Chapter 11
Benefits of Elementary Environmental Education

Ryan J. Brock and David T. Crowther

This chapter discusses the benefits of nature, provides insights for how research and organizations have developed to help people reconnect with the natural world, and concludes with an exploration of a nature club for fourth graders. This chapter intends to inform policy and effective program development for increasing *environmental identity* (E.I.) as a category that could be assessed in elementary-aged children where this development is critical.

Introduction

The natural world has provided humans with food, shelter, and tools over the past tens of thousands of years. Experiences with nature can reduce sicknesses and stress and can help calm patients before and after surgeries (Kahn 1999). Nature can also help children develop a broad sense of values, from humanistic, moralistic, and naturalistic values to scientific, symbolic, and aesthetic ones (Kellert 2002). Nature also can increase children's self-esteem and sense of self (Taylor and Kuo 2006). Simply watching a child play in nature invokes a sense of curiosity. Science education research has also shown that a person's ability to identify and connect with the natural environment can influence whether there is later efforts that go into protecting it (Kahn 2002; Schultz et al. 2004).

R.J. Brock (✉)
Jessie Beck Elementary School, 1900 Sharon Way, Reno, NV 89509, USA
e-mail: Rbrock@washoeschools.net

D.T. Crowther
College of Education, University of Nevada, 1664 N Virginia Street, MS 280,
Reno, NV, 89557 USA
e-mail: crowther@unr.edu

M.P. Mueller et al. (eds.), *Assessing Schools for Generation R (Responsibility)*,
Contemporary Trends and Issues in Science Education 41,
DOI 10.1007/978-94-007-2748-9_11, © Springer Science+Business Media Dordrecht 2014

Elementary Environmental Education Research

Several scales and tests are available for determining the effects of programs designed to strengthen environmental identity. Among those considered were the Connectedness to Nature Scale (Mayer and Frantz 2004) and the Nature Relatedness Scale (Nisbet et al. 2009). Such scales, and several others, usually ask participants to rate themselves in a "Likert-type fashion" with a number system that ranges from "strongly disagree" to "strongly agree." While these scales show positive results of environmental programs in some cases, most of these scales target young adult and adult audiences, neglecting elementary-aged children (Brock and Crowther 2011). Here, we suggest the need to further develop environmental identity scales that are more closely aligned with science education, so as to better take into consideration the developmental and age-appropriate needs of younger students. It should be noted that the research we will discuss in this chapter comes from a larger study involving children in grades 3–5.

Developing Environmental Identities

In addition to general education regarding content instruction, schools also can be a central arena for health promotion and intervention services. These activities can help children develop a healthy identity regarding who they are and who they want to become (Roser et al. 2000). The science education literature suggests that when a person can identify with the natural world, s/he is more apt to preserve and protect it. Conversely, without a sense of place and community, people are more likely to disrespect or destroy their environment and are at risk of losing their sense of themselves and their identity (Kriesberg 1999).

It is because of the importance of identity that terms such as "ecological identity" and "environmental identity" have surfaced when discussing environmental education. Ecological identity refers to the different ways a person interprets his/her relationship with the earth, from values, actions, sense of self, and personality (Thomashow 1995). We define *environmental identity* simply as "how we see ourselves in relation to nature" (Opotow and Brook 2003, p. 250).

Regardless of what term is applied to how one sees his/her connection with nature, such connections have become a popular subject of recent research in science education and schooling. In understanding how one constructs and changes their identity in relation to the natural world, curriculum specialists and educators potentially have one of the most valuable roles in helping children connect to the local environment. In this regard, special considerations ought to be made when working with children in elementary school and creating outdoor curricula, experiences, and assessments that are appropriate and significant.

A Study of Fourth Graders in a Nature Club

Brock (2010) adapted Clayton's (2003) Environmental Identity (EID) Scale so it could be used with fourth graders to determine the impacts of an after-school nature club. With the school residing in a large city, making frequent visits to nature difficult, the study investigated the effectiveness of combining learning in nature alongside the use of natural artifacts in the formal classroom setting. The nine-week club was designed to create experiences for students to investigate and learn about the natural world, with emphasis on local mammals, birds, and the environment. Nine club meeting took place in an after-school classroom; three outdoor sessions were held on Saturdays, spread out between the classroom meetings. The outdoor sessions allowed students to participate in nature hikes, make first-hand observations of nature, set up decoys and call in ducks and geese. Families were encouraged to participate in the experiences as well.

After-school nature clubs provide appropriate and significant opportunities to incorporate authentic investigations that afford opportunities for students to "reconnect" with nature (themselves).

