AN EXPERIMENTAL EXAMINATION OF
THE EFFECTIVENESS OF ENVIRONMENTAL EDUCATION
WITH PRESCHOOL CHILDREN

by

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Abstract

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Empirical evidence on the benefits of nature and the effectiveness of environmental education are increasing, but little evidence examining the effectiveness of environmental education programs with preschool children exists. The current exploratory study examined the effectiveness of a pilot environmental education program, Heroes of the Environment in Training, for increasing environmental knowledge and increasing positive environmental perceptions in preschool children. A total of 107 children at six preschools in rural Northern California participated in the project. Children were individually interviewed before and after the program to assess changes in their environmental knowledge and perceptions. Three preschool classrooms were randomly assigned to receive the program and three were exposed to story time not related to environmental education.

Results revealed that the environmental education program was effective in increasing environmental knowledge for boys in the experimental group and for older children regardless of group. While results revealed that the environmental education program did not increase environmental perceptions, preschool children had relatively positive environmental perceptions at time one, which were maintained over time. Girls in general had more positive environmental perceptions at both time one and time two.
Past research has shown that extant positive perceptions in young children decline in elementary school. Thus, perhaps program such as the current one can help prevent such decline.

These results from the current study can inform educators about how to integrate developmentally and culturally appropriate environmental education at the preschool level and encourages future research on early childhood environmental education and developing better, more psychometrically sound measures.
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Introduction

Environmental concerns such as climate change, water shortages, air pollution, and energy crises are currently foci of international attention (United Nations, 2012; World Watch Institute, 2011). Environmentalists from the field of biology have informed people about the impacts of modern technology and engineering on the degradation of the natural environment and the implications for human health (Carson, 1962; Shiva, 2002; Wilson, 2002). In addition, the current patterns of resource consumption regarding oil and food may overwhelm the earth’s capacity for sustainability. For example, it is estimated that if everyone in the world lived like an average American, it would require four earths to sustain all the people (Ewing et al., 2010). The changing environmental status and over-consumption of natural resources have implications for current and future generations; however, many people are unaware of environmental problems.

A national longitudinal study of general environmental knowledge uncovered that many American adults believe that they know about environmental issues; however, only 12% of American adults actually pass test items on scientific issues related to topics like sources of energy and water pollution (Coyle, 2005). In order to address ways to promote environmental knowledge, to increase sustainable behaviors, and to cope with environmental problems, professionals, including psychologists and educators, work in interdisciplinary teams (Chawla, 2008). Recently, the American Psychological Association dedicated an entire special issue of the *American Psychologist* journal (Anderson, 2011) to the issue of climate change and outlined multiple roles psychologists
can play, such as designing and implementing effective educational interventions to increase environmental knowledge and behavior (Stern, 2011).

**Benefits of Nature**

Another key focus of psychologists includes the benefits of experiencing nature for human beings. Studies on the benefits of the natural environment for health suggest the importance of these experiences. For instance, researchers found that patients in general and psychiatric hospitals spent less time in hospitals if their room faced the natural scenery or received direct sunlight compared to patients who did not have access to natural views (Beauchemin & Hays, 1996; Ulrich, 1984). Likewise, Bowler, Buyung-Ali, Knight, and Pullin (2010) analyzed the effects of exposure to the natural environment on mental and physical health by reviewing 25 peer-reviewed articles. They found that being exposed to the natural environment was effective in improving mental health such as changing levels of anxiety, anger, fatigue, and sadness.

Similarly, the natural environment plays a role in promoting psychological benefits for children. Kuo and Taylor (2004) and Taylor and Kuo (2009) investigated relationships between symptoms of attention-deficit hyperactivity disorder (ADHD) and exposure to the natural environment with children between five and eighteen. Their studies discovered that children who participated in more self-selected activities such as walking and reading in the natural environment had significantly reduced symptoms of ADHD compared to children who spent more time indoors and in human-built places. Children of different ages, severity, comorbid conditions, and socioeconomic statuses all
benefited from activities in the natural environment (Kuo & Taylor, 2004). These studies imply that the natural environment can promote psychological health across the lifespan.

However, contemporary children have limited access to the natural environment because of changes in lifestyles such as urbanization and digital technology. For instance, 80% of Americans live in urban areas (Population Reference Bureau, 2011). The growth of urban populations reflects changes in economic and social patterns that influence the lives of children. To illustrate, Rideout, Foehr, and Roberts (2010) studied children’s time spent on media, including television, internet, and mobile electronics, with a nationally representative sample of 2,002 children ages eight to eighteen. On average, children spent almost eight hours a day on media in 2009 compared to six hours a day in 2004. Increasing exposure to and use of the media technology in addition to living urban lifestyles illustrates children’s decreasing opportunities to explore the natural environment.

