professional development to generate individual action plans for aligning their programs with sustainability learning goals; and third, they reflected on their own learning process. The author analyzed the data from current experiential learning and place-based learning research; in the process, he uncovered common themes.

The first theme relates to the long tradition of using experiential learning within outdoor education and sustainability education programs. Experiential learning engages the learner in doing—creating sensory experiences that foster both cognitive and emotional connections. Developing connections to nature through experiential learning may encourage students to protect it. This has been supported by research demonstrating that people are more likely to act on experiences than on knowledge. The teachers in this study described how bonds of love and gratitude toward natural places are fostered within their students when they engage with the natural world. They also spoke of the critical importance of fostering this connection prior to asking students to protect nature or behave in more sustainable ways.



The second theme that emerged related to the common misconception that the natural world is removed and separate from humans and human activity: that humans are not part of nature. This separation creates a dichotomy between beautiful, pristine wilderness and “home,” or where people live. The author argues that many outdoor education programs focus on pristine wild places, which allows students to connect to these wild places and develop a bond to nature. But, he wonders, do students’ wilderness experiences transfer to their home experiences and their daily actions? While the teachers interviewed assumed the transfer does occur for their students, the author cites evidence in the education literature that shows this isn’t always the case.

Finally, the author argues that place-based learning shifts the focus from pristine, untouched environments to local environments, including the physical space and how people interact with it. It connects educational experiences with the local community and to the place where students live. This local education allows students to see how they, too, are a part of nature, and how their behaviors can directly influence their local environment in either adverse or positive ways. At the same time, local education provides the students with the skills and knowledge needed to sustain and regenerate their community and place. After making the shift to place-based outdoor learning, the participating teachers described that students felt a sense of ownership, familiarity, and call for stewardship, demonstrating the powerful potential of learning and fostering sustainable behaviors in one’s greater backyard.

**THE BOTTOM LINE:** By connecting and experiencing their local place, students develop a sense of how their actions directly influence their community and local environment. This is a critical connection for students to make, as many environmental issues, such as climate change and biodiversity loss, are huge and abstract. Students who engage in place-based outdoor learning demonstrate a sense of ownership and the spurring actions of stewardship. Place-based outdoor learning projects meet the needs of the community. Students themselves might be able to identify these needs, which could be related to habitat loss, local

watershed contamination, or the spreading of invasive species. Engagement in local projects is empowering to students and fosters a sense of ecological citizenship.

Hill, A. (2013). The place of experience and the experience of place: Intersections between sustainability education and outdoor learning. *Australian Journal of Environmental Education*, 29(1), 18–32.

## MAPPING COMMUNITY CONNECTIONS TO STRENGTHEN STUDENTS’ KNOWING OF NATURE

Place-based environmental education provides opportunities for students to learn in a context that is local, familiar, and relevant. The author of this paper focused on a place-based teaching technique—community mapping—to see how it might influence students’ relationships to nature. Community mapping allows community members to express their knowledge, values, and visions spatially as they draw connections between people and place. Additionally, it gives participants a voice as they express their own representations and connections.

To address the relationship between community mapping and knowledge of nearby nature, the author examined a community mapping project conducted with a fourth-grade classroom in British Columbia. The class’s project centered on a local provincial park and integrated diverse disciplines, including social studies, science, and math. During this 12-week project, students went on field trips, took photographs, recorded observations in a field journal, and met with local community members. Students then arranged their written stories, drawings, and photographs on a bulletin board map of the park in their classroom.

To understand how community mapping projects influence students’ understanding of nature, the author conducted interviews with students, analyzed their written work, and observed field trips and the mapmaking process. From this analysis, five learning actions emerged: observation, situated knowing, identifying, restoring,

and transforming. Students engaged in observation as they recorded descriptions of the environment, the connections between living and nonliving things, and human influences on the environment. Through situated knowing, they connected their own stories, as well as those of other community members, with the park. For example, students shared stories on the map about their own experiences at the park, as well as the experiences of First Nations, or aboriginal people, whom they interviewed. As students worked, they began to identify connections between human actions and the environment, such as how litter may affect animals in the park. Students then recognized how the park was a place they needed to care for, maintain, and restore. Students then became environmental educators, or transformers, and shared their new understandings with friends and family, while also voicing their own stories and connections to the park.

These results suggest that community mapping may be a useful tool for connecting students with local places and the natural world. The community mapping project engaged students in direct sensory experiences and interactions with local natural places; in doing so, the mapping project strengthened emotional bonds and highlighted connections between human actions, history, and natural places. After the project, many students expressed attachment and ownership of the park. Furthermore, they recognized how their actions in the park influenced animals, plants, and other people.

To enhance the value and effectiveness of community mapping projects, the author suggests that projects continue for a longer time than 12 weeks. Additionally, future projects could further integrate social and cultural aspects of a place by incorporating the diverse voices of a place and ensuring the project is inclusive and empowering to all members of the community.

**THE BOTTOM LINE:** Community mapping can be a powerful tool for classroom teachers to enhance students' understanding and connectedness to the natural world. Community maps can incorporate field trips, written

stories, interviews, photographs, and artwork as means of understanding and drawing connections between people and place. While this case study was conducted with fourth-grade students, it may be useful for students of all ages as an interactive learning tool.

Jagger, S. L. (2013). "This is more like home:" Knowing nature through community mapping. *Canadian Journal of Environmental Education*, 18, 173–189.

## OUTDOOR RECREATION, AGE, AND ENVIRONMENTAL CONNECTEDNESS

Culture plays a large role in an individual's sense of identity, and it likely also pertains to an individual's environmental identity as well, although this connection has not been well researched. This paper's author attempts to address this question by exploring whether a person's engagement with the Nordic cultural tradition of *friluftsliv* contributes to his or her sense of environmental connectedness.

*Friluftsliv* loosely translates to "open-air life." It encompasses outdoor recreation, the joy of being out in nature, and the idea of living the simple life close to nature. It is a philosophy, a lifestyle, and a tradition. In Sweden, *friluftsliv* has been part of the cultural identity since the late nineteenth century, when industrialization, urbanization, and other factors sparked a movement to get youth and adults into nature. It has continued to develop throughout the twentieth century, and scholars have noted that Sweden today has a strongly nature-inclusive cultural identity. For the purposes of this study, the author defined *friluftsliv* as "nature-based outdoor recreation participation," since it is possible to measure quantitatively.