A variety of sources can be tapped to ensure that such activities are grounded in science content. Sources of information for this purpose include the internet, local pamphlets, local sportsmen organizations, the school's adopted textbook, and the local fish and wildlife service. In many science classrooms today, these kinds of resources are used largely for developing factual knowledge; however, a nature club can be used to explore these concepts more fully.

A Look Inside My Nature Club

Ryan, the first author of this chapter and the teacher of nature club, is a long supporter of encouraging children who live in the city to experience and take in the outdoors; he has spent the past nine years developing after-school nature clubs at his elementary school in Reno, Nevada. Ryan uses a combination of bringing nature into the classroom as well as taking children into nature as a way of blending typical school day and extracurricular educational milieu.

Ryan's Nature Club

The student, and perhaps a friend or two, along with other fourth graders that may not know each other well, enter Ryan's classroom after school. As they sit down at a desk, they can't help but look at the items at the front of the room: antlers, hides,

a skull, and various other treasures of nature. After completing an initial EID survey, which Ryan will use to see environmental identity change from pre- to post-survey, students are asked to wander around the room and observe the items that have been placed at six stations.

Each student is given a nature notebook to use over the next nine weeks, and upon inspecting the items, they record their observations and questions inside it. The students are encouraged to smell, touch, poke, and magnify items with a hand lens. Unknown to the students, Ryan's goal is to use their observations and questions (after initial exploration time) to guide the lesson on the topic of elk—an animal that lives in Nevada. As students begin discussing their observations, Ryan leads them into deeper understandings of how elk survive. Concepts include learning about the differences between antlers and horns, the anatomy of an elk skull, and the reason that elk hairs are "hollow." Ryan points out the evolution of elk's ivory teeth and gives each student an opportunity to take in the smell of an elk, using a purchased "elk scent" fraguent bar. Each concept is initiated by a student observation and Ryan simply expands upon their discovery. A map created by the Nevada State Division of Wildlife is explored as students learn where the different elk herds reside in their state. The culminating experience of the first session is learning how to produce the sounds of the elk using a diaphragm call.

This first club session, as all other sessions, ends with journaling. Students are instructed to find the next blank page in their nature notebook and glue in the journal topic, which is handed to them on a piece of paper. They spend the next ten minutes engrossed in writing on that topic followed by a five minutes student-led conversation about their nature journal entries.

The next eight classroom meetings allow the students to experience nature in a similar manner. (With the difficulty of transporting students out of the city to spend time in nature during the after-school club, natural artifacts are often brought to them.)

A week later, during the second meeting, Ryan's goal is to get the students to begin thinking about nature inside their city limits. Nature photography is used for this purpose. Students are encouraged to bring in their own digital camera, or one is provided to use for the next several months. The students are instructed to take their camera to the playground, look beyond the concrete walkways and human-created structures to find nature, and document it with their camera. When they return to the classroom, Ryan encourages discussion about what natural items were observed and photographed. Students agree that nature, living plants, and animals are seen all over their own school grounds. Ryan challenges the students to take nature photos with their camera of these critters and email their best two or three to him before the next meeting. The next several meetings begin by allowing students to share these photos on the digital projector. Ryan's secondary goal of this learning experience is to get the students to think about nature more than just during a nature club.

The third meeting arrives. Students are encouraged to focus on small mammals living around them. Ryan unpacks a large bin of mammalian items: skulls, hides, replicate animal scat and tracks, and more. As before, Ryan encourages the

students to investigate the items. Their observations help guide the discussions and learning of content knowledge, contribute to an understanding of how these animals interplay with humans, and more importantly, begin to be a vehicle that allows children from the city to identify with a world they may not know. Toward the end of this session, students learn how to use an elk diaphragm call to produce coyote sounds.

In the next meeting, students collaborate as they pretend that scissors, tweezers, or spoon is a beak. They learn which beak works best for certain foods. Ryan presents them with photos of different bird beaks and asks them to guess what type of foods each eats. Near the end of the session, the students move about the room analyzing mounted bird heads and feet. They discuss and write observations about the uniqueness of each beak and foot structure, and how the bird probably uses them. Again, students lead a discussion based on their observations.

A favorite activity is engaging students in a mock town hall meeting to discuss the imaginary issue of a possible local reintroduction of elk. Ryan explains all the roles in this simulation activity that students might play: wildlife biologist, business person in town, worker for the department of transportation, hunter, and so forth. After selecting their role, the students spend time researching relevant background. When all of the students are ready, the town hall meeting begins. A debate occurs for the rest of the session. Ryan likes students to take on a role that contrasts their own perspective. He does this so that students can better evaluate multiple sides of issues facing the community and environment. When Ryan tries to stop the discussion, students urge to go on, because they are so intrigued by the different positions and opportunity to analyze them.

