

ENVIRONMENTAL EDUCATION

RESEARCH BULLETIN

ISSUE 8 · JULY TO DECEMBER 2014



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. Please send questions and feedback to eereseearchbulletins@changescale.org.

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TABLE OF CONTENTS

BEHAVIOR

| | |
|--|---------|
| Social Norms Messaging as a Tool for Conservation Behavior | Page 5 |
| Willingness to Engage in Local versus Distant Environmental Issues | Page 7 |
| Three Criteria for Effective Behavior Change Messaging | Page 9 |
| Using Messages of Fear and Self-Efficacy to Shift Attitudes about Global Warming | Page 10 |

EVALUATION

| | |
|--|---------|
| The Validity of Self-Report Measures of Pro-Environmental Behavior | Page 12 |
| Visitor Motivation and Education Outcomes at the Zoo | Page 14 |
| Global Study of Zoo Education Communication and Effectiveness | Page 16 |
| Memories from Residential Outdoor Education Have Long-Term Impact | Page 18 |
| Evaluating an Experiential Family Outdoor Education Pilot Program | Page 20 |
| Model for Developing and Assessing Civic Environmental Engagement Programs | Page 22 |
| Word Association Task Measures Perceptions of Climate Change | Page 23 |
| Best Practices in Environmental Education and Program Evaluation | Page 25 |

TEACHING METHODS

| | |
|---|---------|
| The Promise of Outdoor Education in Schools | Page 27 |
| Igniting a Lasting Interest in Science | Page 28 |
| Strategies for Integrating Students in Campus Sustainability Projects | Page 30 |
| Environmental Identity Development in High School Environmental Science Course | Page 32 |
| Connecting Zoo Visitors to Climate Change | Page 33 |
| Fostering Young Children's Agency through Sustainability Education | Page 34 |

PROFESSIONAL DEVELOPMENT

| | |
|---|---------|
| Barriers to Using Natural Outdoor Spaces in Early Childhood Education | Page 37 |
| Creating School Buildings That Teach and Encourage Sustainability | Page 38 |

OTHER RESEARCH

| | |
|--|---------|
| Effects of Climate Change Media Messaging on Perceived Risk, Emotions, and Learning | Page 41 |
| Unspoken Worldview Assumptions of Science and Students | Page 43 |

INTRODUCTION

Dear Colleagues,

ChangeScale is partnering with researchers at Stanford University to create this eighth issue of the *Environmental Education Research Bulletin*. The most talented environmental educators we know are conducting place-based programs, collaborating with communities, and using hands-on strategies to make critical links between enhancing environmental awareness, building skills, and supporting informed action. Yet rarely do these committed professionals have time to keep up on the latest research, whose beneficial findings may enhance the effectiveness of environmental education programming. To that end, these bulletins aim to help bridge the research-to-practice gap by summarizing recently reported research. In turn, we hope that practitioners may be inspired to infuse their work with recent research findings.

In this issue, we include synopses of peer-reviewed journal articles that are particularly relevant for front-line environmental education practitioners. We reviewed issues (published from July to December 2014) of a number of environmental education-related journals, including: *Journal of Environmental Education*, *Environmental Education Research*, *Applied Environmental Education & Communications*, *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 *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 you'd like to see covered or journals you'd like us to monitor, or if there's an alternative format that may be helpful. You can send suggestions

to eereseearchbulletins@changescale.org. We'll consider your feedback at the beginning of each cycle and try to adapt accordingly.

For another take on these kinds of articles, you may want to check out the North American Association for Environmental Education's professional development site, eePRO, which has a section devoted to research and evaluation. You may also be interested in the Relating Research to Practice effort of CILS and the Exploratorium, available here: <http://relatingresearchtopractice.org/>

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



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ENVIRONMENTAL BEHAVIOR

SOCIAL NORMS MESSAGING AS A TOOL FOR CONSERVATION BEHAVIOR

Retail business is known for its advertising savvy, much of which is underpinned by research on how people make decisions and what influences those decisions. Recently, other organizations have also been taking advantage of this savvy and applying it to ethical and moral issues. Two examples are the U.S. government's anti-smoking campaign, and WWF's branding of the panda in efforts to save endangered species. Yet, these techniques have not been widely adopted in the field of environmental education. This study considers the implementation of one such technique—social norms messaging—in an energy conservation program and examines the impact the technique had on attitude and behavior changes in students.

Social norm messages provide information about a behavior and are categorized in two ways: descriptive and injunctive. Both types of norms are important and frequently used tools in programs designed to influence environmental and other prosocial behaviors. Descriptive norms describe or give information about the social norms around a behavior and encourage people to regress to the norm, or average, which can have opposing effects. In the case of environmental issues, this most often means citing the average usage of a resource by community members by using statements such as, "The average American home uses 911 kilowatt hours of electricity a month." Those who use more than the described average may then attempt to use less and become average, while those who use less than 911 kilowatt hours of electricity a month might feel justified in using more energy, while still remaining within the average range. An injunctive norm, by contrast, can be used to counteract this effect by applying a moral framework. Saying "Responsible people turn off the lights," for example, invokes a moral framework and, as such, may counteract the actions of those who may have used more energy because they felt they could do so and still be average.

For this study, researchers investigated three groups of middle school Girl Scouts (aged 9 to 12) who had participated in an energy conservation program called Girls' Energy Conservation Corps (GECCo). The three Girl Scout troops were studied sequentially; following each group's study, the researchers made further refinements



to their study protocol. During the GECCo program, all of the study participants played the same card games about energy use, made a mobile about the energy cycle, and learned ways to track their own energy use. All of the participants also received a GECCo Girl Scouts patch upon completing the program.

During the energy-related intervention program, girls were given an initial survey to establish a baseline energy conservation score on a scale of one to five. Three weeks after they had completed the program, the first set of girls ($n = 37$) were randomly sent one of two postcards in the mail. Half the girls received a postcard with a descriptive and injunctive norm (i.e., “Did you know, over three days, the typical Girl Scout switched off 15 lights?” and “Girl Scouts think saving energy and fighting climate change is a good thing.”). The other half received a postcard with a generic “Save energy” message. About a week later, the girls then answered a survey about their conservation activities over the past three days, their attitudes toward the environment, and their views of social norms about conservation. This information was supplemented with parent and group interviews. The researchers used these data to examine the differences in attitudes and behaviors between the girls who received injunctive social norm messaging and those who did not.

At first, the researchers did not find any significant results. Given this, they decided to analyze their results in a new way by splitting the troops into two groups: those who initially reported higher levels of energy conservation and those who reported lower levels of conservation. This more-detailed investigation showed that the scouts who were originally participating in more energy conservation behaviors were encouraged to keep participating by the injunctive social norm message. By contrast, those who received the control message of “Save energy” maintained or decreased their energy usage, particularly if they were already successfully conserving energy. In short, the injunctive social norm message had a significant positive impact on girls who were already participating at a high level in conservation behavior.

Researchers repeated a similar process with a second group of Girl Scouts ($n=27$). Based on feedback from the first group, the researchers slightly modified both the survey and the experimental injunctive social norms postcard. They also significantly changed the control postcard by omitting the GECCo symbol and simplifying the message. The girls were surveyed one week after receiving the postcard. Although behaviors did not change significantly, attitudes (often an indicator of and precursor to behavior) did change. Based on a 5-point scale, the injunctive social norms group increased their attitude score by 1.88, while the control group dropped 3.71 points compared with their initial survey scores.

For the final group of Girl Scouts ($n=53$), the postcards and surveys were further refined. Instead of receiving one postcard, each girl received three postcards with specific instructions to put the cards in the kitchen, in the bathroom, and in their bedrooms. Most significantly, however, the researchers administered the postcards a full year after the girls attended the intervention program. Two weeks later, the girls completed a survey. This study showed no significant findings for behavior or attitudes.

The results from the first group studied suggest injunctive social norm messaging may have more of an impact on energy conservation behavior of students who are already engaged in conservation behavior. The results of this study, as a whole, also suggest that time between the completion of the program and the follow-up postcards impacts the effectiveness of social norm messaging. The first and second groups were administered the follow-up postcards three weeks after the program and found positive effects for injunctive social norm messaging on environmental attitudes (and negative effects on the generic messaging). By contrast, the third group was administered the postcards a full year after the program and found that injunctive social norm messaging had no effect on attitudes. The most effective timing for follow-up through injunctive social norm messaging, therefore, is worthy of further study. In particular, follow-up may be most effective when administered immediately following program completion, which was not tested in this study.

THE BOTTOM LINE:

Social norm messaging can be an effective tool for encouraging pro-environmental attitudes and behaviors. There are two types of social norm messages: descriptive and injunctive. Descriptive social norms share information about the “normal” behavior or resource usage in one’s community, such as, “The average house on your block uses 100 gallons of water per week.” By contrast, injunctive social norms use ethical, social, and moral frameworks to promote certain actions such as, “Do your part to help the drought: use less water.” Research suggests that messaging that includes both descriptive and injunctive norm messages are the most effective. This type of messaging can also be used as follow-up to encourage student attitude and behavior change after an educational program by, for example, sending postcards or emails. This type of follow-up may be most effective if undertaken within the first few weeks after a program is completed, rather than months or a year later.

Bernstein, D., & Puttick, G. (2014). Seeding social norms about energy conservation among Girl Scouts. *Applied Environmental Education & Communication*, 13(3), 171–182.

WILLINGNESS TO ENGAGE IN LOCAL VERSUS DISTANT ENVIRONMENTAL ISSUES

One characteristic of all major current environmental threats is the interconnection of local and global issues. What occurs locally has global implications, and vice versa. This is true for greenhouse gas emissions, as well as for issues such as ocean pollution, overfishing, air pollution, and deforestation, among others. Given this, it is critical for learners to be willing to engage with environmental issues that are close to home, as well as those that are socio-spatially distant. This paper’s authors address how perceived socio-spatial distance of environmental issues affects adolescents’ willingness to engage in pro-environmental behaviors (PEB) to address those issues.

The authors’ literature review reveals diverse opinions about the effect of geographical distance on people’s concern about issues. On the one hand, some researchers have argued that people are more concerned about issues that directly affect them at a local level. On the other hand, studies suggest that people consider distant environmental problems to be more serious. This has been attributed to optimism bias—the idea that things are not as bad as they seem. Given these conflicting findings, the authors aimed to address questions related to the impact of distance on people’s environmental concern in more detail, using the norm activation model (NAM) developed by Schwartz and Howard (1981).

The norm activation model, frequently used in environmental psychology, was originally developed to describe prosocial behavior. According to this model, once a person becomes aware of a problem, he or she evaluates the assumed harmful consequences. In the case of this research, the authors distinguished between egoistic assumed consequences (AC) (i.e., concern for self) and biospheric AC (i.e., concern for nature). In addition, the authors distinguished between problems resulting from socio-economic causes (e.g., poverty) and ecological causes (e.g., pollution). The authors also hypothesized that socio-spatial distance would affect AC, but in different ways. Specifically, they hypothesized that adolescents would report greater egoistic AC for ecological problems close to home. They thought, for example, that environmental pollution in one’s own country would be considered more serious a concern for oneself than pollution in a foreign country. By contrast, the authors hypothesized that biospheric AC would be greater for socio-economic problems far away; they thought, for example, that poor income opportunities in a foreign country would be perceived as causing greater deterioration of natural resources than similar socio-economic problems in one’s own country.

Another element of the NAM model is that the expected barriers to solving a problem mediate behavioral outcomes. For the purposes of this study, the researchers specifically considered the barrier related to perceived behavioral control (PBC), the extent to which a person perceives an action to be

under her or his control, as opposed to under the control of external factors that are personally uncontrollable. In other words, someone with high PBC would feel fewer barriers to action than someone with low PBC. With regard to socio-spatial distance, the authors hypothesized that greater socio-spatial distance between oneself and the problem would correlate with lower PBC.

The final factor of the NAM model the authors investigated was perceived helplessness (PH). The authors differentiate PH from PBC as being more specifically related to an emotional state of feeling overwhelmed by the severity and enormity of the issue. Feeling personally helpless (high PH) is associated with decreased action to address the problem. The researchers hypothesized that greater socio-spatial distance would correlate with feeling more helpless.

To test these hypotheses, the authors conducted their study at 52 schools in Germany: 26 urban schools and 26 rural schools. In total, 938 students completed a questionnaire with items collecting quantitative data. The students were all in 10th grade; 96% of the students were between the ages of 15 and 17, with a few students as young as 12 or as old as 18.

Two different questionnaires were administered that addressed sustainability issues and the students' willingness to take action to address associated problems. The questionnaires were identical, except the "socio-economically not distant" survey referred exclusively to Germany (n=470 students), and the "distant" survey referred to "a developing country" (n = 468). With the distant survey, students were asked to choose a developing country to keep in mind when answering the questions. The vast majority of students chose the region "Africa" (81%), followed by India (17%), China (16%), and South America (8%). In total, 45 different countries or regions were listed; in addition, 35% of respondents chose to not list a country.

Items on the questionnaire measured: biospheric AC resulting from socio-economic problems; egoistic AC resulting from ecological problems; PBC; PH; and willingness to engage in pro-environmental behaviors (WPEB).

Analysis of the questionnaires showed that WPEB did not differ significantly between those referring to Germany and those referring to a developing country. The authors regarded this result as encouraging, since it refutes the notion that students may only be willing to take pro-environmental action regarding local issues. In addition, this result supports a core concept of Education for Sustainable Development, which, among other things, often aims to foster interest and action regarding issues that are socio-spatially distant.

The hypotheses that distant environmental problems would be perceived as less relevant to the self (egoistic AC) and that distant socio-economic problems would have greater consequences for the environment (biospheric AC) were both supported by the data. The authors suggest that, given these findings, educators can counteract these biases by helping students understand the effects that distant environmental problems have on themselves personally and also the effects that local socio-economic problems have on the environment.