The author used data from a Swedish national research program, *Outdoor Recreation in Change: Landscapes, Experiences, Planning and Development*, to investigate the relationship between nature-based outdoor recreation (NBOR) participation and environmental connectedness (EC). Specifically, the author considered four questions:

1. Do regular NBOR participants have higher levels of EC than nonregular NBOR participants?
2. Is NBOR participation a significant predictor of EC when controlling for other factors, such as age group, sex, participation in NBOR as a child, support for universal access to nature laws, current residence, residence as a child, disposable income, and nationality?
3. Do any of the additional factors moderate the relationship between NBOR participation and EC?
4. Is there a significant relationship between frequency of participation in a particular activity type (such as walking in the forest, skateboarding, garden work) and level of EC?

The Outdoor Recreation in Change survey contained 55 questions and was sent to 4,700 people who were randomly selected from the Swedish national personal address register (which lists all Swedish citizens). A total of 1,792 responses were received, from respondents aged 18 to 75 years old. The sample consisted of 55% women and 45% men.

The item on the survey that was used to measure NBOR participation was the question, “Approximately how often are you out in nature on weekdays?” Possible responses were *never*, *seldom*, *rather often*, or *very often*. Informational items accompanying the survey reminded respondents that the survey concerned free-time activities and nature experiences. For the purposes of data analysis, the author re-coded responses *never* and *seldom* as “nonregular participation” and *rather often* and *very often* as “regular participation.” The other variables the author included as potential predictors of EC were age group, sex, participation in NBOR as a child, support for outdoor recreation access, current residence, residence as a child, disposable income, and nationality.

To measure EC, the author used three items from the survey. The items all started with the phrase, “To be in nature usually makes me feel or experience . . .” and

were completed with (1) “a heightened sense about the interplay of nature that everything is connected;” (2) “a feeling that the city is dependent on the surrounding nature;” and (3) “a feeling that all people, including myself, are united and a part of nature.” The author found that the answers to these three questions were highly similar for each respondent (i.e., someone who answered yes to one question was likely to answer yes to all three, and vice versa), which allowed the author to use a composite of the answers to these three items to represent the participant’s EC.

Results of research question 1 showed that respondents who reported having regular participation in NBOR had a higher level of EC. Further analysis through research question 2 provided more information about factors that contribute to EC. Analysis of the second research question showed that, in addition to NBOR participation as an adult, four factors were correlated with higher levels of EC: NBOR participation as a child, support for universal access to nature laws, being female, and being older. Current residence, residence as a child, level of schooling, disposable income, and nationality had no significant effect on EC.

Following up on research question 2, the author investigated the relative contribution of each of the five significant variables mentioned above on EC. This analysis showed that age group and NBOR participation were the most significant predictors of EC, when controlling for other factors. In fact, these results showed that a person’s age may play a larger role in a person’s EC than regular NBOR participation. Specifically, participants from age ranges of 31–45, 46–60, and 61–75 had much higher levels of EC than the youngest age range (18–30). In this secondary analysis, NBOR as a child, support for access, and sex were shown to possibly not have practical significance for predicting EC, since the relative contribution of these factors was very small.

Research question 3 investigated whether any of the additional factors moderate the relationship between NBOR participation and EC. Since age was shown in

previous analysis to be so important, the author focused on whether NBOR participation seems to have more of an effect on EC for certain age groups. The results showed that for the youngest age group (18–30 years) there was no significant difference in EC between regular and nonregular NBOR participants. However, for the older three age groups, regular NBOR participation did have an effect on EC. These findings suggest that merely involving youth and young adults in NBOR may not be an effective way to foster EC; for them, additional supports are needed.

The final research question examined how different types of outdoor activities correlate with levels of EC. Out of the 44 different activities that were analyzed, the author discovered eight items with a statistically significant, positive correlation with EC: *walking in the forest and country, pleasure and exercise-oriented walking, dog walking, walking with poles, garden work, nature picnic and grilling, plant animal study/bird watching, and meditation/yoga in nature*. In addition, three activities were associated with significantly lower EC: *skateboarding, outdoor pool use and waterpark swimming, and waterskiing/wake boarding*. The author found that four out of the eight positively significant activities were also significantly correlated with older age groups, such as *walking in the forest and country*, and that all three of the activity items correlated with lower EC scores were more frequently done by the younger age group, such as *skateboarding*. These results suggest that simple, quiet activities in nature, such as walking, are more likely to promote EC than other activities. This analysis also provided further support for the finding that NBOR does not necessarily foster EC in younger adults.

**THE BOTTOM LINE:** The Swedish culture of friluftsliv, translated as nature-based outdoor recreation, helps foster environmental connectedness. However, the finding that young adults (aged 18–30) showed no correlation between regular participation in outdoor activities and environmental connectedness suggests that youth in this age group may require additional supports to foster a connection with the environment when outdoors. The types of activities undertaken in nature also make a difference in terms of fostering environmental

connectedness. For example, four of the eight activities that showed a significant correlation with high environmental connectedness levels all involved walking, which allows people to take in—and connect with—the environment around them. Other activities that corresponded with higher environmental connectedness included picnicking in nature, plant/animal study and bird watching, garden work, and meditation/yoga in nature. Finally, this research suggests that cultural traditions can help to inform our understanding of EC. Yet, additional research is needed to explore how other cultural identities, such as the Native American and other indigenous cultures, may promote and support environmental connectedness.

Beery, T. H. (2013). Nordic in nature: Friluftsliv and environmental connectedness. *Environmental Education Research*, 19(1), 94–117.

## PROMOTING CONNECTEDNESS WITH NATURE IS EASIER WITH YOUNGER CHILDREN

Promoting a sense of connectedness with nature has become an increasingly discussed topic in EE over the past several years. The basic premise is that those who feel that nature is an extension of their own selves are more likely to take care of it. However, few quantitative studies have been conducted to measure the effectiveness of EE programs at promoting a sustained sense of connectedness with nature. This paper reports on two studies aimed at addressing this gap. The first of these studies was designed to measure the baseline connectedness with nature among students of different age groups and academic tracks in school. After establishing this baseline, the second study measured the short-term and long-term increase in connectedness with nature among 9- to 10-year-old and 11- to 13-year-old students after a four-day EE program.