The next two sessions focus on local birds. The first of these two sessions engages students with turkey artifacts. The second engages students with duck artifacts. In both sessions, the students learn about the animal and nature by observing wings, feet, and hearing stories from Ryan and classmates. Ryan provides various turkey calls for the students to evaluate. Then, they build their own turkey call from string, a plastic cup, and a sponge. During the duck session, a parent of a club member demonstrates on the playground how to set up a spread of duck decoys and provides an opportunity for the students to sit in his duck blind. The parent volunteer demonstrates the retrieval skills of his dog. Upon returning to the classroom, Ryan gives a duck call to each student and encourages them to mimic the sounds he teaches them.

Near the end of the year, Ryan brings in a variety of local rocks and minerals. The students investigate these using a combination of measurements: they determine the name of the minerals based upon their characteristics and use a map to see where they are located near their city. Ryan challenges students to bring in any interesting rocks they collect on their own and encourages them to start a rock collection. Nevada is a treasure trove of rocks after all.

During the final classroom meeting, the students develop a deeper understanding of how humans use items from nature. After participating in a discussion of the many items humans have and continue to use from nature, each student receives a

wing feather from a turkey. They use it to create a quill feather pen, which they use by dipping into watered-down black paint. As they write in their notebook with it, a nature contract is passed around to each student that has been developed by one of their peers with her quill pen. She encourages each student to sign it with the quill pen. Ryan can't help but smile as the students excitedly sign this document that encourages them to continue to be a part of nature.

Although students enjoy and learn a great deal from the more formal classroom meetings of nature club, they gain as much from the three outdoor meetings. The three outdoor meetings are different in that the students visit natural environments instead of examining artifacts from nature in the classroom. Each outdoor session lasts about four hours and the students meet at a different location outside of Reno.

The first outdoor meeting is held at Galena Creek, a regional park at the base of Sierra Nevada Mountains. Being just a short drive away, the area contains a variety of pine trees, hiking trails, a creek, and a fishing pond. Ryan believes this first outdoor experience for the club needs to be a big success to encourage the participation of future outings. The students show up with their digital cameras, ready to take nature photos. As the club members hike along one of the nature trails, they take photos, until they come to an area where Ryan has hidden four secret nature caches. The students learn how to use a GPS and then head into the woods in small groups. When they arrive at the nature cache, they open the box and are given a task to complete. Tasks involve observing pinecones eaten by squirrels, comparing the leaves on different plants, and smelling pine bark to distinguish among different species of pine.

The second activity is a nature hike along the creek. Every four or five minutes, Ryan stops and has the students focus on a specific item near the trail. They learn various things during this short hike. One of the highlights is when students watch brook trout in a creek and follow a snake that darts in and out of bushes along the creek. For several students, this is the first snake they have ever seen in the wild! As families are encouraged to travel on these excursions, parents and siblings become as excited as the club member. They often come back to visit these sites later.

The second outdoor trip is to Washoe Lake, a local, yet infrequently used, Nevada State Park. The goal is to let students experience wetland ecology. During this trip, however, most of the wetlands are dry. Despite that students may have been discouraged, the dry wetlands provide unique learning experiences where we talk about how animals adapt to dry situations, especially in the high-desert environment, where this park is located. The group walks around on some dikes, discovering coyote scat, deer tracks, and other interesting items. The students use their keen observation skills to search out and find camouflaged wildlife artifacts. After exploring the dry wetlands, the group then departs this area and heads up the road to spend several hours hiking to a scenic overlook of the valley. Much time is spent learning about the local plants and discussing the remnants of a fire that came through this area in the recent past. When the group arrives at a scenic overlook, they are encouraged to stop exploring for a few minutes to eat lunch. During this time, Ryan offers a brief history of the area, including a discussion of the early people and tribes who

once lived here. Before heading down, club members pose for a photo with the valley behind them.

The final outing involves using the duck-calling skills that the students learned in a prior session. Ryan's club partners with a local sportsman group, and this group helps students gain access to a local wetland. Some students show up in camouflage, and for the students who don't own this clothing, a pile of camouflage jackets are pulled from a truck to borrow. Ryan leads the students and parents away from the cars and has them pause to observe a small pond of aquatic life. A minnow trap is baited and thrown into the pond. It will be checked on the return trip back to the vehicles. The group continues the walk toward the much larger pond. Students sneak ahead of their parents and the instructor and crawl over the ridge to see a dozen or so ducks on the pond. Excitement builds for everyone, but eventually the ducks fly away. Over the next 30 minutes, the students put their skills to the test: they tell adults how to set up a decoy spread in the water. Once set, everyone hides in the tall, yellow tule brush. The students begin blowing their duck calls; they watch as a few ducks fly overhead.