To find out how much time children spend outside, Larson, Green, and Cordell (2011) conducted a telephone survey with a nationally representative sample of 1,450 households with children ages six to nineteen. The researchers interviewed caregivers and adolescents age sixteen and older. On average, most children reported spending two hours per day playing, exercising, and using media devices outside. Due to a lack of longitudinal studies, it is not clear whether children today spend less time outdoors compared to children in the past; however, it is clear from this set of studies that children are spending the majority of their waking hours indoors and on screen media.
In an illustrative study, interviews of fifty children between age ten to twelve revealed that 80% of the children expressed feelings such as sadness, fear, hopelessness, and anger toward current and future conditions of the earth (Strife, 2012). The researcher found that media such as movies were the primary source of children’s environmental knowledge. However, some children indicated optimistic views regarding current conditions of and future predictions about the earth. These children commented that environmental problems can be solved through environmental actions and green technology such as solar panels, composting, and alternative transportation. They reported that they learned their environmental knowledge and behavior from their parents and teachers, implying that intentional education has a potential to enhance environmental knowledge and behavior.

Environmental Education

The field of environmental education emerged to inform people about environmental problems and issues around sustainability. Environmental education aims to provide opportunities to engage in exploratory learning in order to develop environmental awareness, knowledge, values, attitudes, and skills needed to make informed and responsible choices that protect human health and the environment (United Nations Educational, Scientific, and Cultural Organization [UNESCO], 1977; North American Association for Environmental Education [NAAEE], 2010). The passage of the first National Environmental Education Act in 1970 recognized the importance of environmental education in public schools in the U.S. (Baker, 2000).
Progress in promoting environmental knowledge and behavior has been slow (Coyle, 2005), but encouragingly, environmental education has been integrated into formal school settings. In the 2000s, researchers suggested that environmental education was effective in improving academic achievement among students in grades K-12 (Bartosh, Tudor, Ferguson, & Taylor, 2006; Norman, Jennings, & Wahl, 2006). For example, in one of the largest studies, Lieberman, Hoody, and Lieberman (2005) randomly assigned four schools into environmental education groups with four matching control groups. They found that children who participated in environmental education curricula performed better in writing, reading, and math on standardized state tests compared to children in non-environmental education groups. In response to such research findings, California mandated a law, the Education and the Environment Initiative (EEI), to integrate environmental education into K-12 education in 2011 (California Environment Protection Agency, 2011).

Efforts to integrate environmental education into K-12 education have implications for prekindergarten education. There is increasing attention being paid to preparing prekindergarten children for successful transitions to elementary education because school readiness relates to future academic achievement and college enrollment (Marietta, 2010). However, Yeboah (2002) stated that many children have a hard time adjusting to elementary school settings due to discontinuities in classroom settings, teaching methods, and school policies. Yeboah (2002) suggested that there needs to be a systemic continuation between prekindergarten and elementary education to promote successful transition. Early childhood education would play a role in preparing preschool
children for elementary school by providing the foundations of environmental education along with facilitating emotional, social, physical, and cognitive skills.

Besides getting young children ready for school, early childhood environmental education has the potential to shape children’s perceptions and relationships with the natural environment. Experiences during the first five years of life shape developing brains (Twardoz, 2012). By the age of four, synaptic formation in the human brain occurs at a rapid rate, reflecting the flexibility to develop key affective and cognitive skills, including attitudes and beliefs (Thompson & Nelson, 2001). The brain continues to show plasticity to grow synaptic connections throughout life, but the young developing brain has the optimal capacity to form neural connections (Bavelier, Levi, Li, Dan, & Hensch, 2010; Nelson, 1999). Considering the malleability of the brain, environmental education at early ages could prove to be influential in children learning about environmental stewardship and sustainability.

However, there is little empirical evidence examining early childhood environmental education. For example, there were 39 early childhood environmental education articles from 14 peer-reviewed journals between 1996 and 2007 (Davis, 2009). Most topics focused on preschool children’s knowledge about the natural environment and how children learn in the natural environment such as the efficacy of teaching about gardening projects. Studies that focus on the effects of environmental education curriculum with young children are lacking. There is a need for early childhood environmental education research because such education may build a foundation for the
development of positive environmental experiences and behavior (Chawla, 2008; Davis & Elliott, 2003; Samuelsson & Kaga, 2008).