As expected, PBC did have a significant positive correlation with WPEB in both surveys. In other words, higher PBC was correlated with high WPEB, and vice versa. PH was the only variable that showed only weak or insignificant correlations to WPEB. Specifically, the correlation of PH and WPEB was weakly significant with the Germany sample and not correlated with the foreign country sample. Despite these results, the authors stress that it is worthwhile for teachers to avoid overwhelming learners with environmental and social issues to the point that they feel helpless and fatalistic. They also emphasize that what occurs at a local level—no matter where one is—affects the whole world.

THE BOTTOM LINE:

To understand and address today's major environmental challenges requires tackling the interdependence of local and global issues. To counteract common biases and misunderstanding, it is especially important for educators to help students understand how socio-spatially distant environmental problems pose negative consequences for the students personally, on a range of scales, from local to global. It is also vital to help students understand how local socio-economic and environmental issues, such as greenhouse gas emissions, deforestation, and air and water pollution, pose

potential consequences for the environment close to home as well as at a range of scales.

Busse, M., & Menzel, S. (2014). The role of perceived socio-spatial distance in adolescents' willingness to engage in pro-environmental behavior. *Journal of Environmental Psychology*, 40, 412–420.

THREE CRITERIA FOR EFFECTIVE BEHAVIOR CHANGE MESSAGING

In the face of environmental issues such as drought, encouraging consumers to voluntarily change their behavior—in this case, to use less water—is a difficult, but critical, challenge. Many nonprofit organizations and resource management divisions are taking up this challenge through the use of conservation messaging. The authors of this paper worked with one such nonprofit in Phoenix, Arizona, to increase the effectiveness of their locally run water conservation program. Based on empirical and theoretical research about how people learn, the authors proposed three criteria for effective conservation messaging. These criteria were then applied to the evaluation of the Phoenix program to provide practical suggestions for how the program could be more effective.

The scholars first outlined three criteria for encouraging sustainable behaviors within conservation-focused organizations by summarizing the relevant academic literature. These three criteria deal with the type of knowledge conveyed, the delivery method, and the target audience. The first criterion is that the type of knowledge that is shared with audiences needs to be tailored toward behavior change. In particular, when organizations focus on specialized areas of knowledge, such as water conservation, the information needs to be both procedural and impact-based (i.e., outline the procedure for the behavior change and the impact it will have). Informational knowledge, such as stating, “We are in a drought,” is less effective than saying “Save over 15 gallons of water by taking a shower instead of bath.” In other words, effective messaging provides people with

the “how” of the behavior (i.e., “Take showers instead of baths.”) and also describes the impact of the behavior (i.e., “This will save 15 gallons of water.”).

The second criterion describes effective delivery methods. Research has shown that one-way delivery methods are much less effective than two-way, interactive methods that are reflective and collaborative. Two-way delivery methods mean that, if information is being shared by an organization, audience members have an opportunity to share their thoughts, questions, and opinions about the issue with the organization that delivered the message. Another example is within a classroom where the teacher and students are engaged in a dialogue. This type of interaction helps build trust in both the organization (or teacher) and in the knowledge being conveyed.

The third and final criterion the scholars recommend is that the organization must have an effective and clear target audience in mind. The researchers stress the importance of focusing on local leaders and those who have a disproportionate effect on the project goals. It is also wise to focus on those who may have the means and ability to take up the desired behavior. If the organization wishes to change driving habits, for example, the target audience should be adults who drive rather than adults who primarily use public transportation.

Next, the authors used these three outlined criteria to study the effectiveness of a water education program in Phoenix. They collected data through surveys and interviews with 20 managers involved in the project. They determined that the Phoenix water education effort did not meet any of their outlined criteria; therefore, it was much less effective than it could be. The content of the education program was mainly informational and focused on knowledge around education standards, drinking-water safety, and the water cycle. The delivery methods were all one-way and comprised of books, informational booths, and printed media. Last, the targeted audience was mainly children, who have little agency in making water conservation decisions. The scholars argued that the program should instead target the group who uses the most water: affluent homeowners.

Based on their evaluation, the authors recommended that the Phoenix program incorporate more procedural and impact-based knowledge, adapt interactive educational techniques, and tailor programs to specific actions and relevant populations. They also acknowledged that, despite their findings, this information might be highly contextualized to this particular program, and it is difficult to measure how effective these criteria are at actually reducing water usage over a large population.

THE BOTTOM LINE:

To more effectively reach people with conservation messaging, the authors recommend following three criteria. First, educators can make sure that the information they share is focused on how to adapt a conservation behavior and the impact it will have, rather than just providing general content-based information about the problem. Stating that carpooling to work saves gas and reduces traffic is more effective at changing behavior than saying, “The average American uses 500 gallons of gas per year driving to and from work.” Second, involve people in the learning process by giving them the chance to interact and engage in activities rather than just sharing information. Last, make sure the programs and messages are reaching the audience that matters; i.e., if the focus is on conserving water, target the population that uses the most water and has the ability to change the behavior.

Larson, K. L., & Redman, E. N. (2014). Water education for sustainability: Criteria and recommendations. *Society & Natural Resources*, 27(11), 1213–1222.

USING MESSAGES OF FEAR AND SELF-EFFICACY TO SHIFT ATTITUDES ABOUT GLOBAL WARMING

Public engagement is key to mitigating global warming as it is primarily attributed to human activity, mainly through the emissions of heat-trapping gases in our atmosphere. Since public knowledge of global warming mainly comes from mass media, the effects of media messaging on influencing behavior and engagement is critical to understand. Journalists frequently

communicate this information through the use of fear-inducing messages, with a technique called “fear appeal,” which stresses negative consequences. This tactic has been used in many health campaigns to evoke changes in behavior and attitudes. The effectiveness of using fear appeal with global warming, however, is less studied and, therefore, this research set out to explore the relationship between fear appeal and attitudes and behaviors toward global warming.

Implemented with college students in Taiwan, the study was designed using Witte’s Extended Parallel Process Model (EPPM), which explains relationships between fear appeals and the subsequent behaviors to control perceived dangers and fear. Witte’s EPPM is based on the recipients’ perceptions of four components: (1) severity of the problem; (2) susceptibility of the participant to being affected by the problem; (3) response efficacy, or an individual’s belief that his or her actions to reduce the severity of the problem will be effective; and (4) self-efficacy, or an individual’s belief that she or he can make a difference in solving the problem.

Each of the four components of the model affects how participants perceive the severity of the issue and also their resultant behavior, particularly whether they engage in taking action or avoid taking action. The model theorizes that, for participants to take action, they must feel that the problem is severe and that they are susceptible to being affected by the issue. Critically, they must also feel a high degree of response efficacy and self-efficacy. The other potential response to fear appeal messaging—and the unintended, undesirable consequence—is that the recipient may respond to the fear appeal through avoidance. This can happen if the solutions offered are not perceived as effective or self-efficacious. This avoidance could be a disastrous consequence of using fear appeal messages about global climate change, which is why the researcher sought to examine this issue.

To understand the most effective way to use fear appeal messaging regarding global climate change, the author studied combinations of high-threat/low-threat messages

with high/low efficacy. The author created these messages by selecting four stories from a Taiwanese news database with nearly 2,300 news articles about global climate change. Study participants include 341 undergraduate students enrolled in six communication courses at a university in northern Taiwan; these students completed pre- and post-tests. The pre-test questions measured students' attitudes and behaviors regarding global climate change—specifically, this survey measured participants' attitudes on items related to what they believe individuals should do and what governments should do, as well as the participants' own personal behavioral intentions. Government regulation intentions were also measured and consisted of attitudes toward actions requiring the respondents to mobilize communities and pressure the government to change emissions regulations. The post-test asked similar questions and also included one of the four stories, which the researcher asked students to read prior to taking the test.

This study's findings demonstrate significant differences between the high-threat/high-efficacy messaging (HH) compared to the low-threat/low-efficacy messaging (LL). The HH group displayed a significant positive shift in their attitudes regarding what “individuals should do” between their pre- and post-tests. The HH group also displayed pre- and post-test means significantly higher than the high-efficacy/low-threat (HL) and low-threat/high-efficacy (LH) groups regarding what “individuals should do,” “governments should do,” and “personal intentions,” which in turn had higher means than the LL group. The LL group showed a significant decrease in their attitudes about what “individuals should do,” about what “governments should do,” and in their own “personal behavioral intentions.” In other words, the LL messaging generated negative attitudes as they controlled participants' fear with avoidance. The pre- and post-test results for the “government regulation intentions” among all four high-/low-threat and high-/low-efficacy groups did not show any significant difference. This may be because these types of behaviors were difficult and

time-consuming to carry out. This result demonstrates the limitations of high-threat fear appeal messaging. Nonetheless, the HH group had the most promising outcomes, followed by the HL or LH groups; the LL group had the least positive effect.

Using high-threat/high-efficacy messaging about global warming significantly influenced the attitudes and behavioral intentions in college students. This understanding can provide a framework for effective messaging both in mass media and when teaching. It also demonstrates the importance of avoiding low-threat/low-efficacy messaging for its potential to evoke avoidance and inactivity.

THE BOTTOM LINE:

Fear appeal messaging focuses on negative consequences of a threat, such as the perils of global warming. This type of messaging can be an effective way to motivate pro-environmental attitudes and behaviors toward global warming, but only if participants are given potential solutions that they believe to be effective and that they can personally accomplish. Downplaying the dangers of the threat, or failing to provide suggestions for meaningful and accomplishable action, can lead to avoidance and inaction.

Li, S. S. (2014). Fear appeals and college students' attitudes and behavioral intentions toward global warming. *The Journal of Environmental Education*, 45(4), 243–257.

EVALUATION

THE VALIDITY OF SELF-REPORT MEASURES OF PRO-ENVIRONMENTAL BEHAVIOR

Many environmental problems could be dramatically reduced or solved by the collective efforts of numerous individuals reducing their resource consumption and engaging in other types of pro-environmental behavior. As such, fostering pro-environmental behaviors has become one of the primary goals of many environmental education efforts. To evaluate the effectiveness of these efforts, self-report measures are commonly employed. Self-report measures ask individuals to quantify their own environmental behaviors, typically through surveys or interviews. A critical assumption of these self-report tests is that they accurately reflect individuals' actual environmental behavior. Previous research regarding the validity of this assumption, however, has suggested that self-reports are only weakly associated with actual behavior. Because these self-report tests are easier and often more feasible to gather than objective data on individuals' behavior, it is critical to understand to what degree they are valid and what factors, if any, affect their validity. This paper's authors aimed to address these questions through a detailed meta-analysis of studies that have included objective as well as self-report measures to evaluate the same environmental behavior.

First, the authors outlined several criteria for the studies they included in this meta-analysis. They focused on studies that examined associations between self-reported measures of a pro-environmental behavior and an objective measure of the same behavior. These behaviors ranged from assessments of water usage, energy consumption, and recycling behavior to heads of households' estimates of forests they had cleared on their land that year. To be included, the self-report and objective measures had to be from the same individual or household. The studies also had to include the necessary primary, quantitative data for the authors of this paper to perform their analysis. After an extensive search, the authors found 15 studies that met the criteria to be included in their analysis. These 15 studies included data from 6,260 individuals or households and examined 19 pro-environmental behaviors.

Three objective measures of environmental behavior were used by the studies included in the analysis: device measurement, trained observers, and peer ratings. Device measurement in these studies



involved obtaining readings from water, gas, and oil meters in a household. This is likely the most objective measure; however, only a limited number of behaviors lend themselves easily to this kind of measurement. Trained observers are skilled in observing participants' behaviors and can detect a wider range of behaviors, such as how often certain materials are reused in a household. Trained observers, however, are limited in the behaviors they can discern, especially involving daily activities that are private and might change when someone knows they are being observed. Finally, peer ratings involve asking others who are close to the participant, such as spouses or housemates, to report on participants' environmental behavior. This method provides a solution to some of the limitations of trained observers.

Several factors were examined as potential moderators of the validity of self-report measures, including the characteristics of the participants and the methodology used in each study. The participant characteristics included in this meta-analysis were: percent of male participants and mean age of participants. The methodological characteristics examined included: the number of items in the self-report measure (i.e., how many questions were in the survey or interview for measuring the behavior); the number of response options (e.g., two options for "Yes/No" questions versus seven options on a scale from "Never" to "Always"); whether the participants were individuals or households; the nature of the objective measure (device measurement, trained observers, or peer ratings); type of behavior (e.g., recycling or energy usage); year of publication; and study location.

The authors describe a number of features of the meta-analysis data. The average age of the 6,260 participants was 38.2 years old; 32% of the participants were male. Year of study publication ranged from 1984 to 2011. The mean number of items in the self-report measure was eight (range = 1–65), and the mean number of response options was 4.5 (range = 2–7). For the objective measure, 8 of the 15 studies used device measures, 9 studies used trained observers, and 2 studies used peer ratings. In terms of the

19 behaviors studied, 6 studies measured waste behaviors (recycling or reuse of materials), 5 measured energy usage (electricity, gas, or oil), 2 measured water usage, and 1 each measured food consumption, deforestation, and transportation. Finally, three measures included a combination of several different pro-environmental behaviors.

In terms of the overall validity of the self-report measures, the analysis revealed a significant and large effect size ($r = .46$) of self-reports predicting objective measures of pro-environmental behavior. In addition, 21% of the variance in the self-report measures was linearly associated with the variance in the objective measures. Both of these statistical findings show that the self-reports have some degree of validity for predicting the actual differences in pro-environmental behavior between individuals. The authors, however, caution against thinking that these findings prove self-reports are highly valid. They emphasize that 79% of the variation between self-reports and objective measures of behavior remains unexplained. The authors argue that, while self-reports have some predictive power of actual behavior, it would be false to assume that they are a measure of the actual behavior itself.