Nature Club Experiences

Now we want to introduce you to another side of the nature club—a side that students know is taking place in the background, but soon realize doesn't matter to them—the research component. For nine years, Ryan has been running nature clubs with elementary students and he has always been fascinated with how many students stay an additional hour or more after school to learn about nature and wildlife. Thus, Ryan began collecting information on which components of the club seem to bring the students closer to nature. The following discusses this research.

In seeking to understand which components of the club help to strengthen environmental identity, multiple sources of data are collected during the club events. These include student's nature notebooks, photos taken by students, conversations in class, multiple interviews of participants (before the club began, halfway through, and after the final meeting), a pre- and post-EID (Environmental Identity Scale), and video recordings of each session that are later transcribed. Ryan learns that connections to the natural world are developed by students who participate in this nature club. Their weekly nature reflections, comments from class, interviews, and posttest results all evidence an increase in their environmental identification with nature.

In looking at the results of the Environmental Identity Scale for the entire club, the pretest results displayed an overall mean score of 5.7 points per item out of a possible 7.0. The posttest scores increased to 6.3. The initial EID served the purpose of identifying low, average, and high environmental identity students based upon this group's scores. Students were then selected from each category to follow more in-depth through qualitative measures. The lowest environmental identity students for this club scored a pretest mean of 4.5–5.0, average students scored 5.8–6.2, and the highest students scored 6.6–6.7.

No matter how strong the child's prior connections with nature were when entering nature club, contact and experiences with nature and natural objects help to broaden, deepen, or strengthen each child's environmental identity. According to some of the children's interviews and nature notebook entries, it is the Saturday learning experiences, where they spent several hours engrossed in natural settings. One child, who entered with low environmental identity according to the EID pre-survey, reflected in her notebook that the Saturday experiences created a place to "learn about nature by being in it." Correspondingly, the students with average environmental identity upon entering the club also gained much from the experiences according to their interviews, reflections, and entries in their science notebooks. One student wrote that she enjoyed the direct experiences with the natural world because they allowed her to "feel the breeze" and "see it actually with my eyes."

The implication for curriculum designers and policymakers is that learning experiences need to be developed appropriately and measured, both in the classroom and outside its four walls, to allow students to construct their own meaning of the world around them. A teacher must design experiences for children to learn from nature, as one way children construct knowledge of reality is through their physical interactions (Singer and Revenson 1997). By creating learning experiences where children from the club might interact with objects both inside the classroom as well as during outdoor trips, Ryan's children came to understand nature at a deeper level according to their notebook entries, interviews, and pre- and post-EID results.

The learning process that occurred in a nature club is easy to see. For example, while analyzing a mounted turkey, one child notices a feature on the turkey's leg that is unfamiliar to him. He searches through his memories to help him understand what a spur is. Unable to access any prior knowledge, he begins to think more deeply about spurs. He talks with a classmate who raised chickens when she was younger. Although having no knowledge of turkeys, her prior experiences were different from the boy's and she only had to modify an existing assumption of spurs. She is able to use this prior life experience to think about how chickens have similar looking "things" on them that they use for protection. The idea of being in a place or community to witness a mounted turkey triggers a shared learning experience for her and other students.

In designing environmental curriculum, we provide opportunities for learners to construct their own knowledge of the world around them. Future curriculum planners and classroom teachers need to be prepared for these outcomes, the challenges that come with a lack of funding for outdoor experiences, to be able to create experiences where children interact with their learning both literally and cognitively. An effective experience may require more time for preparation, funding, and better classroom management than lessons where a teacher lectures or has students read from a textbook. The depth of knowledge gained and deeper understanding is well worth the time.

Experiential Learning on Values

Another outcome of the nature club was that it helped students develop positive values about nature. Earlier, it was mentioned that through interactions with nature, students were better able to construct an understanding of the different topics presented. Unfortunately, in many school districts today, the standardized testing of general knowledge has become the basis of determining the outcomes of student learning. As important as tested knowledge is, it isn't the only characteristic that is learned in science classrooms, and definitely not the only attribute of a person that makes them a complete person. The affective side is also what makes us human which is just as important, perhaps more so, when it comes to taking care and loving others, both people and places.