The present study aimed to investigate the effectiveness of a pilot environmental education program with preschool children in an effort to add to the literature base in this neglected field. The study explored young children’s knowledge and perceptions related to the environment along with changes in their knowledge and perceptions after participating in the program. If the program serves to enhance knowledge and perceptions regarding the natural world, this may help provide models for including environmental education in early childhood education. This may prepare children for a successful primary school experience, and help them meet California’s mandate for environmental education.
Review of the Literature

Children’s Emerging Environmental Knowledge

Experiences during early years of life lay foundations for later skills, values, knowledge, attitudes, and behaviors (Samuelsson & Kaga, 2008). People in environmentally related occupations often choose their professions due to their childhood experiences with the natural world and close adults who taught them to explore and care about the environment (Chawla, 1998). This indicates that childhood educational experiences with environmentally motivated adults may play a role in the development of environmental knowledge and positive environmental perceptions.

Research suggests that children are developing ideas about local and global environmental concerns. Several longitudinal studies investigated changes in children’s knowledge about environmental issues such as waste management, deforestation, and climate change (Palmer, Grodzinska-Jurczak, & Suggate, 2003; Palmer & Suggate, 2004). For example, Palmer & Suggate (2004) interviewed a group of 101 children at four, six, eight, and ten years of age, using pictures of rainforests, polar places, and endangered animals. The researchers asked about children’s knowledge related to distant places and environmental problems. The study found that young children had some knowledge about distant places and the effects of environmental change. Such knowledge increased significantly with age. For instance, when asked about the impacts of climate change on polar ice caps at age four, the children had a hard time describing what would happen to melting ice and snow. By age six and ten, they were able to explain the processes and consequences of melting. Likewise, when asked questions about deforestation, younger
children often provided facts related to forests near their neighborhood and short-term consequences such as immediate outcomes of cutting trees such as animals losing their place to sit, while older children provided long-term consequences such as habitat loss and risks of extinction.

These findings are consistent with known developmental cognitive patterns, so there is really no surprise here. However, there is a need for education about environmental issues for young children because they need accurate information in understanding how individual actions influence both local and distant environments. It is also clear that considerations of developmental appropriateness and the cognitive limitations of young children’s understanding of environmental issues are necessary for any educational program. Based on those findings and the fact that there are few studies with very young children, this study implemented a program to promote knowledge and understanding of global environmental concepts in preschool age children. Most research in this area has been conducted with elementary aged children, so this work will be reviewed first.

**Environmental Education with Elementary School Children**

Examinations of the effectiveness of environmental education programs indicated positive impacts on children’s academic skills (Lieberman et al., 2005). A variety of environmental education studies have been conducted with children in elementary school to show changes in their environmental knowledge (Larson, Castleberry, & Green, 2010). For example, Basile (2000) investigated the effectiveness of a seven week experimental environmental education program with 45 children in third grade in an urban elementary
Children were randomly assigned into an experimental and control group. A science teacher taught a unit on habitats for the first group in a classroom setting and the same teacher integrated hands-on and outdoor environmental activities for the second group. After participating in the programs, the children in the hands-on group were able to state more knowledge related to the program content compared to children with classroom instruction only. This indicates that hands-on environmental education is effective in increasing children’s knowledge.

In sum, research points to young children’s emerging environmental knowledge and concepts (Palmer & Suggate, 2004) and improved environmental knowledge upon participation in environmental education programs. Thus, the current study focused on an attempt to increase young children’s knowledge and promote positive perceptions toward the environment.

Facilitation of Proenvironmental Perceptions among Elementary School Children

Environmental perceptions refer to world views, including attitudes towards nature and resulting in environmental behavior (Bogner & Wiseman, 1997). Most studies of environmental perceptions have attempted to examine environmental attitudes among children; however, scales used to assess environmental attitudes often include behavioral components such as intentions to engage in environmental behavior (Larson et al., 2010). Studies on children’s environmental perceptions found that children generally have proenvironmental perceptions, including interests in and sensitivity toward the environment (Johnson & Manoli, 2011; Vadala, 2004). Interestingly, even though children’s environmental knowledge increases with age (Palmer & Suggate, 2004), their
proenvironmental perceptions seem to decrease after age ten (Larson et al., 2010). Strife (2012) found that the majority of children age ten to twelve gained their environmental information through the media. The amount of time children spent watching television, movies, and news was related to negative feelings such as fear of and anxiety toward current and future environmental conditions. In contrast, some children provided ideas and solutions for environmental problems through environmental actions such as recycling. The researchers found that children gained their knowledge and perceptions from their parents and teachers. This suggests that proper education about the environment has the potential to mitigate the effect of negative media images.