The baseline study consisted of 304 students in Germany, with three subsamples: one subsample of 154 students aged 9 to 10 (fourth grade), and two subsamples of students aged 11 to 13 (sixth grade). Of the older students, 74 were



general-education-track students and 76 were university-track students. In Germany, students are split into these two tracks after fourth grade based on their academic achievement (higher academic achievement students go to university track).

To establish the level of connectedness with nature, the authors used the Inclusion of Nature in Self (INS) scale, first developed by Shultz in 2002. The scale is designed to measure the extent to which a person defines himself or herself as part of nature. The INS scale consists of a single question, which shows seven pairs of circles differing in the extent to which they overlap (from not overlapping to completely overlapping). One circle in each pair is labeled “self” and the other circle is labeled “nature.” Each student was asked to choose the pair of circles that best described how interconnected they are to nature. This question was embedded within a questionnaire containing 46 additional items on environmental knowledge and values. For the purposes of this paper, only the results from the INS scale item are discussed.

The results of this baseline study show that the younger cohort (9- to 10-year-olds, median score = 5.33 out of 7) scored significantly higher on the INS scale compared to the older cohort (11- to 13-year-olds, median score = 4.45/7). Among the older students, the university-track students scored significantly higher than the than the general-education-track students (median score 4.71 versus 4.13). The older university-track students still had scores lower than the younger students.

Having established this baseline, the researchers then conducted a study to measure the influence of a four-day environmental education program on the students’ sense of connectedness with nature. This study included 264 students total, 190 of whom participated in the EE program and 74 who were a control group. Of the 190 students who did the program, 135 students were 9–10 years old and 55 students were 11–13 years old, in the general-education track. The program was not offered to the older university-track students. The control group, who didn’t participate in the EE

program, consisted of about half younger students (39) and half older students (35).

The four-day program, titled “Water in life; life in water,” was implemented at a field center in Germany. The same instructor taught all the students during different school outings in the late spring and summer. The students received approximately six hours of guidance every day and spent the nights at the field center. The program included both cognitive and affective aspects, as well as formal and informal learning. The students spent most of the time outside, encountering and exploring a lake and stream. One teaching method was playing “discovery and perception games,” where, for example, students were led barefoot and blindfolded through shallow water to activate their nonvisual senses. Another example of this was having the students lie still for 10 minutes in a grassland next to a small creek in complete silence. Cognitive activities included catching and labeling riparian and aquatic animals in order to judge water quality and acquiring basic knowledge about local and worldwide water problems, among others.

The same INS scale and questionnaire as the baseline study was used to measure the students’ connectedness with nature two weeks before, immediately after, and four weeks after the EE program. The control group completed the questionnaires in the same temporal order, but without any program participation. The regular teachers of the students in the study were asked not to teach anything on the topic of water until after the final questionnaires had been completed.

The results of this study showed significant short-term increases in INS scores among both the younger (9- to 10-year-olds) and older (11- to 13-year-olds) students after the EE program. The increase was significantly higher for the younger students compared to the older ones. And after four weeks, only the younger students’ INS scores remained significantly increased when compared to before the EE program. In other words, the older students reported an increased sense of connection with nature immediately after the program, but by four

weeks later, they felt the same as before they completed the program. In contrast, the younger students felt much more connected with nature after the program and continued to feel that way four weeks later. The control group showed no significant differences in INS scores between the three test times.

The finding that younger students have a higher baseline sense of connectedness with nature is in line with findings from similar studies. The 11- to 13-year-olds are at the age of the onset of puberty, which the authors suggest may play a significant role. They reason that puberty and adolescence tend to be a time where children are seeking greater autonomy and independence, which may also contribute to an increased sense of independence from nature.

With regard to the higher INS scores among university-track students compared to general-education-track students, the authors suggest a few possibilities for why this might be. One is that higher-academic-achievement students have been found to have higher cognitive abilities, which, according to some researchers, has been associated with openness and a greater concern for others. This may be directly related to a sense of greater connectedness with nature. Differences in the education the students receive once they split into the two tracks, and differences in socioeconomic status between the two groups, may also be contributing factors.

The finding that younger students are more apt to increase their sense of connectedness with nature—and to retain this increase—after an EE experience is also in keeping with previous research. One such previous study, by Wells and Leckies (2006), found that only children who spent time in nature before the age of 11 showed greater pro-environmental attitudes and behaviors later on in life.

**THE BOTTOM LINE:** Promoting a sense of connectedness with nature is an essential goal for EE, as it directly relates to how likely a person is to care for the environment. This study found that younger students, ages 9 to 10, report a greater sense of connectedness with nature than older students, ages 11 to 13. A four-

day EE program, which allowed students to encounter nature directly, led to significant increases in this sense of connectedness. However, only the younger students maintained this increase four weeks after the program. This study highlights the importance of providing nature experiences for youth. It also suggests more attention is needed to help students connect with nature as they go through adolescence and also to maintain that connection after the program.

Liefländer, A. K., Fröhlich, G., Bogner, F. X., & Schultz, P. W. (2013). Promoting connectedness with nature through environmental education. *Environmental Education Research*, 19(3), 370–384.

## INTEGRATING INDIGENOUS KNOWLEDGE IN ECO-MENTORING

Indigenous environmental knowledge (IEK) has increasingly been used in environmental education to create more meaningful learning experiences that draw on diverse sources of knowledge. IEK is usually attached to particular places, people, and cultural traditions, and taught through spoken word, imitation, and demonstration. Often this knowledge has been passed down from generation to generation by elder community members. The authors point out that IEK is reflective of everyday life and therefore tends to be integrative, holistic, and practical. In this paper, the authors describe an eco-mentorship program that integrates both IEK and Western scientific inquiry into the curriculum to increase sense of place and ecological understanding.

The focal program in this article was a recently developed Eco-Mentorship Certificate Program and Learning Garden at Trent University, Canada. This program was designed to train preservice pre-K to 12th-grade teachers to integrate IEK into their teaching through lessons on food and gardening. The authors explained the program's conceptual framework and philosophy and provided insight into the program's implementation.

The program's framework includes two major areas of knowledge: IEK and mainstream Western science. The program, which includes four half-day workshops, is taught by instructors with diverse backgrounds in biology, eco-justice, indigenous knowledge, gardening, and teacher education.

Among the key features of the program the authors highlighted was a communal garden called the Learning Garden. Many of the program's lessons take place in the Learning Garden, highlighting inquiry, culinary arts, and our relationship with food.