In addition to these overall findings, there were significant differences in the predictive power of self-reports between studies: some were very accurate while others were not at all accurate. To help understand these differences, the next round of analysis considered various potential moderators. One of the factors that emerged as significant was the percentage of male participants in the study. Specifically, the greater the percentage of males in a study, the more likely the self-report was to be accurate; study analysis shows, on average, female participants tended to over-report their environmental behavior. The type of behavior examined in the study also had a significant effect: specifically, the validity of self-reports was greatest for deforestation-related behavior ($r=.73$), followed by energy usage ($r=.61$), mixed-behavior measures ($r=.55$), food consumption ($r=.31$), transportation ($r=.30$), water usage ($r=.29$), and waste ($r=.28$). Another factor that was found

to be significant was location of the study: specifically, the 10 studies performed in non-Latin American countries had a larger predictive power ($r = .45$), compared to the 5 studies performed in Latin American countries ($r = .36$).

The authors add, however, that several limitations to this study make these significant moderating factors worthy of further study. They determined many factors had no significant moderating effect, including: average participant age, the number of items on the self-report measure, the number of response options, whether participants were individuals or households, the nature of the objective measurement (device measurement, trained observer, or peer rating), and the year of study publication.

In their discussion, the authors emphasize several important implications of this study and suggestions for future research. Given that self-reports are not always highly valid, the authors note that researchers may inadvertently be drawing skewed conclusions about the utility of certain predictive models for behavior. In addition, they argue that it is possible that certain models may overestimate the influence of a particular education intervention on behavior change. By questioning these assumptions and better understanding the factors that skew the validity of self-report measures, researchers may be able to develop better models and educational strategies for addressing environmental behavior.

THE BOTTOM LINE:

Self-report measures of environmental behavior ask study participants to report on the degree to which they perform certain behaviors. Although these measures may have some predictive power for measuring actual behavior, it is incorrect to assume that these self-reports are a highly valid measure of actual behavior. When performing evaluations, if feasible, it is best to find additional ways to measure behaviors objectively, such as through device measurement (e.g., water meters), trained observers (e.g., individuals educated in measuring recycling in waste bins), or peer observers (e.g., spouses or roommates).

Kormos, C., & Gifford, R. (2014). The validity of self-report measures of proenvironmental behavior: A meta-analytic review. *Journal of Environmental Psychology*, 40, 359–371.

VISITOR MOTIVATION AND EDUCATION OUTCOMES AT THE ZOO

Over the past few decades, zoos have become important venues for conservation-focused environmental education. In particular, zoos offer an opportunity to reach adults who may not otherwise be exposed to, or have an interest in, environmental education. One of the defining qualities of zoos as educational settings is that they offer opportunities for free-choice learning, meaning the learner has a great degree of autonomy and individual control with regard to his or her involvement with the various educational elements, such as signage accompanying exhibits or informal talks by zoo staff. Given that learning at the zoo is self-motivated, this paper's authors investigated the variety of visitor motivations at the Toronto Zoo. Furthermore, they investigated whether these different visitor motivations affect the relative success of education efforts.

To understand these motivations, the researchers used the Identity-Related Motivation framework that was developed by Falk (2006) through previous studies in free-choice settings, including museums. This framework posits that museum—or in this case, zoo—visitors' motivations can usually be categorized in one of five of the following ways:

- Explorers: curiosity-driven and seek to learn more about whatever they might encounter at the institution
- Facilitators: focus primarily on enabling the experience and learning of others in their accompanying social group
- Professional/hobbyists: feel a closer tie between the institution's content and their professional or hobbyist passions

- Experience seekers: mainly derive satisfaction from action of visiting an important site
- Spiritual pilgrims: primarily seek a contemplative and/or restorative experience

These categories are based on what the visitor self-reports as his or her reason for pursuing any given visit and may change from one visit to the next.

To conduct their study, the authors also needed to determine what outcomes constitute successful conservation-oriented environmental education (COEE) and how to measure them. Based on their review of the literature, the authors describe the main goal of COEE as having an effect on habitat and species conservation (e.g., lowering the extinction rate); however, this goal is not feasible to measure directly. Instead, what researchers often regard as the key outcome of COEE is behavior change, as long-term changes in conservation behavior will, theoretically, have a positive effect on conservation on a broader scale. Given that long-term behavior change is also challenging to measure, the authors use three factors in this study as predictors of environmental behavior change: (1) learned environmental issues (knowledge); (2) learned pro-environmental actions (skills); and (3) intention to perform pro-environmental behaviors (behavioral intention).

A 20-item survey and structured interviews were used to collect data. The survey was designed to ascertain each visitor's motivation for coming to the zoo. Any participant who scored more than 14 points for a specific motivation category—such as facilitator, explorer, or spiritual pilgrim—was classified as belonging to that group. While each participant was completing the survey, the data collector noted demographic data, such as age group, gender, number of people in the group, and the presence (or absence) of children within the group.

Data were collected during June and July 2012 at the Toronto Zoo, equating to over 49 total hours of sampling. The random sample included 296 participants; of these, 116 were selected to participate in a follow-up interview

based on having a single dominant motivation. Only visitors who looked over 18 years old were approached to take part in the study. Just over half (56%) of participants were female; 34% of participants were young adults aged 18–29, 59% were adults aged 30–64, and 6% were over 65 years old.

For participants whose questionnaire showed them as belonging to a single motivation group, researchers conducted interviews to collect additional information. Specifically, interviewers gathered data on visitor satisfaction and the knowledge, skills, and behavioral intentions that resulted from the visit. To measure knowledge gain, participants were asked to describe specific environmental issues about which they had learned following their trip through the zoo. The number of issues they could recall was tallied. For each issue described, participants were asked about ways they learned to address this issue, if any (skills). To measure behavioral intention, participants were asked whether, as a result of their zoo visit, they were more, less, or just as likely to perform each of the Toronto Zoo's eight target behavioral actions (such as donating personal resources to conservation initiatives).

The results of the survey showed the most common motivation for coming to the zoo was as a facilitator (30%). The next most common motivation group was spiritual pilgrims (10%), followed by experience seekers (4%), explorers (4%), and professionals/hobbyists (1%). This distribution of dominant motivations was significantly different from what was found in a similar study conducted at two zoos in the United States, which suggests that the zoo visit motivations might be significantly different from one zoo to the next. More than half of participants (51%) did not fall into any particular motivation group. The authors note that the model was originally developed at a museum, and that it may be worthwhile conducting further research to create a model for zoo visitor motivations, specifically.

In terms of the effectiveness of education at the zoo, 52% of interview participants were able to report a

specific issue they had learned during their visit. Half of those who reported learning about an issue (26% of all participants) were able to describe at least one pro-environmental action or skill relating to the issue they had learned that day. No significant correlation was found between motivation for coming to the zoo, and the amount of knowledge or skills gained, in part because of the small number of participants found in three of the motivation groups, thus making statistics unviable. The data suggests, however, that spiritual pilgrims and experience seekers had greater knowledge gains than facilitators (based on 70% confidence intervals). This could be because facilitators are more likely to be attending to others, rather than focused on their own learning. Facilitators tended to be accompanied by more children than other types of visitors, which could also distract them from their own learning.

The results regarding behavioral intentions revealed no significant correlation between the overall number of behaviors participants reported being “more likely” to perform and their motivation for coming to the zoo. The most common behavior participants reported being likely to adopt was “sharing wildlife/zoo experiences with others to encourage them to visit and get involved” (83% of participants). Certain behaviors were more likely to be incorporated by particular motivation groups; for example, spiritual pilgrims were more likely to “donate personal resources to conservation initiatives in the future,” whereas explorers were more likely to report their intention to “explore natural spaces and reconnect with the natural world.”

The authors also analyzed the types of issues and actions reported by participants. The most common types of issues about which visitors reported having learned related to threats to and endangerment of species and habitats (69% of reported issues). Issues related to sustainability, such as recycling, waste management, and consumer choices, were also common (27% of responses). In terms of types of actions participants learned they could take, the most common actions had to do with reducing ecological footprints and changing consumer choices (68%), followed by supporting environmental organizations (32%).

THE BOTTOM LINE:

In the context of informal education environments, such as museums and zoos, understanding the motivation of visitors is critical, since learning in these contexts is self-motivated and voluntary. Although the motivation of visitors may differ between zoos and museums, this research suggests that facilitators—those whose primary motivation is to enable the learning of others—comprise a large proportion of visitors to zoos and museums. This paper suggests that facilitators tend to gain less knowledge than other visitors, which may be a result of numerous circumstances (such as, for example, attending to the experiences of others or being distracted by children). Given this, specific efforts should be made to engage facilitators in learning experiences during their visit. Likewise, educators also need to find ways to learn about and reach audiences with other motivations for visiting.

Schultz, J. G. W., & Joordens, S. (2014). The effect of visitor motivation on the success of environmental education at the Toronto Zoo. *Environmental Education Research*, 20(6), 753–755.

GLOBAL STUDY OF ZOO EDUCATION COMMUNICATION AND EFFECTIVENESS

Today, most zoos around the world undertake messaging around environmental conservation and conservation-related action. Previous research at zoos has suggested the effectiveness of using a range of communication strategies—such as signage, zookeeper talks, and docents—to deliver these messages to visitors. However, little research has investigated what communication strategies are currently being employed at zoos around the world and whether these strategies are enhancing visitors’ knowledge, motivation, and actual behavioral outcomes. This study aimed to address that research gap by using a two-phased, mixed-methods approach. The project’s first phase used an online survey; and the second phase involved in-depth zoo case studies, which revolved around direct observation and interviews with zoo staff and visitors. Given the near-ubiquitous use of signage at

zoos, the case studies also investigated the level to which visitors engaged with exhibit signage.

The results presented in this paper were one part of a larger study on zoo education conducted by the authors. The first phase of the research was comprised of an online questionnaire that was distributed to zoos worldwide. Zoos were recruited to participate through direct email to zoo education associations and contacts listed in the *International Zoo Yearbook*. In total, staff members from 176 zoos, representing 50 countries, responded. The zoos were categorized geographically into three regions: Asia-Pacific (n=24); Europe, Middle East, and Africa (n=107); and North and South America (n=45). The questionnaire consisted of 62 questions, 7 of which were analyzed for this paper. One key question focused on the types of printed media used (e.g., signs at the animal enclosures, pamphlets/brochures, and/or worksheets). Another key question focused on the types of educational activities offered at the zoo, such as animal feeding demonstrations with verbal presentation, zookeeper talks (other than animal feeding), animal shows, animal contact areas, and/or docents (volunteer tour guides).

Regarding printed media use at zoos, the findings from the first phase of the study showed that 97% of the participating zoos use signs at animal enclosures. In addition, 72% reported using pamphlets, and 69% use worksheets; 1.5% reported they do not use any signs, pamphlets, or worksheets. Regarding educational activities, 95% of the zoos reported using at least one type of person-to-person education strategy with their visitors. The most frequently offered activities were animal feedings (83%), zookeeper talks (74%), animal contact areas (78%), and docents (74%). The least commonly offered activity was animal shows, which were offered by 54% of zoos; however, animal shows were more commonly used in the Americas (75% of zoos in North and South America).

The second phase of the research involved in-depth case studies at nine of the zoos that had participated in Phase 1 of the project. Two questions were examined in this study, based on the case-study data: (1) How do zoos'

self-reported educational communications compare with direct observation? (2) To what level do general visitors view exhibit signage? The lead author collected data during seven-day visits to each of the zoos. The participating zoos were selected based on geographical location and size. To facilitate data collection from a large number of visitors, only zoos with annual visitation of 500,000 or more guests were considered. In an effort to mirror the proportion of zoos from each of the three geographical regions that responded to the survey, two zoos were selected from the Asia-Pacific region; four were selected from the region that includes Europe, Middle East, and Africa; and three were chosen from the North and South America region.

For the case studies, the authors interviewed 28 staff members across the 9 case study sites. In all cases, the head of education at each zoo was interviewed; in 2 cases, the zoo director was also interviewed. The additional interviews were conducted with both paid and volunteer zoo educators.

The case studies revealed a high degree of consistency between the responses of zoo personnel to the online survey and what the researchers observed during the site visits. Of the few discrepancies found, most involved education communication devices that were observed at the zoo by the researchers but omitted in the survey. In other words, when completing the questionnaire, it was more common for zoo personnel to omit education strategies they were actually employing than to include one that was not observed. Overall, however, the authors concluded that the survey was a relatively reliable representation of the number and type of educational strategies being employed at the zoo.

One of the main findings from the case studies that the authors discuss is the large variation in the quality and quantity of person-to-person education observed at the zoos. In particular, while 95% of the zoos reported using some kind of person-to-person education, upon visiting some of these zoos, the authors found that the educational content or quality of communication device was lacking.

Three of the zoos that reported using animal shows for education, for example, were observed to include very limited educational content in these shows. The animal shows, instead, appeared to be mainly for entertainment.

Another example regarding the varying quality of person-to-person education at the zoos was that only one of the zoos in the case study provided its docents and volunteers with extensive training. Those particular staff and volunteers were able to offer extensive knowledge about the animals on display and were actively engaged with visitors. At some of the other zoos, by contrast, docents were noted to be friendly and approachable, but “lacked even basic knowledge about the animals or facilities within the zoo.” The researchers noted that docents were sometimes observed to act more as crowd control at busy exhibits than as educators.

The lead researcher also conducted interviews with 60 random zoo visitors at each location, for a total of 540 interviews. The researcher selected visitors at random locations deep in each zoo to maximize the likelihood visitors had already spent time at one or more exhibits. The interviews focused on the reading of signage by visitors and, specifically, the researchers asked visitors how many signs they had read at the animal enclosures, based on five scaled options: *all, most, half, some, or none*.