Hungerford and Volk (1990) theorized that environmental education provides basic knowledge and skills that facilitate the development of positive environmental perceptions. To investigate the benefits of environmental education as an intervention strategy to boost proenvironmental perceptions, several studies implemented environmental programs that integrated multiple topics such as global ecology, recycling, composting, and resource conservation. Program evaluations revealed that programs that teach children about the interconnection of ecological topics can increase children’s environmental knowledge and change children’s environmental perceptions positively (Johnson & Manoli, 2011; Larson et al., 2010; Vadala, 2004).

For example, Larson, et al. (2010) conducted an experimental study of the effectiveness of an environmental education program in changing environmental knowledge and perceptions among 133 children ages six to thirteen. The researchers investigated children’s environmental perceptions by measuring their interests in learning
about nature, intentions to protect the natural environment, and awareness of the
importance of ecological interconnections. Sixty four children were randomly assigned
into a five-day environmental education program and 69 children participated in after
school programs without an emphasis on environmental education. Children in the
experimental group participated in a program called Garden Earth Naturalist, a
curriculum developed by the State Botanical Garden of Georgia, Georgia 4-H, and
Georgia Museum of Natural History (Garden Earth Naturalist, n/d). The program aims to
teach children about the interconnections among plants, animals, water, air, and soil. The
locations of the program included a botanical garden, community centers, and youth
centers. Before the program, environmental knowledge and perceptions did not differ
between children in the experimental and control groups. On average, children in both
conditions indicated strong proenvironmental perceptions by showing interest in the
natural environment and the need for environmental protection. However, children of all
ages in the experimental group increased their environmental knowledge and interest in
learning more about the natural environment compared to children in the control group.

The current study aimed to expand on the previous research by implementing a
multi-topic globally-focused environmental education program with preschool children
and an experimental design. Very little work has been done with preschoolers but the
extant literature will be reviewed next.

**Environmental Education with Preschool Children**

There is some evidence that young children have the capacity to gain specific
environmental knowledge from intervention programs. For example, Hadzigergiou,
Prevezanou, Kabouropoulou, and Konsolas (2011) examined the effects of an environmental education program on 159 children ages four and five in eight preschool classrooms in Greece. Children participated in a circle time that taught about the important roles played by trees. The researchers interviewed children to assess knowledge of trees and willingness to participate in tree planting activities before and after the story. Before the tree story intervention, children’s ideas of trees focused around how trees can be used for making products such as furniture, paper, and food. A week after the intervention, children’s ideas about trees reflected the intervention program. For example, children reported that trees were important because they provide protection from flooding and provided oxygen. Children also increased in their willingness to participate in tree planting activities after the intervention. Those findings imply that environmental education has the potential to instill proenvironmental perceptions in preschool children. The study was limited because the program lasted for only one circle time and did not use a comparison group, but it showed the effectiveness of a short environmental education program on improving young children’s knowledge and encouraging environmental behavior.

A similar study from Turkey evaluated an experimental soil education program with preschool children ages five and six from university preschools (Gulay, Yılmaz, Gullac, & Onder, 2010). Ninety six participants were randomly assigned into experimental and control groups. The experimental group consisted of children in the morning programs, and the control group consisted of children in the afternoon programs. The soil program aimed to introduce children to the basic facts about soil, the importance
of soil for living things, causes and effects of erosion, and soil protection. Using a character named Tipitop, the nine-day program provided two to three activities each day such as stories, games, drama, art, and hands-on experiments.

Before and after the program, a researcher showed pictures on a computer screen and asked questions related to soil in order to assess children’s knowledge. Children responded to questions using a computer mouse. At the beginning of the study, soil knowledge of children in the experimental and control group did not differ. After the soil program, children in the program scored higher on the test than children in the control group. The soil program increased children’s knowledge about soil and erosion and increased awareness of the importance of soil protection. Knowledge gains remained upon two weeks after the program. In contrast, knowledge of soil among children in the control group did not change over the span of the study. These studies on early childhood environmental education provide evidence for preschool children’s ability to increase their specific environmental knowledge, awareness, and commitment to environmental causes.