IEK is integrated with scientific knowledge throughout the program. For example, as part of the indigenous food systems topic, the course covers human connection to specific foods and medicines, revisiting indigenous stories as well as chemical compositions and roles of different plants in the ecosystem, all framed within human and ecosystem health.

Lastly, the program uses the integration of IEK and Western science to encourage participants to develop a

sense of place. By sharing stories about different plants and their uses, program participants begin to learn the connections that exist within an ecosystem. These stories also highlight the unique qualities of the local area and how these qualities, like seasonal cycles, relate to food production.

**THE BOTTOM LINE:** Successful eco-mentoring programs can be designed to incorporate both indigenous environmental knowledge and Western scientific knowledge. Particularly rich topics for this focus include food and gardening, with appropriate approaches including educational efforts that are interdisciplinary, inclusive, and experiential. When designed using these principles, such programs can effectively connect environmental education to local ecosystems and increase sense of place among participants.

Kulnieks, A., Longboat, D. R., & Young, K. (2013). Eco-literacy development through a framework for indigenous and environmental educational leadership. *Canadian Journal of Environmental Education*, 18, 111–125.

# PROFESSIONAL DEVELOPMENT

## TECHNOLOGY USE BY NONFORMAL ENVIRONMENTAL EDUCATORS

There is tremendous potential for technology to enhance students' experiences with nonformal environmental education. Instructional technology tools may tie local investigations to global issues, provide access to otherwise inaccessible locations, extend typically brief environmental education programs, and support the intellectual and emotional connections that foster the development of environmental identity and sense of place. Despite this potential, and research in K–12 science education that suggests the effectiveness of innovative educational technologies, little is known about the extent of technology use by nonformal environmental education professionals (NFEETPs). This study attempted to catalogue what technology tools are currently used and how prevalent they are in nonformal environmental education. It also surveyed what influences NFEETPs' choices to incorporate technology.

To study the use of technology in nonformal environmental education, the authors used an online survey to poll NFEETPs, whom they defined as “professionals who support K–12 and lifelong learning efforts outside of the formal K–12 classroom.” The survey included four sections: (1) demographic information about the NFEETPs and their programs; (2) description of the structure of the NFEETPs' program, as well as factors that influence technology integration; (3) NFEETPs' current technology use and training; and (4) a Technology Attitudes, Perception, and Support (TAPS) scale, which explored NFEETPs' views, abilities, and reservations about technology integration.

The 406 NFEETPs who participated in the survey included respondents from almost every state in the United States, as well as Canada, Australia, Japan, South Africa, and Turkey. The participating NFEETPs ranged in experience from under 10 years in the field to over 20 years, and about a third held a formal teaching certificate.

Despite a historical and somewhat persistent technophobia in the environmental education community, survey results revealed that many NFEETPs now recognize the potential of technology to support learning. Despite this philosophical acceptance, many have yet to actually incorporate learning technologies into their programming. The most widespread use of technology by NFEETPs was for productivity



(such as for e-mail and word processing) and presentation purposes (PowerPoint). These uses are fairly minimal when compared with the broad range and potential of learning technologies that are currently available.

The authors identified a lack of exposure to effective learning technologies and successful integration of such technologies in the classroom. In particular, the authors identified several factors that may contribute to NFEEPs' avoidance of technology use in programming. These include the beliefs that integrating technology takes more planning time and that technology may hinder students' connection to the environment. Other factors included the lack of technological skills among teachers and a limited understanding of the magnitude of the benefit learning technologies could provide. The authors suggest that technology-based professional development may help increase NFEEPs' technological pedagogical content knowledge and self-efficacy to integrate learning technologies.

**THE BOTTOM LINE:** Learning technologies have tremendous potential to create more meaningful environmental education experiences for students. Although there is a growing philosophical acceptance of these technologies by informal environmental education professionals, the actual implementation of these tools is limited. Professional development opportunities to gain technological and pedagogical skills may be a necessary step toward incorporating more learning technologies into EE programming.

Peffer, T. E., Bodzin, A. M., & Smith, J. D. (2013). The use of technology by nonformal environmental educators. *The Journal of Environmental Education*, 44(1), 16–37.

## ENVIRONMENTAL EDUCATORS SHOULD HELP DEVELOP CLIMATE CHANGE TEACHING RESOURCES

Climate change is one of the most divisive and controversial issues of our time, yet the authors of this

study propose that secondary science teachers should incorporate it into their curricula. The authors contend that the topic easily lends itself to conversations on the nature of science, hands-on activities in data analysis, and development of critical thinking skills, among other important lessons. Additionally, the authors suggest that environmental educators and researchers are uniquely prepared to help secondary science teachers with developing resources for teaching about climate change.

Given that environmental educators could make substantial contributions to the development of climate change curricula, the authors developed and implemented a needs assessment study to understand (1) whether secondary teachers are willing to include climate change in their lessons, (2) if they feel comfortable with their current level of knowledge on the topic, and (3) which resources and strategies would be most helpful for them in teaching climate change lessons.

To collect their data, the authors focused specifically on the southeastern United States and sent out a survey to middle- and high-school science teachers. The survey, which included several open-ended items and 25 closed-ended items, was completed by 746 teachers. Among other topics, the survey asked the teachers about whether they already included climate change in their curriculum, and what they perceived to be the best strategies for teaching about controversial topics. Additionally, the survey asked them to rate the usefulness of different teaching resources.

Based on the survey results, 77% of these middle- and high-school science teachers reported that they already include climate change in their curriculum and were willing to continue doing so. However, *whether* they cover it and *how* they do so varied significantly by the teacher's subject. For instance, biology, earth science, and marine science teachers tended to cover climate change using the format of a week-long lesson. Ecology and earth science teachers generally reported teaching climate change for longer periods. On the other hand, teachers of physics, physical science, chemistry, and agriculture tended not

to teach climate change at all, citing reasons such as lack of cohesion with state standards or not enough scientific evidence for climate change.

In terms of understanding and comfort levels, only 2% said they have “little understanding,” yet only 24% said they have a “detailed understanding;” the majority claim a “moderate understanding.” As above, there is a difference across subject areas in comfort with teaching climate change: biology and environmental science teachers feel significantly more comfortable with it than agriculture educators.