The results of the visitor interviews showed that 95% of participating visitors read at least some of the exhibit signs. About 5% of visitors reported reading all the signs, 33% of visitors reported reading “most” of the signs, 20% reported reading “half,” 37% read “some,” and 5% read “none.” With the exception of visitors who reported reading all the signs, respondents were asked, “What were the reasons you did not read some of the signs?” Many visitors noted they only read the signs to discover what animal was in the enclosure. The most common reason for not reading all of the signs (33% of responses) was watching animals. Other reasons included insufficient time (14% of responses), already being familiar with the information (13%), difficulty reading or accessing the signs (10%), attending to children (7%), and not finding the animal interesting (6%).

The lead author also made in-person observations of the signage at all the zoos. A wide range in the quality of the signage was noted in terms of educational content, ease of readability (e.g., large enough text), design, and general condition (old/faded or new). The placement of the signs, such as high or low, also made a big difference as to how many people the author observed reading the signs. In particular, at some busy exhibits, signs placed too low and near the front of the exhibit made the verbiage inaccessible to all but a few of the visitors. The authors also noted that the content of signage deserves further research regarding how to best highlight key conservation messages.

THE BOTTOM LINE:

Zoos worldwide employ a range of educational media for teaching about animals and conservation, including printed media such as signs and brochures, and person-to-person approaches such as zookeeper talks and animal shows. The quality and quantity of these, however, can vary dramatically. This research suggests, in particular, that zoo educators should focus on the quality and effectiveness of educational content included both on signage and also in person-to-person educational strategies. Providing more training to zoo volunteers and docents is also beneficial so they have the knowledge and skills they need to be effective educators at the zoo.

Roe, K., McConney, A., & Mansfield, C. F. (2014). How do zoos “talk” to their general visitors? Do visitors “listen”? A mixed method investigation of the communication between modern zoos and their general visitors. *Australian Journal of Environmental Education*, 30(2), 167–186.

MEMORIES FROM RESIDENTIAL OUTDOOR EDUCATION HAVE LONG-TERM IMPACT

For students, spending several days at a residential outdoor environmental education (ROEE) program creates many new and powerful experiences, some of which are remembered for years to come. Yet, to date, only limited research has considered the role of memories as an outcome of environmental education. This study

investigated the memories of students five years after they completed an ROEE program. The gathered memories served as a means of qualitatively measuring the long-term impact of these programs on the students' environmental knowledge, behaviors, social interactions, and personal narratives.

There are many different types of memory. For the purposes of this study, the authors focused on long-term episodic memories, which are memories of a specific event or episode, rather than generalized knowledge (semantic memories). Specifically, the authors focused on autobiographical memories, which are considered a subset of episodic memories that create a part of a person's coherent life story. These memories were considered best suited for investigating the long-term impact of the ROEE programs.

In addition to learning what the participants remembered about the programs, the authors wanted to know how the participants have used these memories. Previous research into memory, reported in the psychology literature, has divided the uses of episodic autobiographic memories into three main categories: directive function, social function, and self function. Directive function refers to when a memory of a past experience is used to direct action and make predictions about the future. Social function is when a memory is used to converse and share stories, thus forging new relationships and maintaining intimacy with friends and family. Self function is when a memory enables a person to develop a coherent sense of self over time. The authors asked: How do memories of ROEE serve directive, social, or self functions? The authors paid special attention to directive functions, since directing future actions and behavior is most closely aligned with the goals of environmental education.

Data for this study were collected at two different research sites: the North Cascades Institute's Mountain School in North Cascades National Park, Washington; and the Teton Science Schools near Grand Teton National Park, Wyoming. The program at the North Cascades Institute (NCI) was a three-day camping experience for fifth graders

designed to foster an appreciation for the local biota and natural and cultural history of North Cascades National Park, as well as stewardship of the environment. The Teton Science Schools program consisted of two different three-day programs. One was for fifth graders, designed to teach the students about different ecosystems in Grand Teton National Park through inquiry-based scientific investigation and encourage environmentally friendly behaviors, such as limiting food waste. The other program was for seventh graders, and focused on winter ecology through a series of field experiences and outdoor recreation activities such as snowshoeing and cross country skiing.

Study participants were high school students (now in tenth or twelfth grade) who had attended one of these programs five years prior to the study. The first author visited classrooms at both schools and interviewed willing students. The sample included 18 former participants from NCI and 36 from the Teton Science Schools. The interviews were semistructured, with a basic outline of questions that became more specific as each interview progressed. The recorded interviews were transcribed verbatim, and the data were analyzed using qualitative data analysis software for emergent themes and categories. Data from each site were analyzed separately so that the findings could be compared and contrasted to one another.

The authors found that the interviewed students recalled many powerful memories from their ROEE experience and that these memories were continuing to serve a variety of functions in their lives. Many of the specific themes that emerged were similar at both sites, with different emphases that reflected the intentions of each program, as well as the different backgrounds of the students.

The most prominent uses of the memories were directive, such as inspiring an interest in outdoor recreation and environmental stewardship. For most students who participated in the program at NCI, the experience was their first time camping in a tent, especially without their families. Many of these students expressed appreciation for the experience and the desire to do it again. That said, most of them had not been able to actually go camping

again, which the authors suggest may be due to their lack of independence as minors. The students from NCI also shared many environmental stewardship behaviors they had implemented into their current lives. They attributed these behaviors to what they learned during the program. These were mostly personal behaviors readily applied at home, such as turning off the water when not in use and not wasting food.

Participants of the Teton Science Schools program reported the knowledge gained in the course had been directly applied to their daily lives, recreational pursuits, and work. Many of the students in the program were regularly partaking in outdoor recreation activities both before and after participating in the course, and so were able to put to use specific knowledge about the outdoors, such as how to look at snow layers and predict the avalanche danger. The students also credited their experience from the course with inspiring greater enthusiasm for environmental stewardship, especially with regard to learning about and caring for the local landscape.

The participants shared that the ROEE program had also significantly helped them with their social skills (considered a directive function) and had served for years as the basis of social interaction (a social function). Social skills included learning to work with others, make new friends, and be more outgoing within group settings. The memories served as a basis for social interaction by being a source of shared experience that facilitated reminiscing with friends who also attended the program. The memories were also shared with family and friends who did not attend the program, which promoted participation in the program by younger students and siblings.

Some of the shared memories seemed to serve a self-function, which are the memories that give a sense of continuity to one's life. Many students reported the trip was one of the most memorable experiences of elementary school and, overall, a fun and positive one. The authors propose that these types of memories may relate to self-confidence and a sense of empowerment needed to pursue environmental goals.

THE BOTTOM LINE:

This study is one of the first to explore the use of memories as a measurable outcome of environmental education experiences, considering whether these memories can be used to evaluate the long-term effectiveness of a program. Using the three memory-use categories defined in the psychology literature—self, social, and directive—the authors investigated the different ways in which memories of a residential environmental education program had impacted students' lives, as reported five years after the experience. Results showed that the memories served a variety of functions that were aligned with environmental education's goals, such as promoting environmental stewardship and an interest in outdoor recreation.

Liddicoat, K. R., & Krasny, M. E. (2014). Memories as useful outcomes of residential outdoor environmental education. *The Journal of Environmental Education*, 45(3), 178–193.

EVALUATING AN EXPERIENTIAL FAMILY OUTDOOR EDUCATION PILOT PROGRAM

No Child Left Inside (NCLI) is a U.S. national movement encouraging youth to spend more time in nature, with the intention of increasing environmental literacy. The movement was initiated as a direct response to the growing disconnect between youth and nature, a trend attributed to technological advancements, people's increasingly complex daily lives, and the No Child Left Behind Act of 2001. This Act refocused core K–12 curriculum on reading, mathematics, and science, leaving little time for other subject areas, including environmental education.

In 2012, an NCLI pilot program implemented in Cache Valley, Utah, sought to address this disconnection with nature within the local community through an annual week-long environmental education program available to families. Each day of the week included two educational sessions, which were led by volunteer naturalists and held at city parks, campgrounds, and other similar locations. The organizers designed each session to connect to the

Utah Core Curriculum and focus on specific topics such as bugs, rocks and basic geology, edible plants, snakes and reptiles, birding, and fire safety. They designed the sessions to be hands-on and experiential, encouraging participants to, for example, touch living animals, catch and identify water insects, and investigate bug collections. The sessions also included activities that attempted to connect the on-site session back to participants' homes; these activities included backyard birdhouse kits and nature journaling. The study on which this article reports assessed the program's influence on children's enthusiasm for nature-related behaviors, as well as the program's ability to reach all children regardless of demographics.

To evaluate how this program influenced children's enthusiasm for nature-based activities, the authors administered "post-then-pre" surveys, which were given at the end of each session and allowed children to reflect on their after-program and before-program attitudes. Children, with the assistance of their accompanying adults (parents, grandparents, or other guardians), answered 10 questions related to environmental attitudes and behavior on a Likert-type scale. The first eight questions focused on children's excitement toward nature, such as "How excited are you to go exploring in the backyard?" and "How excited are you to learn more about wildlife, nature, or forests?" The last two questions focused on recycling, an environmental behavior that did not take place during the educational session, but that may have been impacted due to an overall increase in environmental awareness.

Adult participants took a demographic survey, which collected data related to age, household income, highest level of parental/guardian education, religious affiliation, marital status, race and ethnicity, and whether the family unit participated in or belonged to environmental conservation groups. The purpose of this survey was to evaluate whether the program participants represented the overall regional population or a fraction of it.

Of the 481 participants who attended 1 or more of the 11 educational sessions (this does not include children under the age of 1), 54 children (17%) and 31 adults

(20%) completed the survey. Those who completed the children's survey ranged from age 2 to 13, with more male children (64%) than female (36%) attending the environmental program.

Notably, children expressed increased excitement for each of the environmental behaviors represented in the survey after participating in the program. While these results are encouraging, they do not give insight into long-term excitement or participation in environmentally related behaviors, although similar studies conducted over an eight-month period indicate retention.

A closer look at the increase in excitement after participating in this NCLI pilot program shows an average increase of 0.7 on the 5-point Likert-type scale used in this instrument. While this is not a large change, it may be enough to suggest an overall increase in curiosity, interest, and willingness to explore the outdoors. Smaller increases were reported for the two questions on recycling; this may perhaps reflect the fact that the behavior of recycling was not addressed directly in the program.

Although the program clearly increased child participant enthusiasm toward nature, it did not effectively represent the demographics of the region. Latinos comprise 10% of the Cache Valley, but had no representation throughout the week of programs. With Latinos representing the fastest growing demographic group in the United States, it is critical that environmental education programs find ways to reach out and explicitly welcome participants from the Latino community. Barriers with this group may include unfamiliarity of environmental programs, language, or cost. The authors did not explain how participants were recruited for the programs in this study.

Another interesting result from the demographic survey was the lack of participation in prior environmental conservation programs. More than half (58%) of families reported that they had never participated in an environmental conservation program before, and a quarter of families (23%) reported that they participated in an environmental conservation program only once a year.

THE BOTTOM LINE:

Giving families opportunities to engage in hands-on, nature-based activities—such as exploring natural areas and learning about wildlife—can increase children’s excitement toward environmental behaviors. This enthusiasm can continue to be fostered through activities in the program that connect the program with the visitors’ home environment, such as birdhouse building kits or backyard scavenger hunts. Nature journals can also help youth record and recall environmental experiences, extending the impact of the program. To recruit participants accurately representing the demographics of the community, additional efforts may be necessary, such as creating program flyers in various languages, advertising at cultural centers, and providing scholarships to low-income families.

Brand, J. C., Radel, C., Brain, R., & Greene, J. (2014). Developing, implementing, and evaluating a No-Child-Left-Inside pilot program. *Applied Environmental Education & Communication*, 13(4), 261–268.

MODEL FOR DEVELOPING AND ASSESSING CIVIC ENVIRONMENTAL ENGAGEMENT PROGRAMS

There are a variety of perspectives on the impacts of human activity on the environment, but many people believe creating a more sustainable future requires a fundamental cultural transformation. Individuals who rethink patterns of human activity to consider their implications and chart a new course through changes in actions, policies, or other means can help create this transformation. How to achieve such shifts, however, remains unclear. There are different ideas in the literature and others in practice, yet increasing civic engagement stands as a common guiding principle across them.

Recognizing that youth and young adults are a particularly critical group to include in civic environmental engagement, this paper’s authors propose a five-part model to identify gaps in the environmental education literature, develop research priorities, and guide the development

and evaluation of programs. The researchers propose that too little is known about which nonformal programs are effective in engaging young people and what qualities of these programs make them effective. Thus, this paper’s objective is twofold: first, to develop a model that can be used by practitioners, and second, to demonstrate the need for empirical studies that test the model in order to strengthen the outcomes of youth engagement programs.

To inform development of the model, the authors draw from the youth civic engagement literature and the empirical environmental education literature. Together, these bodies of literature focus on various elements of youth-based programs. Because there are many definitions and interpretations of engagement, the authors define engaged citizens as “members of society who are aware of their rights and responsibilities in society and actively participate in shaping the system norms, resources, regulations, and operations.” Given this definition, fully engaged citizens are those individuals who are conscious of how different parts of the system interact with each other and affect the lives of community members and others. Empowered to act and inspire action, engaged citizens recognize that they can individually and collectively influence various societal factors that shape those outcomes. The authors emphasize a distinction between behaviors and actions by acknowledging that actions are intentionally or consciously adopted with clear motivation and reasoning, as shown in the literature.

The authors focus on youth for a number of reasons, although achieving the transformation needed to address sustainability requires civic engagement at a broad scale. The period of adolescence is a critical time of transition as youth move into adult roles and responsibilities. In the course of human history, youth and young adults have been at the forefront of many transformational movements. Young people may also serve as messengers for other members of society, carrying the reasons and motivations for action into their homes to reach across generations. They also tend to take more risks than older members of society and have more available time to focus on issues of concern or interest. To engage this population, the

authors justify a clear need for a systematic approach for developing and evaluating youth engagement programs that are informed by theory and practice.