In order to examine whether children gain general environmental knowledge, Witt and Kimple (2008) implemented an environmental education program that incorporates multiple topics such as metamorphosis, plants, and recycling. Eighteen children in a preschool classroom participated in 30-minute activities every day for a month. Before and after the program, the researchers asked children about questions related to program content. For example, children were asked to identify recyclable objects and to tell about photosynthesis. Before the program, the majority of children gave incorrect answers.
related to program content, but most children were able to give accurate information to interview questions after the program. For example, no children could correctly name recyclable objects before the program, but all children were able to give examples of recyclable materials after the program. However, the study is limited due to lack of a control group. The current study expanded the limited literature on preschool children’s environmental knowledge. It investigated the effectiveness of a multi-topic environmental education program with preschool children to examine whether preschool children gain better global understanding of environmental concepts related to the earth as a whole, as well as examining potential change in environmental perceptions.

**Preschool Children’s Environmental Perceptions**

The few existing studies on preschool children’s environmental perceptions suggest that young children have positive perceptions in general about the environment. For example, Musser and Diamond (1999) interviewed 42 preschool age children (25 girls) from a university laboratory preschool by showing two alternative picture cards for each item illustrating environmental or non-environmental actions focusing on recycling, energy saving, and wildlife conservation. Children chose the degree to which those cards represented their own actions and ideas by pointing to big or little circles. Results showed that children provided proenvironmental answers to many questions, including saving water and energy, caring for wildlife and plants, and picking up trash. However, it is unclear whether asking young children about their environmental actions reflected their actual perceptions because young children are still developing their environmental knowledge.
Similarly, a recent interview with 171 preschool children from Turkey revealed that they enjoy outdoor activities and understand the importance of protecting wildlife and plants. Also, children reported that they engage in reusing and recycling in addition to conserving water and electricity. The study also found that environmental perceptions did not differ by gender, but children from high socioeconomic status reported more proenvironmental perceptions than children from low socioeconomic status (Gulay, 2011). This suggests that preschool-based environmental education programs might provide special opportunities for children from lower socioeconomic groups to learn about environmental concepts and improve their perceptions toward the environment.

A primary goal of the current study was to investigate preschool children’s environmental knowledge and perceptions related to ecological topics such as water, composting, recycling, and wildlife, by individually interviewing preschool children before and after participating in an environmental education program. First, this study evaluated whether preschool children who participated in the environmental education program increase their knowledge related to the program content compared to children who do not participate in the program. Second, the study investigated whether preschool children who participated in the program improved their environmental perceptions. Lastly, the current study aimed to examine gender, age, and socioeconomic status in relation to program effectiveness.
Methods

Participants

Power analysis indicated that a total of 64 participants were needed to detect medium effect sizes (Faul, Erdfelder, Lang, and Buchner, 2007). Thus, thirty two participants were to be randomly assigned to the experimental group and 32 to the control group. One hundred and ten participants were actually obtained in the current study from six preschool programs in rural Northern California. Data from three participants who were less than 36 months of age were removed due to inconsistent answers on interview items. This indicated the potential developmental inappropriateness of the interview questions for the youngest children. The remaining 107 participants ranged in age from 36 months to 68 months, with a mean age of 52 months (SD = 7.46 months) and a mode of 60 months. See table 1 for demographic variables.

Twelve children (11.2%) did not complete the post-program interview. An attrition variable 0 (dropped out) to 1 (completed) was used to examine differences in those who completed and dropped out of the study by group, gender, and age. Age in months was categorized into younger children (36 to 53 months) and older children (54 to 68 months) using a median split approach. Chi square analyses revealed that those who dropped out did not differ from those who remained, $\chi^2 (1, 107) = 0.51, p = .55, V = .07$, gender, $\chi^2 (1, 107) = 2.15, p = .34, V = .12$, or age, $\chi^2 (1, 107) = 0.73, p = .54, V = .08$. There were also no differences between participants who completed and dropped out in their pre-program scores on environmental knowledge, $F(1, 103) = 0.29, p = .59, \eta^2$
Thus, children who dropped out of the study did not differ from children who completed it.

Chi square analyses were used to examine the adequacy of randomization. Groups did not differ significantly in percentages on older versus younger participants. However, there were significantly more boys in experimental group, \( \chi^2(1, 107) = 5.5, p = .02, \eta^2 = .23 \). However, variance and sample size ratios met ANOVA assumptions of homogeneity. There were no gender differences in pre-program environmental knowledge or violation of assumptions, so gender was not used as a covariate.