The strategies teachers rated as most appropriate for teaching about climate change were to “explain scientific uncertainty, present the rationale for how people interpret climate change differently, discuss advantages and disadvantages of climate related policies, and discuss the history of climate change science.” Most teachers were interested in the goals of “connecting science to everyday life” and “emphasizing critical thinking.” The educational resources teachers ranked most useful were student action projects, hands-on activities, and lab work, with data sets, videos, and pictures following close behind. In terms of the scope of climate change education, most teachers are interested in teaching about its effect on the world as a whole.

The ways in which climate change affects us, and the ways in which we might combat it, are extremely interdisciplinary. The diversity of perspectives on climate change also means that careful thought and preparation must go into planning curriculum. As the authors put it, “environmental educators—who have been working through the sticky, wicked, fuzzy, and interdisciplinary issues of hazardous waste, environmental justice, [and] nuclear energy . . .—are well prepared to address these challenges.”

The authors conclude that many life science and environmental science teachers are willing to include climate change in their curricula, especially as a way for students to develop the skills of critical thinking and

synthesizing multiple perspectives. Moving forward, environmental educators and researchers should help develop climate change teaching resources because of the experience that they have in working with diverse perspectives and backgrounds, as well as working in controversial and cross-disciplinary fields.

**THE BOTTOM LINE:** Despite the previous taboo on teaching about climate change in schools, teachers are willing and interested in incorporating it into their curriculum because of the important skills that it can help students develop. Although there are many organizations and agencies developing these resources to help teachers, environmental educators are uniquely positioned to add their input because of their knowledge and experience in working with controversial, interdisciplinary issues. The results of this survey can be used to guide environmental educators in developing strategies, goals, and activities related to climate change that will be useful to teachers.

Monroe, M. C., Oxarart, A., & Plate, R. R. (2013). A role for environmental education in climate change for secondary science educators. *Applied Environmental Education & Communication*, 12(1), 4–18.

# OTHER RESEARCH

## ANALYZING THE UNDERLYING ETHICAL ASSUMPTIONS OF ENVIRONMENTAL EDUCATION

Environmental education (EE) programs often take a stance, sometimes implicit, about the ethically appropriate relationship between humans and their environment. However, this paper's authors argue that most current environmental education research fails to consider the rich diversity of ethical positions within the field of environmental ethics. In this paper, the authors present a framework for analyzing the ethical positions embedded in educational materials and social exchanges.

The authors analyzed 50 key books and articles published since the 1970s in the field of environmental philosophy to generate a comprehensive picture of the various ethical theories that theorists have described. Most EE research, they argue, has been occupied by a simple anthropocentric versus nonanthropocentric dichotomy. Anthropocentric theories assume that only humans need to be considered in our ethical decision making because only humans have intrinsic value. For anthropocentric theorists, animals, plants, and ecosystems only have value insofar as they help fulfill human needs or desires. Nonanthropocentric theories, by contrast, argue that nonhuman entities have intrinsic value that must be considered when deciding an ethical course of action. It is often assumed in environmental education research that anthropocentric views are inherently "nonenvironmentally friendly." This is not always the case. The authors' framework indicates how diverse positions have been taken up within these two general camps, and there are yet other theories that do not start from a question of value at all.

At the top level of the authors' framework, they distinguish between "value-oriented" and "relation-oriented" ethical theories. Within the value-oriented theories, there are anthropocentric and nonanthropocentric varieties. The authors map the various value-oriented theories on the basis of three dimensions: what moral object(s) demands consideration, how the human-nature relationship is conceived, and how the value of nature is understood. In developing this framework, the authors show how ethical theories are more complex than the standard anthropocentric/nonanthropocentric dichotomy suggests.



For instance, one anthropocentric view might suggest a person only needs to consider other currently living humans when making decisions; that nature is something found mainly in wilderness settings; and that such nature has instrumental value in that it provides a psychological benefit to humans. A different anthropocentric view might maintain that a person needs to consider both living humans and future generations; that nature and humans are more tightly integrated; and nature, thus, has instrumental value in the sense that without nature, humans would lose something essential about their “human-ness.”

Similarly, nonanthropocentric views can be differentiated on the basis of how far they extend the circle of moral consideration. Do they, for example, demand that all sentient animals deserve to be taken into account? Do they demand that the health of entire species be maintained? Additionally, the nature of the reason for this moral consideration may vary. For instance, a snail might be seen to have objective value in itself, regardless of whether a human is there to sense that value, or the snail’s value might depend on how one individual appreciates it, or how it contributes to the flourishing of other life in an ecosystem.

In contrast to value-oriented views, the authors describe relation-oriented views as problematizing the human-nature distinction more fundamentally. Many of these theories are considered radical in the sense that they argue that human relationships with nonhuman entities bear the mark of power dynamics similar to those in human societies themselves, such as race-, gender-, and economic-based forms of struggle. These theories also share a concern for the practical and political implications of various ontologies—the fundamental ways we understand the relationships between humans and nature that might be problematic at their very root.

The article includes a decision tree of questions one can ask when analyzing a text or social interaction in order to identify its underlying ethical assumptions within a typology of possibilities. The authors are careful to note that, unlike formal ethics, our moral lives and intuitions can be messy or even contradictory at times. Nonetheless,

incorporating a more sophisticated understanding of the diversity of philosophical theories into EE research can help us appreciate these complexities.

**THE BOTTOM LINE:** While environmental education research has drawn upon environmental philosophy, some argue that the field has done a poor job of understanding the full breadth and complexity of ethical positions. By considering a framework of attributes of ethical theories, researchers can more carefully and thoughtfully analyze textbooks, policies, and conversations that occur in environmental education settings. Using an ethical framework can also help educators understand how the methods and materials used in creating learning experiences carry with them ethical assumptions that are sometimes hidden. Being cognizant of the full range of ethical possibilities might also help educators fine-tune their practice by considering the practical or political implications of their assumptions, or by drawing upon the complex moral intuitions that learners might bring to the table.

Kronlid, D. O., & Öhman, J. (2013). An environmental ethical conceptual framework for research on sustainability and environmental education. *Environmental Education Research*, 19(1), 21–44.

## INVESTIGATING THE BEST TERM FOR GLOBAL WARMING

Research shows that what communicators call a phenomenon, or how they frame it, has a tremendous effect on how audiences come to perceive that phenomenon. Although most Americans are familiar with the term *global warming*, there are three other phrases that have been coined by different influential advocates to describe environmental changes: *climate change*, *climate crisis*, and *climatic disruption*. Despite a general awareness found in the literature that the way an item is named makes a difference in audience perception, the researchers found no evidence of any study empirically examining the differences in the perceptions of these four phrases. Given this, the researchers conducted a pilot study to investigate whether and how



these different terms affect beliefs related to changes in the Earth's temperature. This study offers insights that can be applied in a variety of communication contexts and provides a research framework for future experiments.