Students with average to high environmental identities in the club made great strides toward strengthening their values of taking care of the environment. Through interviews, Ryan found they all entered the club wanting to take care of the environment. This was also apparent in their notebook entries during the first four weeks. (Yet each student in the study initially only expressed shallow ways of doing so.) Their textbook type recall reflected their prior learning about taking care of the world around them. Answers ranged from "If something happens that is big all the humans can die…trees produce oxygen, so maybe humans would die too" to another student's response, "We can plant lots of trees and stop cutting down trees for paper…because then we can't breathe that well." One student spoke with a passion about protecting the many places she had read about and learned about from passive measures. She said during one interview, we need to protect "all the tropical land and all the trees in the forest…putting things in the ocean from sharks and animals eating them may die…don't litter all the time." However, when asked what she could do right now, in her high-desert environment, she couldn't come up with a way to help her local community or environment.

Unfortunately, students' prior experiences of "protecting" the environment often come from passive experiences instead of direct encounters with the outdoor environment. Without this direct experience, fourth graders are not necessarily able to apply knowledge learned in science class to their local environment. Without direct experiences to help students develop their affective aptitude, they initially recite the broad concepts but are unable to articulate how to apply them to their everyday lives. Classrooms today, where learning is only focused on preparing learners to memorize factual information for a standardized test, lack in producing citizens who truly relate with the content on the affective side. We have to move American education away from emphasizing learning through lectures and books exclusively (Coyle 2005).

Nature club allows students to interact with nature and artifacts from it, increasing club member's affective values by the end of the nine weeks. According to qualitative data from midpoint interviews, notebook entries, and

conversations in nature club, not much change is seen until after four weeks, indicating that single occurrences will not make much impact and students need to have encounters over longer periods of time to truly feel a connection and part of the natural world. Examples heard during the midpoint interview echoed those from the preinterview: "don't litter because the animals don't have anywhere to live," "It is good to take care of the environment because it can help you survive and stuff like global warming," "Stop cutting down trees for paper and our breathing, because then we can't breathe that well." Students also continued to reference where they obtained these ideas from, which included *Times for Kids*, a magazine they read in class, TV, and prior lessons from school. However, during their final interviews, the way students described taking care of the environment changed. One student stated, "There are sometimes two sides to a story" when dealing with environmental issues. Three other students had very similar discussions, understanding that there are complex issues in how one values nature. None of their conversations revolved around simple answers as before. They had begun to talk about their personal actions that they could easily control and begin with, versus through saving the rainforest campaigns. One mentioned he had started recycling at home. Another spoke of the battles that had started in her head when her actions went against her beliefs, such as using her family's boat: She enjoyed being on it but realized that it released amounts of oil into the water.

In the research literature, there is inconsistency in the length of time a program needed to be conducted to have an impact on environmental identity for children. This particular study may guide policy and program development in that it took a minimum of four weeks to detect only the beginning of a change in some of these students with higher E.I. scores. For the lower E.I. scoring participants, it truly took the entire nine weeks in combination with the classroom and fieldtrip settings to see a change in E.I. both through the scores on their surveys and the qualitative measures.

The following table displays student mean scores from the environmental identity scale pretest and posttest, followed by their increase in score. Although all students increased their scores after the nine-week club, those students in each category (high, average, low) increased similarly. Students who entered the club with low environmental identity through direct and indirect experiences with nature increased the most. According to their post-interviews, these students believed the outdoor experiences in nature were the most fun and were the one component that helped develop connections with nature. One student mentioned, "I could learn about nature by being in it and having fun at the same time." Concomitantly, the students who entered with high environmental identity, who had many prior experiences in the natural world, benefited from the personal reflections. One student with high environmental identity said during her last interview, "I think the journaling…make me think so much more about what I was actually doing and what we were talking about."

High	Average	Low
6.7–6.9 (.2 increase)	5.8–6.4 (.6 increase)	5.0–6.2 (1.2 increase)
6.6–6.7 (.1 increase)	6.2–6.7 (.5 increase)	4.5–5.7 (1.2 increase)

The social components of a nature club seem to impact affective development as well. With activities designed to include social interaction, students learn from each other. Students with high environmental identity become leaders who share their knowledge and beliefs about the natural world. Examples of students with higher environmental identity model and discuss their views of nature with lower environmental identity students, evident from week one. This is integral to the E.I. growth for these children. Students with lower environmental identities especially benefit and often learn to take on the values of their peers through simple conversations and tasks. One such example took place while walking back from calling ducks. A student with low E.I. told another student with average E.I. how he wished he could shoot all the ducks flying overhead. The response to this was, "You can't shoot them here you know. So that's good. Because ducks need a habitat." The child with low E.I. thought about the statement and replied, "You can't shoot them here, but you can shoot them everywhere else." The other child responded, "No you can't." A conversation then began about hunting regulations, limits, and seasons and why those are important to conservation. Those with higher E.I. were leaders and mentors to those with lower E.I.