Pre-program scores of environmental knowledge and perceptions between experimental and control groups were examined using one-way ANOVAs. Environmental knowledge did not differ by group, \( F(1, 103) = 0.45, p = .50, \eta^2 = .004 \), gender, \( F(1, 101) = 0.43, p = .52, \eta^2 = .004 \), or age, \( F(1, 104) = 0.55, p = .66, \eta^2 = .02 \).

There were also no gender differences in environmental perceptions, \( F(1, 87) = 1.47, p = .23, \eta^2 = .02 \). However, there were differences in environmental perceptions by group and age at pre-program. The control group scored higher than the experimental group on environmental perceptions at pre-program, \( F(1, 89) = 4.46, p = .04, \eta^2 = .05 \). Also, older children scored higher than younger children, having more positive perceptions at pre-program, \( F(1, 87) = 12.16, p = .001, \eta^2 = .12 \). Thus, analyses utilized age as a covariate when examining perceptions. However, variance and sample size ratios met assumptions of homogeneity.
Procedure

Prior to implementing the environmental education program, a pilot study was conducted with a group of five preschool children in order to examine whether children understood and were interested in the program content. The primary researcher implemented one lesson plan with the children and two research assistants practiced interviewing the five children using the interview protocols.

Table 1

*Demographic Variables (N = 107)*

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<tr>
<th>Variable</th>
<th>Experimental (n = 61)</th>
<th>Control (n = 46)</th>
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<tbody>
<tr>
<td>Gender</td>
<td></td>
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<tr>
<td>Girls</td>
<td>30 (49.2%)</td>
<td>33 (71.7%)</td>
</tr>
<tr>
<td>Boys</td>
<td>31 (50.8%)</td>
<td>13 (28.3%)</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>36-52 (Young)</td>
<td>32 (52.5%)</td>
<td>18 (39.1%)</td>
</tr>
<tr>
<td>53-68 (Old)</td>
<td>29 (47.5%)</td>
<td>28 (60.9%)</td>
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Preschool program directors and teachers were contacted via e-mail, phone calls, and personal networking. Each preschool program sent parental permission forms home for the parents and legal guardians via parent mailboxes. Instead of active consent, passive consent was used due to the lack of sensitive subject matter and minimal, if any risk, to children. Parents and guardians who wished to decline their child from
participating returned the form to their classroom teachers. If parents didn’t mind their children learning about the environment, they needed do nothing. Parents and legal guardians had a week to respond back to classroom teachers. While the consent procedure allowed a larger sample size, there were logistical constraints that prevented the collection of socioeconomic data, so analyses could not be conducted using socioeconomic statuses. See Appendix A for the parental consent form.

The Institutional Review Board (IRB) approved the use of passive consent (IRB 12-026) based on support for the waiver of signed informed consent stated in the United States Department of Health & Human Service’s Code of Federal Regulations (Protection of Human Subjects, 2009). Section 46.117(c) (2) states that the signed consent requirement can be waived if the project can be carried out without signed consent in real educational settings. Given that an environmental education program can be implemented and assessed by teachers and parents in preschool settings, the experimental procedure resembled normal lesson plans children regularly experience in preschools.

Upon consent, each individual child was invited to participate in a pre-program interview by a research assistant in his or her classroom during free-choice activities. Children were told that they could cease participating at any time if they wished. Children’s verbal assent was also obtained during the initial interview. Research assistants led environmental knowledge and perception interviews before and after the program. It took about ten minutes to complete. See Appendix B and C for the measures.

Three preschool classrooms were randomly assigned to the Environmental Education program. Center directors provided children’s ages in months and provided
the percentage of children at their centers who receive government subsidy childcare vouchers. All but one preschool program were privately owned and had a very few families receiving government subsidies for child care services. Thus, as stated above, socioeconomic status could not be examined.

The primary researcher visited each preschool classroom during scheduled group time. Children in the environmental education group participated in seven 15-minute group activities over a four week period. Children in the control group participated in seven 15-minute group activities unrelated to environmental education so that they had the same amount of exposure to the researcher and interviewers. Children’s environmental knowledge and perceptions were assessed by the same two research assistants prior to and at the conclusion of the program.

**Protocol**

**Environmental Knowledge.** This study assessed children’s environmental knowledge using a picture interview developed by the author based on the methodology of the Peabody Picture Vocabulary Test (PPVT) (Dunn & Dunn, 1981). The PPVT measures language abilities such as vocabulary knowledge with children as young as age two. Studies using the PPVT indicated that preschool children can identify correct words by pointing at pictures (Gray, Plante, Vance, & Henrichsen, 1999). Picture interview formats have been used in studies measuring children’s environmental knowledge (Palmer, 1995; Palmer & Suggate, 2004). In the current study, children were shown a total of six picture cards and asked to identify correct items. Each card included a set of
four pictures. For instance, an interviewer showed pictures of animals and ask a child to identify a compost critter. Higher scores indicate more correct answers. See Appendix C.