In reviewing the literature, the authors found that the term *global warming* has been associated with more concerned responses from participants, while *climate change* resulted in less concerned responses. In addition, they found more people stating they were unaware of the topic *climate change*, compared to surveys using *global warming*. The terms *climate crisis* and *climate disruption* have not been previously investigated.

For this study, a convenience sample of 10 undergraduate public speaking classes from a midsized Western university resulted in a final sample (N = 224) comprised of 103 male and 121 female participants. The majority of participants (90%) were freshmen and represented every college within the university. The independent variable was an article manipulated to ensure it presented a brief, yet balanced, perspective on the Earth's atmosphere and environment. There were five experimental conditions: four manipulations, each using one of the coined phrases, plus one control condition. In each manipulation, participants were given an article to read that mentioned the respective term once in the title and six times in the body of the text. The article was not administered to the control group. Also within each condition, the Consent to Participate form mentioned the respective term twice. The authors used a survey to capture the audience's responses regarding the subject matter, as well as demographic data.

Results indicated the young adults were least concerned when presented with the term *climate crisis*, while *climatic disruption* elicited the greatest concern. The researchers suggest the term *climate crisis* performed the worst because it created a backlash effect of disbelief and perceptions of exaggeration. The term *global warming* also garnered concern from students, almost on par with *climatic disruption*.

Despite this feedback, the majority of participants reported a neutral position on the idea of having a moral duty to do

something about this environmental issue. This finding is in keeping with previous research showing that naming an issue doesn't significantly impact an individual's willingness to act. The participants responded that, if any of their money or time needs to be spent on correcting issues with the environment, they would rather their contribution come through the normal day-to-day activities, such as environmentally friendly purchases. The students indicated they were more willing to make a purchase considered energy efficient—such as buying a light bulb, a household appliance, or a motor vehicle—than commit to a personal investment or involvement—such as joining, donating money to, or volunteering time with an organization working on the issues of the environment.

The findings from this research suggest the importance of understanding the impact of particular words or phrases will have on audiences. This initial research concurs with other findings, suggesting that a person's perception of the "seriousness of the problem" does not significantly change when the terms *global warming* or *climate change* are used. The authors' exploratory study builds on previous research and confirms prior studies by including an understanding of reactions to the terms *climate crisis* and *climatic disruption*. Implications suggest that, if a communicator is writing or speaking to a concurring audience, the terms may be appropriate to use interchangeably. On the other hand, if a researcher, policymaker, linguist, or student is looking to make a persuasive case for there being an issue with regard to the Earth's rising temperatures, these phrases should not be seen as synonymous, because in environmental rhetoric, the names really do matter.

**THE BOTTOM LINE:** Initial research suggests that the phrases used to name environmental issues truly do matter. In each of the areas where significance was discovered, the term *climate crisis* was most likely to create backlash effects of disbelief and reduced perceptions of concern, most likely due to perceptions of exaggeration. On the other hand, *climatic disruption* and *global warming* performed either the best or second best in each of the areas of significance. *Climate change* was next best. Although debate continues over which phrase is best, this research suggests that *climatic disruption*

and *global warming* should be used instead of *climate crisis*, particularly when communicating with skeptical audiences.

Jaskulsky, L., & Besel, R. (2013). Words that (don't) matter: An exploratory study of four climate change names in environmental discourse. *Applied Environmental Education & Communication*, 12(1), 38–45.

## POTENTIAL BACKFIRE OF ONE-WAY COMMUNICATION CAMPAIGNS

Large-scale public campaigns about contentious environmental issues can be among the most effective ways to change public opinion and spark meaningful action. However, if these public campaigns aren't approached in the right way, they can actually generate increased public criticism regarding the issue. The authors of this paper discuss two public campaigns: one was publicly criticized and the other successfully raised public concern and led to federal policy changes. Specifically, the authors investigated how one-way communication can either succeed or backfire depending on the context. In the study, the authors considered whether the audience members were positioned as receivers of the information (one-way communication) or whether they were positioned as active participants in the issue (two-way). Upon finding that two-way communication was more successful in engaging the public positively, the authors then propose different ways to create two-way communication streams. Furthermore, they use their findings to develop a framework for determining appropriate approaches to public media campaigns depending on the goals, audience, and constraints, such as time and money.

The first campaign the authors discuss is Project Painted Apple, which was undertaken by the Ministry of Agriculture and Forestry (MAF) in New Zealand. The six-year campaign (1999–2005) was a government effort to eradicate an invasive pest moth that threatened the country's horticulture industry by using aerial spraying of biological insecticide over urban communities. The program exposed residents to potential health risks. Throughout the first few years of the program, the MAF tried to keep a low public and media profile. However, as their initial eradication efforts were not

succeeding, and the extent of the insecticide spraying grew, a heated public battle started in the media over the potential public health risks. The MAF responded with an advertising campaign designed to quell concerns over any long-term health effects from the spray. They also attempted to demonize the invasive painted apple moth so that residents would support the eradication effort. However, this one-way communication effort did little to dampen opposition in the media. In 2006, the moth was declared eradicated and the campaign ended.

The second campaign the authors discuss was called 0800-Smokey. In 2002, the air quality in Auckland, New Zealand, was poor because they lacked legislation to control vehicle emissions or the quality of second-hand vehicle imports. Environmental and health monitoring showed people were dying prematurely due to air pollution. The Auckland Regional Council (ARC)—the local government authority responsible for environmental protection—sought to create a public mandate for vehicle emissions and fuel quality standards. ARC began by surveying residents to find out about their concerns related to air quality; in the process, ARC found they valued clean air and particularly disliked “smoky” vehicles. Using this as the basis of their campaign, ARC built partnerships with a number of organizations, including an advertising agency that designed the campaign (which included a street theater); shop owners, who dressed their window mannequins with face masks bearing an 0800-Smokey logo; and the motor vehicle association, which provided free vehicle emissions tests. A free phone hotline, “0800 SMOKEY,” was also organized. Residents were encouraged to “Dob in a Smokey Vehicle,” which meant that they should report a smoky vehicle to ARC. “Dobbed-in” vehicle owners were sent letters that outlined Auckland's air quality issue and offered free vehicle emission tests. The campaign ran for six weeks and received over 55,000 calls “dobbing in” over 27,000 vehicles. The campaign resulted in the federal government committing to legislative changes for mandatory vehicle emission testing and better fuel quality. In addition to these policy changes, surveys of residents showed that 0800-Smokey dramatically increased public awareness of the issue as a major regional environmental problem.