The model the authors developed consists of five components: (1) engagement activity; (2) engagement process; (3) initiating and sustaining factors; (4) mediators and moderators; and (5) outcomes. They describe the first of these components, engagement activity, across three dimensions: objectives, structure, and quality. Objectives describe the types of environmental actions. Structure refers to how the program experience is shaped by the density of activities, such as those that occur over a long time period or others that are relatively more intense and concentrated, such as summer camps or youth conferences. Program leadership, or the level of youth engagement in planning and governance, also contributes to structure. The participant experience, such as finding the activities meaningful, helps define the program quality.

The second component of the model, the engagement process, refers to the ways in which youth interact with the program and is defined by three factors: intensity, breadth, and duration. Intensity is how frequently youth participate in the activities, along with other factors such as what kinds of emotional responses or knowledge the program generates. Breadth refers to the diversity of activities, and duration refers to the consistency of the youth participants' engagement over time and the amount of time spent on activities. The authors identify "motivation(s) to become engaged and remain engaged" as initiating and sustaining factors (component 3 in the model) and recognize that these factors occur across multiple levels: individual, social, and system. Mediators and moderators (component 4) encourage, interfere, or interact in other ways with the engagement process to affect its outcomes. And finally, the authors organize outcomes (component 5) with respect to individual, social, system, and environmental results.

Overall, the authors of this paper propose a simple, tractable model for practitioners to use in designing and evaluating youth programs. In the paper itself, an extensive list of questions is included for consideration in program development and evaluation for each model

component in an effort to improve civic environmental engagement. The model, and the associated list, could be used as tools in program development, implementation, and assessment.

THE BOTTOM LINE:

To continually refine and improve environmental education programs, it is important to measure both the short- and long-term impacts on students. Programs with long-term goals especially need to include milestones along the way with measurable objectives; in this way, program administrators and educators can better understand whether and how their educational programs are achieving their intended goals and objectives. These measurable objectives can provide helpful tools for iteratively improving program design by learning from the various factors, such as structure and program quality, that together determine its effectiveness. A model, such as the one described in this paper, can help administrators and educators consider evaluation and program success through a careful and systematic process.

Riemer, M., Lynes, J., & Hickman, G. (2014). A model for developing and assessing youth-based environmental engagement programmes. *Environmental Education Research*, 20(4), 552–574.

WORD ASSOCIATION TASK MEASURES PERCEPTIONS OF CLIMATE CHANGE

Understanding climate change is elusive. Climate change cannot be seen, touched, smelled, or heard; it is intangible and, therefore, to understand it, it must be conceptualized. Accurately communicating and conceptualizing climate change is challenging as it has a vast scale and magnitude, is layered in complexity, and is riddled with uncertainty. Furthermore, studies demonstrate that individuals' environmental and political views strongly influence how they perceive climate change. Some perceptions can be counterproductive to accurately understanding climate change. Prior research, for example, has found that 61%

of Americans associate climate change with geographically and psychologically distant events. This sense of distance can generate feelings of disempowerment or avoidance of an issue that is perceived to be too large and overwhelming or someone else's problem.

The authors of this study used a word association task to understand how different groups in Australia—scientists, government employees, and community members—perceive climate change. In this task, participants wrote down the first words that came to mind when thinking about climate change. The task was included as part of an online survey, which had 5,036 respondents from metropolitan, regional, and rural Australia. A nearly identical survey was also administered at a scientific conference on climate change (n=103), to the Victoria State Government Department of Sustainability and Environment (n=68), and to members of the general public (n=229). The first three words of each respondent were collected, amounting to 8,650 words total.

The data were organized based on the self-identification of the respondent, categorized by three groupings: (1) scientist (including academics and researchers), (2) government employee, and (3) community member. Words were homogenized to account for semantic differences, and the frequency magnitude for each word was calculated to account for differences in sample sizes among the different groups.

The word most frequently used by all three groups of respondents was “hot.” Other frequently used words and phrases were: dry, weather, pollution, global warming, sea level, carbon dioxide, water, and melting ice caps. These words and phrases illustrate a common perception of the tangible, physical effects of climate change on the environment.

Commonalities of climate change conceptions were also seen within different groups. Government employees, for example, associated climate change with issues and impacts they expect to confront, such as disaster,

food security, water, and future. Responses received from scientists and community members shared more commonalities than government employees and elicited responses demonstrating a conception of cause and effects (e.g., temperature, storms, and flooding), as well as social responses (e.g., politics). Scientists were more likely to associate climate change with attributes of weather, such as weather changes and extreme weather, and made associations with the nature of climate change as uncertain, inevitable, and adaptable. Community members were more likely to associate climate change with causal effects, such as pollution, and the consequences of climate change, such as dry and melting ice caps.

These elicited responses illustrate a tangible perception of climate change among Australians. Although this does not mean respondents agree with these associations, they are aware that these associations exist, increasing the possibility of public discourse. Some challenges to this discourse may be the perceptions of weather versus climate. Scientists, government employees, and community members shared a number of word categories relating to weather, which suggests a lack of understanding about climate and climate change. Personal experiences with local weather, for example, influence perceptions of climate change, highlighting misconceptions between weather and climate. Another challenge, and concern, is the lack of anthropogenic-related responses from community members (e.g., mass migration due to sea-level rise and famine). This suggests a perception of climate change in which human activity is not an influencing factor.

As exhibited by the use of the term “inevitable” by scientists, the impacts of climate change can no longer be avoided. To that end, scientific and research institutions are shifting their focus from mitigation and intervention to adaptation. The question has become: How do we adapt to the changing climate? While “adapting to climate change” is a phrase increasingly used by scientists, nonscientists have not yet adopted this new perception, suggesting a miscommunication between scientific and nonscientific communities.

THE BOTTOM LINE:

Climate change is a large, abstract topic and, therefore, people often hold different perceptions—and misperceptions—about what it is, how it is caused, and what to do about it. A quick way to assess people's understandings or misunderstandings about climate change or to motivate an open discussion about the topic is to invite them to list all the words they associate with climate change. The larger brainstormed list can be shared with the group as a prompt for discussion or can be typed into an online word-cloud generator to see which types or clusters of words appear most frequently. Such strategies can be used pre- and post-assessment to bookend units on climate change and, in a classroom setting, may also help quickly ascertain student preconceptions.

Moloney, G., Leviston, Z., Lynam, T., Price, J., Stone-Jovicich, S., & Blair, D. (2014). Using social representations theory to make sense of climate change: What scientists and nonscientists in Australia think. *Ecology and Society*, 19(3).

BEST PRACTICES IN ENVIRONMENTAL EDUCATION AND PROGRAM EVALUATION

The authors of this paper conducted a literature review to understand current approaches to environmental education program evaluation. Specifically, the study considered best practices in environmental education, focusing on the criteria for “best practices” as indicated by the North American Association for Environmental Education (NAAEE) and its published *Guidelines for Excellence in Environmental Education*, with a particular emphasis on how NAAEE suggests different EE programs and initiatives might be evaluated in different settings.

The literature review included studies published between 1999 and 2010; the researchers used keywords such as “environmental education” and “evaluation.” The authors vetted articles by reading the articles' abstracts, and they ultimately selected papers that described programs that

served participants in the 4-to-18-year-old age range. Selected articles included an evaluation component and a description of the program, resulting in evaluated practices that included active participation, place-based learning, project-based learning, and outdoor instruction, among others. In all, this literature review highlighted 21 teaching practices, which were derived from 66 articles describing 86 environmental education programs that were included in the review.

Following selection of the articles, the authors coded the papers for mentions of best practices and for learning objectives such as increased environmental knowledge, awareness, skills, attitudes, intention, behavior, and enjoyment. The authors also coded whether the findings related to the learning objectives of the program were null (no significant results), mixed (significant results for fewer than 50% of participants), or positive (positive outcomes for at least 50% of the participants).

Of the 86 programs mentioned in the articles, 49 were in the United States. The sample included a mix of residential programs, field trips, and those involving a classroom component. Evaluations of these programs included both qualitative and quantitative approaches, and 35 were classified as mixed methods. Most evaluations included a comparison of pre- and post-experience responses to surveys, although some studies only measured post-experience outcomes or included a delayed measure that considered the persistence of effects in the months after the program ended.

Experiential education, issues-based education, and direct contact with nature were among the most frequently offered explanations for program success, although few of these hypotheses included accompanying empirical data. Empowerment (i.e., measuring locus of control, self-efficacy, or self-confidence) and student-centered learning were also supported by the literature as effective practices. Knowledge was the most commonly tested and reported outcome, followed by attitude change. Behavior and awareness were the least commonly tested outcomes.

Largely, this review found that environmental education program evaluation often does not look deeply enough at the ability of various education practices in achieving desired outcomes. Instead, evaluations are primarily summative and/or focused narrowly on an isolated program. Most studies in this review, for example, provided circumstantial—rather than empirical—evidence to suggest a link between the program and the appearance of a desired outcome. The authors suggest that future evaluations focus more intentionally on determining the factors that contribute to a program's success, instead of trying to only understand whether a program succeeded or failed.

THE BOTTOM LINE:

Although progress had been made in terms of environmental education program evaluation practices and use, more emphasis is needed to understand outcomes other than knowledge and attitude change, such as behavior change. For evaluation studies that are published in the peer-reviewed literature, researchers should consider looking more deeply at the connections between desired outcomes and the teaching practices that most effectively bring about those outcomes. This will enhance understanding of what makes environmental education successful.

Stern, M. J., Powell, R. B., & Hill, D. (2014). Environmental education program evaluation in the new millennium: What do we measure and what have we learned? *Environmental Education Research*, 20(5), 581–611.

TEACHING METHODS

THE PROMISE OF OUTDOOR EDUCATION IN SCHOOLS

In most school settings in the United States, elementary students have limited opportunities to learn in outdoor settings, yet recent research has demonstrated several positive benefits associated with such opportunities. In this article, the authors provide a brief literature review of various positive impacts of outdoor education on achievement, behavior, and environmental attitudes. Additionally, the authors highlight several practical outdoor activities and suggest useful resources for classroom teachers.

Previous research has shown connections between frequent outdoor learning experiences and enhanced science achievement in students. Guided by a properly trained teacher, outdoor learning opportunities can result in greater student engagement and higher science achievement. Often, these outdoor learning experiences serve as a means to increase scientific content knowledge and develop environmentally conscious students. Even learning in familiar outdoor settings, such as schoolyards, helps students engage with, and form attachments to, the world around them. In particular, the authors of this article noted that their students—elementary-aged students from a public K–5 school in the Pacific Northwest—showed increased academic success when given the opportunity to learn outside.

Previous research has demonstrated positive benefits of outdoor learning, beyond engagement and academic outcomes. When students were given unstructured time to play outside, classroom behavior often improved and teachers experienced easier classroom management. With such unstructured time outdoors, students may also develop positive environmental attitudes. Hands-on, experiential learning has also been linked to physical and emotional development, in addition to cognitive development.

Based on their literature review, the authors offer several suggestions as to how to effectively incorporate outdoor experiences into school learning. Specifically, they emphasize the use of schoolyards. To encourage play within natural landscapes, schools can integrate native plants, nature-inspired play equipment, and school gardens into existing schoolyards. In urban areas, setting up bird feeders,



building portable planter boxes, or planting rooftop gardens can all be effective ways of supporting outdoor learning. For schools with easier access to natural areas, the authors suggest using nearby fields, forests, streams, or gardens as the context of lessons. When children engage in learning outdoors, teachers should emphasize the use of the five senses. In getting children to use their senses and describe observations outside (such as asking, “What do you notice when you try to wrap your arms around this tree?”), teachers help students develop basic science concepts.

Because outdoor learning can enrich and deepen scientific understanding, the authors recommend that teachers infuse their current curriculum with outdoor learning experiences. Additionally, the authors provide links to specific resources (such as the Children and Nature Network, the Pacific Education Institute, Project WET, Project Learning Tree, and Project WILD), as well as practical examples, supported by research, of outdoor science activities that teachers can implement in schoolyard settings. The following list, adapted from the article, suggests key science learning concepts and environmental education activities that help build basic science skills.

- **Observing:** Encourage local wildlife in the schoolyard with bird feeders and native plants; allow students to observe an insect’s life cycle or note how other plants and animals or the seasons change over time.
- **Classifying:** Students can group living and nonliving things based on unique characteristics.
- **Measuring:** After observing similarities and differences in native plants or animals, students can use that knowledge to measure new outdoor discoveries.
- **Communicating:** Students can keep a science journal to note their outdoor observations and use the journal during class discussions.
- **Inferring:** Students can use their senses to investigate a plant or animal outdoors and then make a conclusion about why that living thing is able to exist in the schoolyard, or draw a conclusion about other places students would find those plants or animals.

THE BOTTOM LINE:

Outdoor education opportunities should be a priority in education. Schools should provide access to outdoor settings on school property and teachers should integrate outdoor experiences into traditional curricula as a means to enhance science learning. By engaging students with outdoor learning experiences, schools help support science achievement and engagement, as well as encourage positive environmental attitudes within students. Schoolyards are often effective places for outdoor learning experiences. Practical means with which to enhance schoolyard learning experiences include building school gardens, constructing bird feeders, and incorporating native plants.

Rios, J. M. & Brewer, J. (2014). Outdoor education and science achievement. *Applied Environmental Education & Communication*, 13(4), 234–240.

IGNITING A LASTING INTEREST IN SCIENCE

Several studies have documented declining student interest in science and science-related careers in the United States. An active interest is what motivates people to continue learning and engaging with issues involving science throughout life. There is concern, therefore, that declining student interest in science will lead, overall, to a less scientifically literate and engaged population. This study sought to identify factors that ignite student interest in science, not just during the particular activity, but also over the longer term. The researchers reviewed empirical studies as well as theories on sparking student interest in science.