**Environmental Perceptions.** This is the first study utilizing the revised Children’s Attitudes Toward Environments Scale for Preschool Children [CATES-PV] (Musser & Diamond, 1999) to evaluate an environmental education program. While the name of the scale suggests a measure of attitudes, content taps into environmental perceptions including ideas and resulting behaviors. The original CATES-PV was a 15-item interview scale with a Cronbach’s alpha of .68. Initial development of the CATES-PV was tested with 42 children ages 40 to 73 months (Musser & Diamond, 1999). Evidence for discriminant validity was obtained via a nonsignificant relationship between the scale and a vocabulary test ($r = .24$, $p$ value not provided). A recent study of the CATES-PV with 171 preschool children indicated a Cronbach’s alpha of .72 and test-retest reliability of the scale was established after a two week interval at $r = .95$, $p < .001$ (Gulay, 2011). Although these lower alpha levels were not ideal, there were no other measures of preschool children’s environmental perceptions available. The content of the measure overlapped with the current study’s lesson plans and allowed an evaluation of changes in environmental perceptions over time. Considering that this is a pilot study, this measure was used and modified.

Some items on the CATES-PV illustrated situations over which children have little control. For example, one item asks children about their preference of residence locations and another question asks children whether they support hunting versus animal protection. These items reflect family values and choices, not purely environmental
perceptions; thus, they were removed from the interview protocol based on considerations of developmental and cultural appropriateness as stated by the

*Developmentally Appropriate Practice in Early Childhood Programs Serving Children from Birth through Age 8* (2009) established by the National Association for the Education of Young Children (NAEYC). Furthermore, the current study modified sentence structures used in the original questions because they contained judgmental language that could mislead children to answer how researchers desired. For example, the original questions presented that “some children” engage in environmental behavior while “others” engage in nonenvironmental behavior. In order to show children that people behave differently, questions in the current study used “some children” to describe both environmental and nonenvironmental behavior. In addition, three new items were added to reflect lesson plans on composting and electric energy.

The original internal consistency reliability of the current modified CATES-PV was $\alpha = .40$. The deletion of items from the scale was decided based upon item reliability and content analysis. Item number two, “Some children use both sides of paper when they draw or write. Some children only use one side of the paper when they draw or write” was deleted because it did not correlate with the other items in the scale. Item number seven, “Some children like to play inside. Some children like to play outside” was discarded due to the lack of clarity in relation to environmental perceptions. Item number fourteen, “Some children put left over food in special place for composting. Some children don’t have a special place to put left over food for composting” was discarded due to lack of clarity and a weak correlation with other items. The modified
CATES-PV-R was summed using twelve items. Unfortunately, this only increased internal consistency to $\alpha = .57$. Scores range from zero to 48 with higher scores indicating proenvironmental perceptions. See this measure in Appendix B.

**Lesson Plans.** The current study implemented an environmental education program, Heroes of the Environment in Training, developed by the author based on integrations of elements of environmental education programs and activities for young children such as the Garden Earth Naturalist (n/d), Project Learning Tree (American Forest Foundation, 2010), Project WET (Project WET Foundation, 2000), and Hands-On Nature (Lingelbach & Purcell, 2000). Larson et al. (2010) demonstrated that a multiple topic environmental education program like the Garden Earth Naturalist was effective in increasing children’s environmental knowledge. The environmental education program introduced children to global topics about whole ecosystems using pictures, stories, puppets, and demonstrations over a four week period. Previous studies found that storytelling and hands-on activities were effective in increasing preschool children’s knowledge and changing their behavior (Crozier & Tincani, 2007).

The lesson plans are designed to integrate the quality criteria for developmentally appropriate curriculum standards of the *Early Childhood Environmental Education Programs: Guidelines for Excellence* created by the North American Association for the Environmental Education (NAEEE, 2010). The guidelines state that early childhood environmental education programs should teach children about interconnections among ecological systems; similarities and differences among plants, animals, places, and people; and discuss how people can engage in environmental actions. Based on the
framework, the lesson plans provided opportunities for children to participate in group activities that facilitate multiple experiences and social interactions in order to develop environmental knowledge and skills. See Appendix E for complete lesson plans.
Results

Changes in Environmental Knowledge

Changes from pre- to post-program scores between the participants in the experimental and control groups were analyzed using mixed model ANOVAs. There was no main effect for group, $F(1, 87) = 0.45, p = .50, \eta^2 = .005$, or a group by time interaction, $F(1, 87) = 0.02, p = .89, \eta^2 = .20$. However, there was a main effect for time, $F(1, 87) = 22.03, p < .001, \eta^2 = .20$. Children in the experimental and control group both improved their environmental knowledge equally over time. See table 2 for changes in means and standard deviations in environmental knowledge by group.