The authors discuss several key successes and failures of each of these campaigns, and they offer possibilities for how each of these campaigns could have been improved. Specifically, they attribute much of 0800-Smokey's success to the variety of ways in which it engaged citizens, including initial public surveys to gauge what matters to the public and providing an avenue for citizens to actively participate in the solution (through calling in their smoky neighbors or getting their smoky cars inspected). In contrast, Project Painted Apple Moth did little to consult with or engage the community. This approach excluded and alienated the residents who were affected by the spraying.

While 0800-Smokey did relatively more to understand and engage people, both of these campaigns employed largely one-way communication strategies. The authors point out that another key reason for their relative success was the context of the two campaigns. Project Painted Apple Moth was dealing with a project that could pose a potential health threat (making it controversial), whereas 0800-Smokey was attempting to remedy an existing health threat. They argue that the more contentious the issue, the more there is a need to involve affected local communities and media with interactive or participatory (two-way) approaches. Two-way communication recognizes the audience of the campaign as an active participant in negotiating the issue and playing a role in developing solutions. For example, the authors suggest Project Painted Apple Moth could have developed a representative community group, engaged with existing and trusted local networks, and involved the residents in the program through activities such as monitoring moth traps.

Finally, the authors suggest a framework for determining the appropriate amount of two-way communication for a public media campaign, taking into account three factors: campaign goals, the audience, and campaign constraints. In short, the more contentious the goals and the more impacted the audience will be, the more need there is for two-way communication. However, the authors also point out that the constraints such as the organization's willingness to co-develop solutions and dedicate time and money all need to be considered so that the goals of the campaign are realistic.

**THE BOTTOM LINE:** To craft successful public environmental campaigns, it is essential to take into account the context of the issue and understand the existing public opinion regarding the issue being communicated. If the program's goals are contentious, or the campaign's audience will be highly affected by the issue, using a top-down, one-way communication approach could garner criticism. In those cases, it is likely to be more effective to engage the audience in interactive approaches that allow the audience to be part of negotiating a solution, and to encourage their participation in the campaign through two-way communication.

McEntee, M., & Mortimer, C. (2013). Challenging the one-way paradigm for more effective science communication: A critical review of two public campaigns addressing contentious environmental issues. *Applied Environmental Education & Communication*, 12(2), 68–76.

## INVOLVING YOUTH IN URBAN PLANNING

Historically, children have been restricted in their ability to express their opinions when it comes to the design of their cities. Adults often assume that youth might not have the maturity or background to provide helpful input, yet when given the opportunity, kids can have important and insightful perspectives. Although it may be common to see children as not-yet-developed in their ideas, recent sociological research has shown that children can be “valid informants of their own worlds.” In this article, the authors discuss the value of involving children and young adults in planning and urban design. The authors highlight case studies from around the world that have influenced their own work. They also introduce two exploratory programs they started in Australia. The authors discuss how these case studies have succeeded in garnering increased input from children in terms of city planning and a simultaneous rise in beneficial environmental education outcomes.

The first case study the authors highlight is a London organization, which works with kids to increase children's engagement related to aspects of urban planning. The

program, My City Too!, supports approximately 35 youth ages 12–16 called “the youth ambassadors.” These young people work with volunteer urban design professionals in order to see their ideas transformed into practical reality. In this program, the youth are not only supported in their contributions but are also taught skills to make best use of their ideas.

Another program the authors highlight is called the Everyday Urbanity Project, which is based in Helsinki, Finland; Tokyo, Japan; and Bendigo, Australia. The developers of this program have created an easy-to-use geographical information system, which they’ve dubbed soft-GIS. The program uses aerial images, drawing features, and pop-up survey questions that ask youth to share their thoughts and opinions online about the city in which they live. The program aims to gain different perspectives in order to make that information available to professional urban planners. This project collects both quantitative and qualitative data. Another project that has influenced the authors is a program in Dapto, New South Wales, Australia, called the Dapto Dreaming Project. This program worked with children in a mixed-media, combination effort to elicit input in a final plan. The youth showed that it was best to “protect nature, provide direct travel pathways but also pathways that meander through natural areas, and promote community building, physical activity and learning.”

The authors then profile two exploratory programs they started in Australia. The first, Coffs Harbour’s Young Ambassadors for Design Project, met with high school students biweekly through the 2010–2013 school years. Professionals working in the urban planning sector shared with the students career information from first-hand experience. This program was intended to inspire students to meet their academic goals as well as to help city planners gain insight into the wants and needs of young citizens. The program members then had the opportunity to advocate their ideas at local “community forums.”

The second program the authors piloted was called The Place of Our Children in Community Building. The project was commissioned by the City of Greater Bendigo, Victoria, Australia, and was aimed at eliciting children’s and young

people’s views about a current plan for development and the state of the city at the time. Three schools participated: a suburban primary school, a suburban secondary school, and an inner-city secondary school. A series of activities were conducted in all three schools over a period of nine hours, spread over three nonconsecutive days. The leaders, who were both university researchers and city staff, used workshops, photography sessions, “neighborhood walks,” questionnaires, drawings, and discussions to gather suggestions for planning policy in the program. These activities were all designed to help youth develop an understanding of their city, the local environment, and urban planning and design. This project resulted in a large dataset of both quantitative and qualitative data that were used by the city for urban planning purposes. For example, the youth expressed which streets they felt were safest and easiest to cross and which felt unsafe because of heavy or fast-moving traffic.

In their discussion, the authors note two roadblocks for those looking to elevate the voices of children in designing city spaces. These roadblocks are the ability (or inability) of the youth to share their ideas and the ways in which the professionals implement the opinions of the youth. However, the projects highlighted in the article show that child engagement in urban planning is possible. Not only that, but involvement in urban planning allows young people to learn about their local environments and cities, develop critical skills for becoming involved in the democratic process, and learn to productively address complex urban planning and environmental issues.