Often overlooked is how traditional teaching (which typically is directed by the teacher) allows students little access to the ideas and thoughts of their peers. A benefit of creating a community of social inquiry is the awareness of what other students are thinking about the topic at hand (Splitter 2000). Program and policy developers are encouraged to take this into consideration so that the entire range of children with different levels of E.I. may benefit from the social experience.

Newfound Hobbies

Ryan's Nature Club provides an enrichment opportunity for the students who attend. Unfortunately, during a normal school day, instruction is often directed by curriculum choices outside of Ryan's control. Since high-stakes policies were put into place, many enrichment activities have been cut or reduced to allow more instructional time for the content that is assessed to measure a school's Adequate Yearly Progress. Many principals and teachers now focus on math and literacy and deemphasize, or even totally remove the time spent on elementary science (Marx and Harris 2006). Science isn't the only subject to suffer, as physical education, arts, and social studies have also taken similar hits. With the emphasis on math and literacy, our high-stakes policies appear to be slowly changing the emphasis of

investigation and inquiry to more rote memorization of facts. Activities that used to be seen in classrooms which helped enrich students' lives and encourage inquiry are disappearing. This is not the case in Ryan's nature club.

Participants recalled how the nature club had helped them find new passions in life. A few students became more interested in hunting. One child even encouraged his father to get back into his old hobby of hunting. Nature photography became a newfound passion for one young lady. Rock collecting was picked up by two boys halfway through the nature club because of one lesson focusing on local rocks of the area. One boy, whose family had no real interest in the outdoors, aspired to explore nature more often, leading to family hikes around Nevada. Even a year later, this child's father talked about the impression the club had on his son. Another child's parent sent an email to Ryan stating that the child and "her dad were practicing their duck calls last night and she is getting pretty good. I see her hunting with her dad in the next couple years." Both of these students entered Ryan's Nature Club with low environmental identity. The nine weeks of a nature club, with only an hour or so a week of classroom learning, combined with three Saturday excursions results in much needed enrichment for the students, so much so, that parents witnessed incredible changes in their children. The significance of both more funded in- and out-of-school learning experiences cannot be overstated.

Implications for Science Education

In this era of high-stakes policies, the increased science content, both factual knowledge and conceptual understanding that students walk away with from a nature club, is worthwhile. The club piggybacks upon the standard based content that is introduced during the normal school day and allows students to get more personal with it and construct deeper understandings. Ryan's study also reveals that students develop other skills that are equally significant in fostering scientific understandings and environmental identity. First, many students walked away with a newfound hobby, such as rock collecting, hunting, fishing, and nature photography. Of the six students followed in-depth through qualitative means, four began new hobbies. One other student believed he "liked to identify plants" but wasn't sure if this was considered a hobby.

Another concept which emerges from this research is the strengthening of social identity, especially for the two students with lowest environmental identity. Both of these students made specific references to the social aspects of the club during their mid- and post-interview. For these students, who lack prior experiences with nature (according to their interviews and notebook entries), the social components where students complete activities collaboratively and learn from each other through conversations and discussions are uniquely evident and a critical aspect of the club. These two students shared more with their peers as the club progressed and noted that one of the top three things they enjoyed about the club was making new friends.

A third unintentional outcome is the development of process skills. Many fourth graders in the club talk extensively about how nature club increased their observational skills, especially with respect to noticing more details in nature. Of those students intently followed, three of the six made specific references to having a more keen sense of observation. This was also apparent in each of the six student's nature notebooks, where more details began appearing in later entries as well as during the last two Saturday outings. It is during these last nature experiences outdoors where most every student kept Ryan busy, showing them a variety of items they discovered. Students were eager to present their findings and inquire what a plant, track, or other item is or to share their discovery and relate it to a prior nature club experience.

Designing Curriculum Appropriately and Significantly

This study was conducted after school, and although it combined formal components of classroom learning, it also used out-of-school educational aspects. However, lessons learned from this study could easily be transferred to the formal realm of education.

Children benefit from direct experiences with their learning (Kahn 2002). Lectures and textbook reading alone do not fully develop the cognitive aspects of learning. Additionally, in order for elementary children to develop values about nature, it is best that they come from direct experiences and encounters, as "the formation of values typically move from relatively concrete and direct perceptions to more abstract levels of experiencing and thinking" (Kellert 2002, p. 132). These experiences may require more time in the classroom, as a high-quality field experience or science lab requires time to allow student interaction with the content. Teachers who reduce such experiences and succumb instead to fast-paced, textbook-led instruction may provide a less well-rounded education for their students.