Based on the authors’ literature review, they first provide a comprehensive overview of the nature of interest. Rather than trying to define interest, they present three characteristics of interest that reflect commonly recognized views of scholars. These three characteristics of interest are: (1) interest biases individuals toward feeling satisfied and enjoying certain activities as they occur, and it also encourages individuals to reflect more fondly on

memories of those activities; (2) interest disposes people toward seeking out additional experiences with the object or activity of interest; and (3) interests are changeable, and how quickly they change depends on the degree of internalization, which occurs when something is deemed as meaningfully relevant to a person's life. The more internalized an interest, the deeper the roots, and the less likely a person is to radically change his or her interest in the topic.

The next topic the authors review in depth is the difference between situational and personal interest. Situational (or direct) interest is the attention and enthusiasm for a topic or activity in the moment it is encountered. Individual (or indirect) interest is characterized by a disposition or personal preference for a subject. To illustrate this difference, the authors provide an example of situational interest as being riveted by a shark display at the aquarium and individual interest as liking anything to do with sharks or identifying one's favorite subject as marine biology. Situational interest that is reinforced through further engaging in related activities and other forms of positive feedback has the potential, over time, to develop into an individual interest.

The specific issue the researchers wanted to address in this study was how to bring about a positive change in interest in students' negative attitudes toward learning science. In other words, the researchers asked, "How can a teacher ignite situational interest in a student who is not interested in science?" And then, "How can this situational interest in science be reinforced to become a personal interest?" To answer these questions, the authors reviewed empirical studies published in science education journals between 2003 and 2013 related to the terms *situational interest* and *individual interest*.

This review revealed three stimuli that were consistently noted for positively effecting change in students' negative interest in learning science, which the authors coined as follows: (1) heat of novelty, (2) fuel of involvement, and (3) oxygen of meaningfulness. These three stimuli, arranged in a triangular diagram where each stimulus

comprises one side, is what creates the Interest Combustion Triangle (ICT).

The heat of novelty refers to activities that trigger students' situational interest. Based on their review, the authors outline several types of experiences that increase the heat of novelty. These experiences: (1) are unexpected, suspenseful, or surprising; (2) are different from those normally encountered in class; (3) produce feelings of success when doing science; (4) promote practical work; (5) provide a variety of choices and give students autonomy; and (6) teach students by combining teaching with play. Studies have also shown that science teachers who present a sincere and nonjudgmental concern, and listen to their students' ideas or questions about science, also tend to ignite science learning. All of these aforementioned techniques elicit positive emotions. Another way to spark novelty in learning is by provoking cognitive conflict in the student. In other words, this novelty can be sparked by identifying a misconception held by a student, acknowledging it, and presenting the correct scientific view—or better yet, by helping the student discover the correct understanding for him or herself.

The fuel of involvement refers to engaging students in activities so that they feel autonomous and/or socially related to others. Hands-on and personal activities are one way to promote autonomy in learning and to allow students the chance to internalize the meaning of the subject matter. This autonomy in learning also makes it more likely the student will feel personally connected to the material and start to develop an individual interest in the subject. Social and group activities can also be a way of fueling involvement; these activities can also connect the subject matter with something personally relevant to most students: their friends. Overall, the fuel of involvement is about finding ways to maintain student interest so that the initial heat of novelty does not dissipate.

Finally, a robust fire of interest requires the oxygen of meaningfulness. This means helping students discover ways that the material is personally relevant to their lives and/or connected to what they already know about

science. If students feel the material is relevant, they are more likely to want to accommodate that material in their understanding of the world. Finally, students are also more likely to then develop a sense of ownership and internalization of the subject matter.

The authors proposed a teaching strategy for implementing the ICT, which they call K-W-L2-R, based on an established teaching method called K-W-L (Ogle, 1986). The strategy includes a series of five questions on which teachers and students can reflect together. The first two questions are asked before the activity: (1) “What do we Know?” and (2) “What do we Want to find out?” After the activity, the next three questions are asked: (3) “What did we Learn?” (4) “What do we still need to Learn?” and (5) “How Relevant is this learning to my life?” This teaching strategy covers all of the aspects of ICT. It can help students feel like teachers listen to and understand them; it can also help students and teachers discover cognitive conflicts, which fuels a sense of novelty and initial interest. K-W-L2-R allows for involvement and further inquiry, and it can also help students discover how the material is meaningful to their lives.

THE BOTTOM LINE:

Igniting a sustained personal interest in science or environmental issues is critical for fostering lifelong learning and engagement. The Interest Combustion Triangle (ICT) provides a framework for lighting and sustaining the fire of interest. The three sides of the ICT are: (1) heat of novelty, (2) fuel of involvement, and (3) oxygen of meaningfulness. The first step is sparking students’ initial interest with novel and exciting experiences. The second step is to give students the opportunity to be involved through hands-on learning or group activities. And finally, the third step is to find ways to make the material meaningful and personally relevant to students’ lives. This ICT framework can be applied to teaching any subject material.

Jack, B. M., & Lin, H.-S. (2014). Igniting and sustaining interest among students who have grown cold toward science. *Science Education*, 98(5), 792–814.

STRATEGIES FOR INTEGRATING STUDENTS IN CAMPUS SUSTAINABILITY PROJECTS

Local issues of sustainability have become part of the dialogue at university campuses. To that end, over the past decade, campus sustainability initiatives have proliferated throughout the United States. These initiatives have mostly focused on recycling programs, energy usage, and carbon footprints. A concurrent trend is the broadening of these initiatives to include campus land management, comprised of plant and soil stewardship as well as the restoration and protection of vulnerable areas. Examples of campus land management projects and corresponding research suggest the importance of student–administration collaboration, but none have outlined a framework to create or replicate successful collaborations.

Using a land management and safety intervention at Cornell University, this paper’s authors qualitatively studied the process and potential for students to collaborate, act, and learn from on-campus land stewardship. They used a conceptual framework called adaptive co-management (ACM), which encompasses social learning, shared action, and social capital or networking. When applied to management, ACM is accomplished through learning-by-doing, flexibility, interdisciplinary and evolving solutions, and power-sharing on multiple levels. It is often used in complex, interconnected, and uncertain or changing issues, such as those that might be encountered with land management. This framework provided structure for interviews with students and was also used to measure the extent of student involvement.

The issue at stake in this study involved two creeks that flank Cornell University. The northern Fall Creek, its associated gorge, and trails comprise 26.5 acres of natural space. Students travel to class by crossing one of the many bridges suspended over the creek and are able to enjoy the scenic views and natural habitat, as well as the drinking water and hydroelectric power the creek provides the university. Friends of the Gorge (FOG), a student organization, was founded in 2008 after a series of drowning incidents. The goal of

FOG is to balance gorge safety, recreation, and stewardship. Issues surrounding the gorge were compounded in 2010 with six suicides that occurred off the gorge bridges. These tragedies prompted the university to build tall chain-link fences along all campus and nearby city bridges. In an effort to find permanent solutions, university administrators invited FOG students to participate in discussions. The authors studied this discussion process to decipher evidence of ACM, as well as its usefulness in campus sustainability initiatives.

The researchers invited 10 undergraduate students who had been the most active in FOG weekly meetings to participate in 30- to 60-minute semi-structured interviews. The interviews were conducted in fall 2011, which was less than a year after the six suicides and after the fences had been constructed. Interviews were recorded, transcribed, and coded using predetermined codes generated from relevant literature. Unexpected and contradictory codes were also used to assess the validity of the study. The findings revealed five interrelated themes that all pointed to the use of ACM: engagement in the policymaking process, shared action, involvement and civic leadership, diversity of friendship, and systems orientation. Following, each of these themes is discussed.

After the suicides, students expressed mistrust toward university administrators and also strong emotional responses regarding the unsightly chain-link fences. Engaging in the long-term policymaking process allowed students to learn of alternative perspectives, ask questions, contribute their opinions, and reformulate their own position based on their learning. One student reflected, "As we've had discussions among ourselves and with university officials, as we've sat in on talks, all of our viewpoints have matured."

This social learning experience also generated motivation for shared action. FOG members compiled all viewpoints and wrote a position paper about balancing gorge safety and access to these natural areas. This shared action was also expressed through the involvement and civic leadership students demonstrated as they involved other student organizations, participated in trail maintenance, and made

and installed safety signs along the trails.

The learning experiences and collaborative participation forged diverse friendships between students across academic majors and social scenes. During the interviews, students discussed their collaborative work with fraternities to organize trash pick-up events in the gorge and how these events brought a diverse array of students together while creating environmental learning experiences for those not involved in environmental-based organizations.

Finally, students spoke of their new understandings of integrated human-natural systems, how humans are part of nature, and how thoughtful stewardship is both healthy for humans and the environment alike.

Finding successful solutions to the bridge safety, gorge accessibility, and natural aesthetic issues demonstrated how students engaged in social learning, social action, and social networking. These findings suggest that ACM framework could be useful in understanding, designing, and evaluating campus sustainability efforts.

THE BOTTOM LINE:

Increasingly, students are becoming involved in campus sustainability projects, such as plant and soil stewardship, restoration projects, and land management. Their involvement provides opportunities for collaborative learning, networking, and the development of critical skills for being engaged citizens. Adaptive co-management (ACM) is a framework that provides helpful tools for students and administration considering collaboration on campus projects. It highlights the importance of social, or collaborative, learning and actions, and creating opportunities for social networking. ACM also highlights the importance of developing interdisciplinary and evolving solutions as well as allowing students to share in the responsibility, as well as the power, to enact change.

Krasny, M. E., & Delia, J. (2014). Campus sustainability and natural area stewardship: Student involvement in adaptive comanagement. *Ecology and Society*, 19(3).

ENVIRONMENTAL IDENTITY DEVELOPMENT IN HIGH SCHOOL ENVIRONMENTAL SCIENCE COURSE

During the past decade, high school environmental science courses have gained prominence, exposing more youth to environmental topics. Yet, little research exists on how the curricular content and activities of these high school courses influence students' relationships with the environment. This ethnographic study investigates how various environmental science activities impact students' environmental identities, which the authors of this study define as the connection one feels toward the natural environment.

The study took place at a northeastern U.S. public high school, which serves both rural and suburban students. The environmental science course was a lower-level elective course, which many students signed up for as they considered it a less-challenging alternative to chemistry. (Both courses meet the physical science course requirement.) The class was comprised of 17 students in 10th to 12th grade (ages 15 through 20); of these, 10 students elected to participate in the study. The researchers interviewed the students at the beginning, middle, and end of the semester and asked the students to reflect on their reactions to the course activities, how their behaviors and beliefs changed (or did not change), and which activities they found to be most influential. The researchers also interviewed the teacher on these three occasions; questions focused on goals for the course and if they had been met, as well as perceptions of the impact of activities on students. In addition to interviews, the author conducted participant observations, videotaped class sessions, and observed dialogues between students and the teacher. These additional forms of data collection were used for triangulation purposes; the researchers then compared data collected through those means with the interview data.

From the student interviews, four course activities emerged as being particularly influential: (1) an ecological footprint lesson and inventory of everything the students

owned; (2) a field trip to a local landfill; (3) a town meeting regarding wetland development; and (4) a class debate regarding drilling in the Arctic National Wildlife Refuge.

For each activity, the author coded student interview responses for themes demonstrating the affirmation or disconfirmation of identity, environmental identity, and identity "confusion." The ecological footprint activity, for example, required students to reflect upon their consumer identities and how their consumer-materialistic lifestyles influence the environment. Students spoke of "feeling personally bad" that their consumer actions led to so much environmental destruction, an emotional response suggesting the disconfirmation of student consumer identities. Furthermore, students spoke of wanting to change their behaviors by "buying less stuff." This response reflects the strengthening of student environmental identities. Additionally, the author noted the ecological footprint activity provided an effective model for coupling experiences that provoke negative feelings with empowering ones, such as how to minimize personal waste.

The affirmation of environmental identities was demonstrated in the trip to the landfill, which included a tour of the recycling facility. This experience focused on the local environmental issue of linear waste streams and how waste, instead, can be used as a resource. During the interviews, students positively reflected on how the landfill facility worked to keep the surrounding wild habitat free of contamination and converted emitted methane into energy for a local university. This activity affirmed students' environmental identities with a real-world, local example of pro-environmental action. It also gave them concrete ways to participate by promoting recycling and reuse efforts at school and home.

The wetlands town meeting also focused on a local environmental issue: the development of affordable housing on local wetlands. The wetlands are a popular public recreation area and were familiar to many students. In addition, some students lived in affordable housing, allowing them to connect with and personally relate

to this environmental issue. For the meeting, students were broken into groups of two or three and assigned roles, which included developers, social workers, bird enthusiasts, and recreational users of the land.

During the post-meeting interviews, students noted the importance of understanding multiple perspectives from various stakeholders. Some students felt convinced by all arguments made; they spoke of being “right in the middle” and neutral about what to do. These comments indicate “identity confusion,” where the students were uncertain of how they feel. While considering various perspectives is imperative, educators must also promote critical thinking skills that help students weigh the different sides.

Identity confusion was also noted in the Arctic National Wildlife Refuge debate, which asked students to consider whether drilling should be allowed in the refuge. Students were assigned to either pro-drilling or anti-drilling sides and provided time to research and debate. While some students felt the debate affirmed the ideas they already had about anti-drilling, the majority of the interviewees spoke of understanding both sides, but not being able to choose “where they stood.” This, again, speaks to the importance of scaffolding argument assessment skills, as well as conflict resolution, negotiation, and consensus making.