**THE BOTTOM LINE:** Children and young adults can provide legitimate, valuable, and insightful input into the design and planning of the cities where they live. In the process, they gain valuable skills in communication, urban design, and environmental planning; at the same time, the cities benefit from their innovative perspectives. The highlighted programs suggest that children want to engage with the environment and that interacting with the place in which they live can lead to a greater local connection.

Wilks, J., & Rudner, J. (2013). A voice for children and young people in the city. *Australian Journal of Environmental Education*, 2(1), 1–17.

## INVESTIGATING WRITTEN MATERIALS AT NATURE CENTERS

Written materials are often used to enhance environmental knowledge acquisition, one of the primary goals of nature centers. Despite the importance of these resources, the content and form of written materials have not been deeply studied. In this article, the author presents the results of a survey on the use of written materials at nature centers throughout the United States. The survey investigated the content that is presented as well as the medium.

The survey was disseminated to 1,800 nature centers in the United States, of which 563 responded. This sample of 563 nature centers represents all census regions and states of the U.S. The survey included information on the types of written materials offered to guests and the source of these materials. In particular, the author focused on the use of outside texts, or writing produced outside of the nature center, because interpreters often borrow from these texts to appear more relevant to visitors who may have encountered these texts elsewhere.

A majority of respondents indicated that their nature center offered seven or eight different kinds of written materials, most commonly including brochures, handouts, books, and signage. The number of written materials offered did not vary by region or setting (urban, suburban, or rural). Two-thirds of the nature centers surveyed said they used outside text in their written materials. These most commonly included quotes, citations, or references from Aldo Leopold, Rachel Carson, Richard Louv, the Peterson Field Guides, or state-level agencies; 79 authors in total were named in the survey.

Based on these findings, the author makes recommendations for improving the quality and effectiveness of written materials in nature centers by combining these results with prior research. First, the author suggests improving the adaptability of permanent signage by using Quick Response (QR) codes that can be scanned with mobile devices to access online written materials. While brochures can be quickly amended and updated, signage is much more difficult to change. Experimenting with QR codes could be a way of overcoming that challenge.

Next, the author suggests using contemporary environmental literature to relate to visitors. Visitors will be more receptive to writing that reflects experiences with which they are familiar. For this reason, the author also proposes that environmental interpretation includes more examples from popular culture, in addition to classic and contemporary environmental literature. Using direct quotations from an author's work can also enhance the authority and authenticity of a text and reinforce the connection with the visitor.

The author also suggests historical documents, such as letters or diaries, may be used to support learning by presenting information from a specific perspective. Historical texts often have a clear voice that can help visitors relate to people and circumstances that may not be as overtly familiar. Few nature centers (1%) reported using historical texts; therefore, this may be a relatively new area to explore.

Nature centers may also benefit from evaluating whether local texts help visitors connect with interpretive messages. The success of this approach will depend on the audience served by the nature center; if a center serves primarily local audiences, using texts or quotes from local naturalists and writers may help to connect visitors with the messaging and enhance learning.

Lastly, the author suggests incorporating outside references as a way of extending learning for individuals who may be interested in finding more information and to recognize the contributions of authors whose work is used in the text.

**THE BOTTOM LINE:** Although traditional materials, such as brochures and signage, can help visitors at nature centers and other sites connect with ideas and promote effective learning, audiences can also benefit from other strategies that improve the quality and effectiveness of the learning experience. These materials might include using Quick Response (QR) codes on signage to access online material; incorporating relatable references from contemporary literature and popular culture; using historical text and direct quotations to relay the perspectives of others; including writing from local authors and naturalists; and

incorporating outside references to extend the learning experience.

Cagle, N. L. (2013). Quantifying the presence of written materials and the use of outside texts in nature centers for environmental education. *Applied Environmental Education & Communication*, 12(2), 108–117.

## CHALLENGES AND OPPORTUNITIES IN EARLY CHILDHOOD EDUCATION RESEARCH

Early environmental experiences can help children develop environmental knowledge and concern; support their physical, emotional, and cognitive development; and increase their “naturalistic intelligence”—their ability to recognize and classify parts of nature. The prevalence of environmental education in early childhood education is growing; however, there is a dearth of research on the topic. This paper discusses many of the challenges to conducting research with young children, as well as suggestions for developmentally appropriate research methods.

Adults’ perceptions of children are the root of much of the difficulty with research involving young children. Historically, children have been seen as incomplete beings on their way to adulthood. The author points out that this developmental theory diminishes the importance of a child’s voice. A shift toward constructivist theory, which supposes that children construct knowledge from their life experience and, therefore, understand the world around them as complete individuals, has helped alter this dynamic. However, it remains difficult for adults to put aside their experience of childhood and acknowledge that the children they are working with may hold a different perspective from their own life experiences.

Ethical and communication issues create further hurdles to doing research with young children. Because of their unique standing as individuals who are competent decision makers, yet not fully responsible for themselves, it is ethically necessary to obtain consent from parents or guardians when young children are involved. This means that parents have

the power to limit access to children’s voices. Even with parental consent, communication barriers present another layer of difficulty. Entering children’s social worlds can be a major hurdle, and developing a rapport with a child is often a necessary step to hearing their point of view. As noted above, it is difficult for adults to shift their perspective to that of the child, which is crucial for truly hearing children’s voices. Furthermore, it can be difficult to interpret children’s actions and emotions, and their accounts are often exaggerated or even make-believe.

Traditional research methods, which include tools such as questionnaires and long interviews, do not work with young children. The author posits that an alternative “mosaic approach,” a multi-method approach using cameras, drawing, tours, mapmaking, ranking exercises, and other methods, may prove more fruitful. Strategies, such as observing children during silent activities, obtaining audio recordings of playtime to find out how children interact with the people and things around them, and giving children cameras to document what they are interested in or what they think is important, are all ways to understand children’s experiences. Talking to caregivers and parents who are much closer to the children than the researchers can also yield valuable insights. Though children are often viewed as incapable of participating in the research process, with the correct tools and approach, it is both possible and valuable to incorporate their voices.

**THE BOTTOM LINE:** Including children in research presents many challenges, including logistical, ethical, and communication hurdles. However, innovative methods, such as the mosaic approach, which combines photography, observations, and audio recordings, can be used to gain valuable insights into how young children experience environmental education.

Boileau, E. Y. S. (2013). Young voices: The challenges and opportunities that arise in early childhood education research. *Canadian Journal of Environmental Education*, 18, 142–154.