Students need time to develop affectively and intellectually. In looking at a classroom scenario, where most classes are unable to provide experience upon experience of in-depth nature study in an outdoor setting, understanding the minimum length of time for direct and high-quality indirect experiences for students to increase their environmental identity is appropriate and significant. For students with lower environmental identity, this study found that longer lengths of time, seven to nine weeks of direct and indirect experiences with nature, are required. Students with higher environmental identity strengthen their connections to the natural world more rapidly still require a minimum of four to five weeks of both indirect and at least one direct experience with nature.

Curriculum developers and teachers alike need to reassess the current school curriculum to ensure that social learning components are present, as these allow children to develop a sense of reinforcement, peer interaction, modeling, and belonging.

The teacher's background in science, nature and creating appropriate activities for 3rd–5th graders, is very important at the elementary level because it creates the foundation for effective pedagogy. Teachers who have a passion for science often move to the middle school or high school level where they can teach it throughout the day. At the elementary level, teachers that have strong content knowledge in science are relatively uncommon. This problem emphasizes the need for well-rounded training for instructors of elementary curriculum and programs or the need for collaborations with content experts and teaching specialists to create optimal learning situations and curriculum for students.

The Ideal Situation

What would the ideal learning situation look like for elementary students? First, the state and national priorities for science curriculum would need to be reexamined to include more focus on environmental sciences at the elementary level. Second, educators will need to understand both the science content and developmental implications of implementing the curriculum that best reaches the needs of the students that they work with. Teachers must learn to allow students to value nature through experiences lived and intimacy felt, rather than on acquiring additional facts (Kahn 1999).

If students are to value nature through their experiences, they need to have learning experiences in nature. This means dedicating some financial resources to permit field trips to natural areas.

It is our opinion that every child should experience an overnight trip in a natural setting at least once during their elementary years. This is occasionally made a reality when an energetic teacher within a school makes it possible. Most elementary teachers don't appear to want to take on the extra burden of such intense planning, preparation, and responsibility. There are very few rewards, such as merit pay, available for teachers who do these things. Other times, local organizations, led by specialists in outdoor education, search from school to school to find a teacher who is willing to give the overnight experience a try, with additional assistance and expertise from the organization. In our area, organizations such as Sierra Nevada Journeys and Great Basin Outdoor School offer excellent experiences for classes, with associated costs.

In our district, which houses 64 elementary schools, the cost for funding an overnight experience for every student in a particular grade is somewhat difficult to calculate. The following is based upon a one-night camping trip for fourth graders at Ryan's school, where a teacher has developed the trip and only district busing and campground fees for the 75 students and 20 parents are calculated. Meals are excluded, as student groups plan and provide their own food. Total cost for the annual trip might run about $1,000. With only one campground within 60 miles to

hold this large of group, the school is limited in campground choices. This means a minimum of $64,000 for the school district for every fourth grader to experience such a trip. This price tag pales in comparison to what districts spend on textbooks, classroom resources, and the standardized exams.

Although the costs for outdoor experiences and overnight camping are expensive, there are ways to alleviate these costs such as through some of the tactics used in Ryan's school. The fifth-grade class at this school has been able to make an annual trip only because of partnering with a different sportsman's groups each year, which help cover the majority of the cost. It has been a lot of work for the teacher who leads this trip to seek out organizations with the same mission of getting kids into nature, presenting at their board meetings, and writing follow-up reports. Although cumbersome, the process has formed good collaborations between the organizations and the school. Hiring a motivated coordinator for the school district to build these relationships and enable every fifth grader to attend this natural experience would be ideal. Why are teachers not compensated for their participation? Should merit pay be linked in some way with building partnership?

Parent involvement is another key element in environmental education and outdoor experiences. Having experiences that allow parents to get involved with their child is important. When parents see the value, then opportunities arise outside the school day where families begin to develop identities with nature.

Having checkout nature kits that elementary teachers can use within their districts will help increase some hands-on learning experiences dealing with nature. It is unrealistic to learn about nature 100 % of the time outdoors, unfortunately. However, like Ryan's Nature Club, nature can be brought to the students through artifacts and so forth. While elementary teachers are generally hesitant to teach science due to lack of science content and pedagogical science content knowledge, these kits could help increase both of these (Appleton 2008). The hands-on nature materials will help the teacher instruct outside of a textbook while at the same time allow students to investigate nature through real objects from their state.

Being an ideal situation, as mentioned above, we wish more consideration would take place regarding the building of new elementary schools. It is easy to get jealous when reading articles or books describing school context and teaching experiences embedded with a nearby stream, wooded vacant land, a forest, or even a wetland. They simply walk out their classroom door and engage the students with their natural environment in minutes—no buses needed. Including in the design, areas near the building will drastically increase the amount of time teachers take their students outside. Incorporating science, writing, research, and more can take place around such communities.