THE BOTTOM LINE:

Whether teaching in formal or informal settings, it is important for environmental educators to reflect on how activities influence students’ environmental identities. To do so, educators must find ways to connect learning experiences to students’ lives, providing them with opportunities to reflect on their learning. Using local environmental issues as the context for learning activities makes learning relatable and pertinent for students, allowing them to see the complexity of environmental issues. Issues that are frequently in the news or currently being debated in government can also spark interest and engagement. So that students can successfully develop their identities and perspectives on environmental issues, educators must also foster critical thinking, problem solving, argument assessment, and consensus-making

skills. Otherwise, students can stall in “identity confusion” and the inability to weigh various arguments.

Blatt, E. (2014). Uncovering students’ environmental identity: An exploration of activities in an environmental science course. *The Journal of Environmental Education*, 45(3), 194–216.

CONNECTING ZOO VISITORS TO CLIMATE CHANGE

Communication of climate change issues has notoriously been difficult due to a high degree of politicization and trouble with making the topic relevant. Zoos and aquariums can address these challenges by presenting climate change as a relevant issue in a politically neutral space. The authors of this study predicted that visiting the zoo would correlate to feeling more connected to nature, which would relate to increased thought, interest, knowledge, and concern for climate change. The authors hypothesized that feeling connected to nature would correlate with having a more liberal political identity, engaging in pro-environmental behaviors, and having higher trust in zoos as sources of information.

To test their predictions, 7,182 visitors to 10 zoos and 5 aquariums were surveyed. Visitors were given one of two surveys, focused either on attitudes or behavior. The attitudes survey included 15 questions from the ‘Six Americas’ study on global warming (Leiserowitz, Maibach, & Light, 2009), an ongoing study about perceptions of the health consequences of global warming and key beliefs held by people living in the United States. The survey also included questions and statements about zoo experiences, connection to animals and nature, and general tendencies toward environmental behavior; for example, “Seeing animals at a zoo or aquarium makes me think about my concern for animals in the wild;” and, “Do you think that global warming is happening?”

The behavior survey contained eight questions related to climate change mitigating behaviors. Additionally, this survey included questions about perceived control over

climate change (self-efficacy), trust in the zoo or aquarium as an information source, awareness of climate change threats, sense of connection to animals at the zoo or aquarium, concern over climate change effects, religious and political opinions, and technology use.

Generally, zoo and aquarium visitors reported a moderate level of connection to both nature and zoo/aquarium animals. Those who were members of the zoo or aquarium reported a higher sense of connection, as did people who visited the zoo or aquarium often. People who reported a greater sense of connection also said they had a greater concern for climate change and felt a greater responsibility to take action. Furthermore, zoo and aquarium visitors who felt a greater connection to animals also had higher self-efficacy and a stronger belief in climate change. Individuals who reported a higher connection to nature and animals also tended to identify as more liberal and were more likely to see zoos as trusted information sources.

These results suggest that zoo visits can positively contribute to peoples' views on climate change by increasing their feeling of connection to animals and nature, and also making nature and climate change relevant. This information is important to consider when designing interpretive signage or exhibits; zoos and aquariums might consider building these experiences to encourage a sense of personal connection.

THE BOTTOM LINE:

Zoos and aquariums are politically neutral spaces where visitors can form and cultivate connections to nature and wildlife. When surveyed, people who said they visited the zoo or aquarium often, or were zoo or aquarium members, were more likely to feel this sense of connection and generally more concerned about climate change. Furthermore, a higher sense of connection was correlated with several positive cognitive and behavioral feelings toward climate change. These institutions can use this information to curate experiences that increase a sense of connection with animals and nature, thus also increasing concern, interest, and responsibility for broader global issues such as climate change.

Clayton, S., Luebke, J., Saunders, C., Matiasek, J., & Grajal, A. (2014). Connecting to nature at the zoo: Implications for responding to climate change. *Environmental Education Research*, 20(4), 460–475.

FOSTERING YOUNG CHILDREN'S AGENCY THROUGH SUSTAINABILITY EDUCATION

Young children have great potential to act as agents of change and contribute to long-term sustainability. Research to date has demonstrated that children's new ideas and solutions can reach other members of society through sharing with families. Children have the ability to initiate and participate in developing solutions to environmental problems; this has been discussed in a variety of contexts, including early childhood education for sustainability. Little is known, however, about what constitutes agency in early childhood education. In other words, what is it that makes children feel capable and able to take action with regard to sustainability issues? This study investigated what occurred when preschool-aged children faced a given problem and proposed solutions in the context of sustainability. The paper outlines a methodology for analyzing how children establish agency in formal preschool settings and describes a process that may be applicable to other types of learning experiences in sustainability education.

The researchers analyzed two experiences related to sustainability using video recordings made at a preschool in Sweden. The preschool has a pedagogical profile that focuses on the environment and sustainability and incorporates outside learning into its daily schedule. The videos recorded activities that were typical of the school's approach to learning about and engaging in sustainability issues. In total, the researchers analyzed 30 hours of video footage. The teacher had the intent of creating experiences related to sustainability by bringing the students outside and helping focus their attention on the world around them. The teacher encouraged the students to discover their own questions and challenges involving the natural

world. The researchers focused on two scenarios that unfolded: pea plants facing impending rain and a bird's nest disturbed by the sounds of nearby construction. The children in the study were 4- and 5-year-olds with "lively and wordy" verbal communication.

The researchers specifically assessed how children anticipated a sustainability problem, what choices they made in a course of action, and how the process was closed and fulfilled. The authors acknowledged many different dimensions of agency, such as connectedness, engaging with the environment, questioning, belief in capacity, taking a stance, and strategic action. Given these many dimensions, the authors chose to focus on children's connectedness to and engagement with the environment. Children's connectedness refers to how children relate to their surroundings in an emotional and spontaneous way. Engagement with the environment involves how children learn in and about the environment.

Examining how two small groups of students moved through each of these issues independently, the researchers drew upon the work of philosopher, psychologist, and education reformer John Dewey (1859–1952). Dewey argued that experience is interwoven continuously in the living process, and people achieve change through a variety of experiences. His notions of experience became known as his principle of continuity, where something is always carried over from one experience to the next. Every new encounter in the world involves actions and readjustments; from that viewpoint, agency emerges in the process. Continuity emphasizes that there is always a purpose attached to an activity.

Dewey described three key aspects to every experience of continuity: anticipation (a beginning); course of action (a development built on choices); and fulfillment (a closure when the purpose of the activity has been achieved). Through this framework, the researchers analyzed the verbal and nonverbal actions of the students in four stages: (1) discerning a problem by negative anticipations; (2)

negotiations of choices to solve a problem; (3) negotiations turning into physical action to solve a problem; and (4) improved activities and/or fulfillment. They used a type of analysis developed by other researchers—practical epistemological analysis—to discern how meaning was established between the students and their environment.

In the garden, two students (called by their pseudonyms Emma and Sara; all student names in this study are pseudonyms) quickly identified the rain as a potential threat to the pea plants. Together, the girls expressed a negative anticipation when they figured out the potential problem. Sara and Jonas, the third student in their group, then related what they were experiencing to what they had seen on television about plants that die. Instead of giving new directions or suggestions, the teacher directed her attention to the students' self-identified focus, and offered subtle agreement with their anticipation as to whether the plant would be destroyed by the rain. The group of students moved into problem-solving mode, with Sara first suggesting that they should build a shelter for the plant. Together, they began to draw possible structures that could protect the plants. The group moved into an iterative process where they negotiated choices (e.g., use of glass, wood, or a net for the structure) and became increasingly active through the problem-solving mode by acquiring more suitable supplies for the drawings and surveying materials at a nearby woodpile. From the course of action, they moved through a process toward fulfillment, as they settled together on an effective design. "This is really nice; we did it!" said Sara, establishing a positive aesthetic relation with their creation.

The researchers argue that all of the objects (such as the pea plants, boards, shed, drawing tools, woodpile, and net) and subjects (the children and the teacher) were involved in and connected within an open-ended process that involves student-led courses of action and subtle teacher approval that mirrors the approval of the students. A similar trajectory (i.e., problem anticipation, course of action, and fulfillment) unfolded when dealing with the bird's nest issue.

In both examples, the young children self-identified a sustainability issue that they cared about in the local garden and worked together to solve the problem by themselves. This type of learning experience enables students to enact agency with regard to solving environmental problems. This process facilitated students connecting and engaging with each other, the issue, and the environment across multiple scales—from the plant level to the broader surrounding environment—to foster key dimensions of agency.

THE BOTTOM LINE:

Students discover their sense of agency when they are allowed to identify a sustainability issue they care about, explore the problem, and discover both their individual and collective abilities to create solutions. Teachers can help foster these experiences by providing the learning setting for students to discover sustainability issues in their local environment and stepping out of the way to allow students to move through a problem-solving process. Teachers can positively reinforce the sustainability relevance of the issue identified and use other positive value judgments throughout the process to encourage the students' course of action. These types of activities can be used in sustainability education by taking students outside, working in a garden, or directing the attention toward other sustainability-related issues.

Caiman, C., & Lundegård, I. (2014). Pre-school children's agency in learning for sustainable development. *Environmental Education Research*, 20(4), 437–459.

PROFESSIONAL DEVELOPMENT

BARRIERS TO USING NATURAL OUTDOOR SPACES IN EARLY CHILDHOOD EDUCATION

Natural outdoor spaces can range from wilderness preserves to unmanicured spaces, such as an overgrown lawn or a small patch of nature under a stand of trees. The importance of bringing children into these spaces has been well established as a means of improving resiliency as well as social, emotional, physical, and cognitive development. Yet, these settings are still greatly underutilized in early childhood education. Stringent accreditation regulations and an increased focus on learning standards may explain some of the barriers, but the authors of this study asked whether the beliefs of early childhood educators regarding the value of outdoor education is also playing a role. This study explored the beliefs and practices of early-childhood educators to understand the predictors and barriers of using natural outdoor settings.

The study focused on 46 educators in early childhood programs (programs for children ages 3–4); these programs included preschools, childcare centers, and Head Start initiatives. The study took place in northern Minnesota in an area known for an abundance of green space, natural resources, and outdoor recreation. Participant educators answered a self-administered questionnaire regarding their beliefs about natural outdoor settings as educational resources. This included questions on the importance of natural outdoor settings for children's social, emotional, physical, and cognitive development. Educators were also asked about the importance of natural outdoor settings for developing children's appreciation for the environment. Educators reflected on their personal relationship with nature (nature relatedness) and reported the amount of time that they usually spent in nature, their concern toward nature, and their environmental behaviors. Finally, educators were asked how often they used natural outdoor settings while teaching. Educators who indicated natural outdoor settings as difficult to use wrote free responses regarding what they saw as the primary barrier to teaching outside in nature.

The findings demonstrated most educators agreed that outdoor experiences in natural settings are important for children to develop an appreciation for the environment (mean = 4.43, SD = 1.28, where 1 = strong disagreement and 5 = strong agreement). Educators generally agreed that outdoor experiences are important for young children's



social, cognitive, and physical development; even so, they rated the perceived difficulty of using these spaces as somewhere in between difficult and easy ($M = 3.00$, $SD = 1.41$). On average, educators indicated they use natural outdoor spaces for teaching only about once a month. The educators reported using maintained outdoor settings, such as mowed lawns, playgrounds, or landscaped parks, “often” or “once a week.”

The results indicated that educators perceived the primary barrier to using natural outdoor settings to be a lack of walking access and/or the need for public transportation to these sites. Other barriers included lack of time, winter weather, safety concerns, and lack of extra supervision for the students. Given the abundance of green space and natural environments where the study took place, these results surprised the researchers. Another surprising result was that educators did not report the trend of an increased focus on academics and decreased time allowed for free play in early childhood education as barriers.

In light of educator responses, the researchers developed several recommendations. They recommended that professional development efforts should focus on reducing barriers by considering teachers’ beliefs and practices concurrently. It is clear, for example, that teachers value the use of outdoor natural spaces with their students, but need support to put these values into practice. Professional development efforts can focus on teaching educators how to use natural outdoor settings in the winter, how to prepare children for outdoor experiences in a timely fashion, and how to minimize potential safety issues. Informal sharing among early childhood educators and support from environmental educators can provide help in recognizing nearby natural areas or in creating small patches of nature on school property. Discrepancies between educators’ beliefs and practices are well-reported and researched, highlighting the importance in providing educators with time to develop and implement best practices.

THE BOTTOM LINE:

Natural outdoor settings, ranging from wilderness preserves to unmanicured yards, are prime locations for

early childhood development. Early childhood educators generally understand this importance, but encounter practical barriers to taking their students outside, particularly in areas beyond the schoolyard or playground. In particular, transportation, winter weather, and safety concerns are primary barriers. Professional development could focus on minimizing these barriers while concurrently supporting educators with finding or creating nearby natural spaces. Educators’ experience with using a range of natural spaces can provide formal and informal training and support informal training to those with less experience in this realm.

Ernst, J. (2013). Early childhood educators’ use of natural outdoor settings as learning environments: An exploratory study of beliefs, practices, and barriers. *Environmental Education Research*, 20(6), 735–752.

CREATING SCHOOL BUILDINGS THAT TEACH AND ENCOURAGE SUSTAINABILITY

In the last several years, an increasing interest has led to increased resources being put into making school buildings more sustainable. The majority of these efforts have focused on the physical elements of green building, such as reduced energy consumption and indoor air quality. There has been much less attention given to the social dimension of what it means to create green schools and how building design can facilitate that. This article explores the idea of using school design to teach about, and support the teaching of, environmental issues. The author proposes a framework called the Teaching Green Building Model for Learning (TGB model). This model can be used to consider dimensions of how a school building, the people within it, and various teaching strategies can all interact to encourage environmental education within a school.

One of the most common ways to use a green building to teach about environmental issues is to put up signage that provides, for example, information on environmental features of the building or reminders to recycle. Although

this is a good place to start, this type of teaching is passive and individual and allows limited opportunity for discussion and activity. One of the author's primary goals in this paper was to expand the sense of possibilities for how to use a building to teach by including space for social interaction, discussion, and physical engagement. To do this, the author researched several schools that have already instituted TGB features. She also incorporated theory from environmental education, architecture, and museum studies.

The TGB model presented in this paper includes three spectrums of engagement: (1) formal to informal engagement, (2) passive to active engagement, and (3) individual to collective engagement. Engagement in all of these cases can involve person-environment interaction (personal context) and/or person-person interaction (sociocultural context); all are supported by the physical environment (physical context). Finally, these educational strategies can also be considered along a spectrum of passive/instructional strategies to active/experiential strategies. The idea behind this framework is to create a variety of possibilities that work together to support student engagement with environmental issues in and around the school building. The article then includes examples of how to consider and contain elements along each of these spectrums in school and curriculum design.

The TGB model can be used for both formal and informal learning. Formal teaching can include lesson plans designed around green building features, such as maintaining a school garden, or studying features of the green building, such as solar energy production. The building can also be used in nonscience classes, such as arts and humanities. This can be done, for example, by sketching the school campus or writing a history of the school grounds. The green building can also provide a backdrop for informal learning that goes on between classes, such as with signage, energy feedback monitors that provide real-time energy information, or play structures made of recycled materials, which can serve as reminders about environmental awareness. Additionally, informal learning activities can be held, such as gardening clubs or environment-awareness clubs.

A second dimension considered by the TGB model is the degree to which building features solicit active versus passive engagement from students. Signage, as mentioned, is a passive, unidirectional way of teaching. A more active approach could be accomplished by offering guided or self-guided tours of the building and grounds, pointing out environmental features of the design. Another way to encourage active engagement is by teaching students to help maintain the environmental performance of the buildings, such as by turning off lights, lowering thermostats in the colder months and raising them in the warmer months, or operating windows to optimize heating and cooling of the building.

A third consideration is the degree to which each student has opportunities to engage with the green building individually versus in a social setting. Offering students opportunities to engage on their own can allow for reflection without the distraction of other people. On the other hand, social interaction and observation with other people has been shown to offer opportunities for increased understanding and shifts of perspective in educational research done in other settings—such as museums. The author highlights two ways to consider the social aspect of green buildings: social interaction and social norms. Social interaction refers to thinking about ways the building, as a space, can encourage social interaction, exploration, and learning; for example, the building can include physical spaces for student groups to meet. The building can also be designed in such a way so it encourages unplanned interactions, especially around teaching green features. Social norms can also be considered; this relates to encouraging positive behaviors, such as recycling. Building design and features can encourage the development of these social norms by making behaviors like recycling highly visible and convenient.

The author also discusses other aspects of building design considerations, such as architectural configuration and design. She discusses, for example, how the aesthetic choices of the building communicate the underlying philosophy and values of a school.

Finally, the author discusses the role of the culture of a school, which can institute guidelines and mission statements that demonstrate and support commitment to environmental sustainability. She also notes that it is important to consider the space and time that students have outside of formal class time. If students are so busy that they do not have time to linger between classes or for self-directed learning, many of these informal environmental education features may be ineffective.

THE BOTTOM LINE:

The Teaching Green Building Model for Learning (TGB) offers a variety of mutually supportive ways to create and use a building—in particular, a school—to enhance environmental learning. Specifically, the model suggests three spectrums of student engagement to consider including in building and program design: (1) formal to informal, (2) passive to active, and (3) individual to collective. These suggestions provide a framework for considering ideas that go well beyond signage on walls to incorporate opportunities for interactive behaviors and activities, such as school gardens, building tours, art projects, and environmental clubs. Although many of the ideas speak specifically to the design of new school buildings, many can be implemented regardless of how green a building already is. This framework, for example, could encourage the creation of visual displays, hands-on activities, or activities outside the building that are tailored to the existing school environment.

Cole, L.B. (2014). The Teaching Green School Building: A framework for linking architecture and environmental education. *Environmental Education Research*, 20(6), 836–857.

OTHER RESEARCH

EFFECTS OF CLIMATE CHANGE MEDIA MESSAGING ON PERCEIVED RISK, EMOTIONS, AND LEARNING

Media plays a significant role in shaping the public discourse on, and understanding of, environmental issues by spreading information quickly and widely. For contentious issues such as climate change, the way messages are framed has been found to be critical, because it affects people's willingness to act. Less understood, however, are the ways in which different representation styles of messaging and attributions of responsibility influence perceived risk, emotions, and learning. In particular, media can convey messages through sensationalist or neutral representational styles and attribute responsibility for the environmental issue to human or natural causes. This study addresses this important gap in understanding of climate change communication through an experimental research design with 72 students at a German university.

The researchers investigated the use of different representation styles and responsible agents used in brochures about local climate change impacts. They used invasive species as the focus of the information presented and examined perceived risks, emotions, and learning with participants. The issue of invasive species was chosen because it represents an immediate local effect of climate change as different climate patterns can create less favorable conditions for native plants and more favorable conditions for once-foreign ones. Also, invasive species cause problems for some people by triggering allergic reactions. This choice of an immediate, local problem allowed the researchers to control for other factors that may influence perception of climate change, such as immediate versus long-term consequences and local or global scales.

Some central questions guiding this study included: (1) Does a sensational style of communication lead to a higher perception of risk and stronger negative emotions than a neutral representational style? (2) Do different responsible agents (nature versus human) elicit different emotions, and do they alter risk perception? (3) Does a sensational style, along with different responsible agents, influence how much and what type of information is learned?



The study employed a 2 x 2 experimental design, meaning the information that the brochures presented varied in terms of their representation style (sensational or natural) and responsible agent (human or natural). One example of sensationalist messaging included, “Pollen enters our lungs *deeply* and is *very aggressive*,” versus the neutral style that explained, “Pollen enters our lungs and can be aggressive.” To vary cause attribution, brochures explained either that humans distribute seeds and pollen of invasive plants (humans responsible), or that birds, wind, and waterways distribute them (nature responsible). Before participants read the brochures, the researchers used a survey to assess each participant’s prior knowledge of climate change and invasive species, as well as prior risk perception. The students read five brochures that displayed the same variations in representation style and attribution of causes. The first brochure centered on local effects of climate change, such as temperature and rainfall, and the others addressed four different invasive species. The students promptly rated their emotions and perceptions of risk after reading each brochure and then completed a post-test that assessed learning outcomes.

Prior perception of risk was moderate across participants, while prior knowledge of climate change, assessed by participants’ self-rating, was generally low. The researchers controlled for the effect of some differences in prior knowledge on learning outcomes. Perception of risk for each participant was determined by numerous items, such as items assessing impacts on humans, impacts on species, and general perceived risk.

The study found that perception of risk was higher in sensationalist-style conditions than neutral-style conditions. Negative emotions, comprised of sadness, anger, and guilt in the analyses, were also stronger in sensationalist-style conditions than the neutral-style conditions. Representation styles affected anger and sadness, but not guilt. To the surprise of the researchers, they found no effect of responsibility attribution on negative emotions. Increased perception of risk was also found to enhance negative emotions, mediating between

the representation styles and resulting emotions. The sensationalist style raised both perceptions of risk and negative emotions.

Participants in the sensationalist-style conditions performed better on the learning tests than those in the neutral-style conditions. In open-ended questions, those in the sensationalist-style conditions also expressed a relatively greater number of negative statements than those in the neutral-style conditions, but there was no effect of attribution responsibility on negative statements. When considering the interaction between style and attribution, participants in the sensationalist-natural causes conditions made more neutral statements than those in the sensationalist-human causes conditions.

Although the relatively small sample size of this study limits its generalizability to a larger population, the results offer an exploratory contribution to understanding the effects of message framing on public perception in the environmental education field. The researchers assume their results from this experimental study with brochures may be generalizable to information texts used in websites or newspaper articles, because the features, not the medium, likely influence risk perceptions, emotions, and learning.

THE BOTTOM LINE:

Variations in representation styles of information about climate change can have strong effects on risk perception, emotions, and learning. Using a sensationalist style can affect greater knowledge acquisition than presenting the same information in a neutral style. A sensationalist style, however, can also influence the development of negative informational aspects and trigger negative emotions. Mentioning human causes, as opposed to natural causes, of the negative effects of climate change creates a more negative overall perception of climate change and its impacts. Although a sensationalist style enhances learning, it also reduces the complexity and balance in information that people recall. These findings present a dilemma: While sensationalism is effective in some aspects of learning, it can create a negative bias that may also inhibit action.

Otieno, C., Spada, H., Lieblar, K., Ludemann, T., Deil, U., & Renkl, A. (2014). Informing about climate change and invasive species: How the presentation of information affects perceptions of risk, emotions, and learning. *Environmental Education Research*, 20(5), 612–638.

UNSPOKEN WORLDVIEW ASSUMPTIONS OF SCIENCE AND STUDENTS

Our basic understanding of how the world works and how it can be understood form the foundation for how we absorb and learn new information. For most humans, if new information fits in with our basic worldview, we will more readily accept it, and vice versa. Although many people assume science to be completely rational and without any presuppositions at all, there are, in fact, basic tenets or underlying assumptions that are rarely spoken or examined. These basic tenets are critical for understanding how science works as a method and what it can tell us about the universe. Each student also has basic ideas of how the world works; these ideas are rarely examined and they may or may not correlate with the scientific worldview. These discrepancies could have an effect on students' understanding and interest in science. This study examined the worldview of high school students, as well as what students perceive as the scientific worldview. The author also explores the consequences of these findings with regard to students' learning of science.

The author focused on three basic tenets of the scientific worldview: that the universe is ordered, comprehensible, and uniform. That the universe is ordered means that there is some regularity to it; order allows us, for example, to expect that if something drops, it will go toward the ground (not in some random chaotic direction). A comprehensible universe means humans can understand something about the order of the universe; e.g., the theory of gravity helps us comprehend why the dropping object goes toward the ground. Related to this comprehensibility is the notion of methodological reductionism, meaning the best way to understand something is by examining

each phenomenon separately. One example would be to study the nature of gravity acting on the falling object separately from the chemical composition of the falling object. Finally, that the universe is uniform means there is basic uniformity in the order of things throughout space and time. Uniformity allows us to assume that the theory of gravity is as relevant on Earth as it on Mars or on a faraway planet, and as relevant today as it was 1,000 years ago. These basic worldview propositions of science do not mean that every single scientist has the same view, or that these propositions should never be questioned. Rather, they are basic underlying assumptions that are shared by most scientists.

For this study, the author interviewed 26 students in their last year of high school in Sweden (approximately 19 years old). The author asked two basic questions: (1) What views do students themselves have concerning the order, comprehensibility, and uniformity of the universe? and (2) What views concerning the order, comprehensibility, and uniformity of the universe do students associate with science?

To ascertain students' responses to these questions during the semi-structured interviews, the author asked the students to sort and comment on five cards, each containing a different statement. The five statements were:

- “There are patterns/order in the universe that wholly or partially can be discovered and understood by humans.”
- “The universe is incomprehensible for humans.”
- “If you want to understand the whole universe, the best way is to try to understand every phenomenon separately.”
- “The physical laws that are valid here are also valid in every other place in the universe.”
- “The physical laws have always been valid; that is, they were valid also a long way back in the history of the universe.”

For each card, the author asked the students to sort the cards into piles according to whether they agree, disagree,

or do not know; concurrently, the author asked the students to explain why. Then, the students were asked to sort the card again as either supported by science, contradicted by science, or neither supported nor contradicted by science. Again, the students were asked to explain their decision to sort the card the way they did. The interviews were recorded and transcribed. The transcripts were translated from Swedish to English for the purposes of this article.

The results showed most of the students agreed the universe is ordered in some way, and this order can be, at least partially, discovered by humans. Many of the students emphasized, however, that it is not possible to understand everything about the universe. This was exemplified in their response to the statement, “The universe is incomprehensible for humans.” Almost all of the students said their own view was that the universe is, indeed, incomprehensible. Surprisingly, almost all of the students stated that science holds the opposite view to their own, viewing the universe as comprehensible. In other words, the students felt that science is based on the idea that the world is much more comprehensible than they, themselves, believe.

With regard to methodological reductionism—the concept that the best way to understand the whole is to examine all the parts and the interactions between them—about half of the students said they did not think this was the best approach for understanding the universe. On the other hand, almost all of the students understood methodological reductionism to be the approach of science, thus highlighting another discrepancy between their own views and those of science.

With regard to uniformity of laws over space, many students believed this was not the case. Many felt that the physical laws are different on Earth than they are on another planet, which is a misunderstanding. They also associated this view with science. Most of the students did agree that laws are valid throughout time, and have always been valid, and that this was also the view of science (which is correct).

In summary, the results of this study highlighted major discrepancies between students’ own worldview, the worldview they perceive science to hold, and that which is actually held by the majority of scientists. This study highlights the importance of addressing these underlying presuppositions directly in teaching. Raising these questions could prompt valuable discussion and inquiry. In addition, understanding these important concepts could help students feel more resonant with the scientific worldview, and also expand their understanding of the universe.

THE BOTTOM LINE:

Science is based on several presuppositions, such as that the universe contains order, the universe is comprehensible, and scientific laws are uniformly valid over space and time. These presuppositions are often taken for granted and rarely directly discussed. In many cases, students do not understand these presuppositions; if they do understand them, however, they can feel that this is in conflict with their own worldview. Uncovering and discussing these underlying assumptions of science in teaching could enhance students’ interest in and acceptance of scientific ideas as well as broaden their understanding of the universe. This can be done explicitly or incorporated into existing teaching material, such as, for example, when discussing how water freezes, educators can discuss whether it is true that water would freeze the same way anywhere in the universe and at any time in the history of the universe.

Hansson, L. (2014). Students’ views concerning worldview presuppositions underpinning science: Is the world really ordered, uniform, and comprehensible? *Science Education*, 98(5), 743–765.