Creating more high-quality environmental education or outdoor programs will greatly benefit environmental identity and student connections with nature. In Ryan's school district, he has seen after-school cooking clubs, science clubs, language clubs, and just about anything else you can think of. Currently, Ryan is one

of the few teachers in the district offering nature clubs, elk clubs, duck clubs, and turkey clubs. Students flock to them and fill them up in a day or two—(he has to limit numbers). Children are passionate and curious about nature. We simply need to create more opportunities that allow them time to investigate it.

References

Appleton, K. (2008). Developing science pedagogical content knowledge through mentoring elementary teachers. *Journal of Science Teacher Education, 19*(6), 523–545.

Brock, R. (2010). *Exploring the development of fourth graders' environmental identity through participation in a semi-formal nature club*. Unpublished dissertation, University of Nevada, Reno.

Brock, R., & Crowther, D. (2011, January). *Linking Piaget's cognitive development theory to environmental identity development through use of an After-School Nature club*. Paper presented at the Association of Science Teacher Education (ASTE) International Conference on Science Education. Minneapolis. Proceedings available online: http://theaste.org/meetings/2011conference/2011proceedings.pl

Clayton, S. (2003). Environmental identity: A conceptual and an operational definition. In S. Clayton & S. Opotow (Eds.), *Identity and the natural environment: The psychological significance of nature* (pp. 45–65). Cambridge: MIT Press.

Coyle, K. (2005). *Environmental literacy in America: What ten years of NEETF/Roper research and related studies say about environmental literacy in the US*. Washington, DC: The National Environmental Education and Training Foundation.

Kahn, P. H., Jr. (1999). *The human relationship with nature: Development and culture*. Cambridge: The MIT Press.

Kahn, P. H., Jr. (2002). Children' affiliations with nature: Structure, development, and the problem of environmental generational amnesia. In P. Kahn & S. Kellert (Eds.), *Children and nature: Psychological, sociocultural, and evolutionary investigations* (pp. 93–116). Cambridge: MIT Press.

Kellert, S. R. (2002). Experiencing nature: Affective, cognitive, and evaluative development in children. In P. Kahn & S. Kellert (Eds.), *Children and nature: Psychological, sociocultural, and evolutionary investigations* (pp. 117–151). Cambridge: MIT Press.

Kriesberg, D. A. (1999). *A sense of place: Teaching children about the environment with picture books*. Englewood: Teacher Ideas Press.

Louv, R. (2006). *Last child in the woods: Saving our children from nature-deficit disorder*. Chapel Hill: Algonquin Books of Chapel Hill.

Marx, R. W., & Harris, C. J. (2006). No child left behind and science education: Opportunities, challenges, and risks. *The Elementary School Journal, 106*(5), 467–477.

Mayer, F. S., & Frantz, C. M. (2004). The connectedness to nature scale: A measure of individuals' feeling in community with nature. *Journal of Environmental Psychology, 24*(4), 503–515.

Nisbet, E. K., Zelenski, J. M., & Murphy, S. A. (2009). The nature relatedness scale: Linking individuals' connection with nature to environmental concern and behavior. *Environmental and Behavior, 41*(5), 715–740.

Opotow, S., & Brook, A. (2003). Identity and exclusion in rangeland conflict. In S. Clayton & S. Opotow (Eds.), *Identity and the natural environment* (pp. 249–272). Cambridge: MIT Press.

Roser, R. W., Eccles, J. S., & Sameroff, A. J. (2000). School is a context of early adolescents' academic and social-emotional development: A summary of research findings. *The Elementary School Journal, 100*(3), 443–470.

Schultz, P. W., Shriver, C., Tabanico, J. J., & Khazian, A. M. (2004). Implicit connections with nature. *Journal of Environmental Psychology, 24*(1), 31–42.

Singer, D. G., & Revenson, T. A. (1997). *A Piaget primer: How a child thinks*. Madison: International Universities.

Splitter, L. (2000). Philosophy for children. In M. Robertson & R. Gerber (Eds.), *The child's world: Triggers for learning*. Camberwell: ACER Press.

Taylor, A. F., & Kuo, F. E. (2006). Is contact with nature important for healthy child development? State of the evidence. In C. Spencer & M. Blades (Eds.), *Children and their environments* (pp. 124–140). New York: Cambridge University Press.

Thomashow, M. (1995). *Ecological identity: Becoming a reflective environmentalist*. Cambridge: MIT Press.