Table 2

Means and Standard Deviations in Environmental Knowledge by Group

<table>
<thead>
<tr>
<th>Group</th>
<th>Pre</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$M$</td>
<td>$SD$</td>
</tr>
<tr>
<td>Experimental</td>
<td>2.1</td>
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</tr>
<tr>
<td>Control</td>
<td>2.0</td>
<td>1.1</td>
</tr>
</tbody>
</table>

Gender. Group and gender were used as factors to analyze environmental knowledge in mixed model ANOVAs. There was no main effect for group, $F(1, 85) = 0.97, p = .33, \eta^2 = .01$, or gender, $F(1, 85) = 0.58, p = .58, \eta^2 = .01$. However, there was a main effect for time, $F(1, 85) = 13.72, p < .001, \eta^2 = .14$. This result was qualified by a significant time, group, and gender interaction with a medium effect size, $F(1, 85) = 7.43, p = .01, \eta^2 = .08$. Simple effects tests revealed that boys in the experimental group
significantly improved their environmental knowledge from pre- to post-program, $F(1, 34) = 5.16, p = .03, \eta^2 = .13$. Environmental knowledge among boys in the control group remained the same. Girls did not improve over time, $F(1, 51) = 2.43, p = .13, \eta^2 = .05$ (See Figure 1). This finding indicates that boys in the experimental group improved more in their environmental knowledge than girls of either group or boys in the control. Table 3 shows changes in means and standard deviations in environmental knowledge by group and gender.

**Age.** Group and age were used as factors in mixed model ANOVAs. There was no main effect for group, $F(1, 85) = 0.70, p = .41, \eta^2 = .008$. However, there were main effects for age, $F(1, 85) = 3.91, p = .05, \eta^2 = .04$, and time, $F(1, 85) = 21.62, p < .001, \eta^2 = 20$. These results were qualified by a time by age interaction, $F(1, 85) = 4.53, p = .04, \eta^2 = .05$. This finding indicates that older children scored higher than younger children, regardless of group membership, improving their environmental knowledge over time. See Table 3 for means and standard deviations.
Table 3

*Means and Standard Deviations in Environmental Knowledge by Group, Gender, and Age*

<table>
<thead>
<tr>
<th></th>
<th>Experimental</th>
<th>Control</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Girls</td>
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<td>2.7</td>
</tr>
<tr>
<td>Boys</td>
<td>1.9</td>
<td>3.1</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Young</td>
<td>2.3</td>
<td>2.5</td>
</tr>
<tr>
<td>Old</td>
<td>2.0</td>
<td>3.2</td>
</tr>
</tbody>
</table>

*Note. *p < .05.

Figure 1

*Changes in Environmental Knowledge from Pre- to Post-Program by Group and Gender*
Changes in Environmental Perceptions

Mixed model ANCOVAs were used to test environmental perceptions using time and group as factors. Age in months was controlled due to a significant difference between younger and older children at pre-program. There were no main effects for group, $F(1, 69) = 2.59, p = .11, \eta^2 = .04$, or time, $F(1, 69) = 0.07, p = .79, \eta^2 = .001$. Also, there was no group by time interaction, $F(1, 87) = 0.05, p = .83, \eta^2 = .07$. However, the results indicated that participants in general showed proenvironmental perceptions, scoring at the top range of the perception scale. The control group was significantly higher at pre-program than the experimental group. This indicates a possibility of a ceiling effect. See table 4 for changes in means and standard deviations in environmental perceptions by group.

Table 4

Means and Standard Deviations in Environmental Perceptions by Group

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th></th>
<th>Post</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Group</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td>37.5</td>
<td>5.4</td>
<td>38.9</td>
<td>6.3</td>
</tr>
<tr>
<td>Control</td>
<td>39.1</td>
<td>5.0*</td>
<td>40.8</td>
<td>4.2*</td>
</tr>
</tbody>
</table>

Gender. Group and gender were also used as factors in mixed model ANCOVAs. There was no main effect for group, $F(1, 67) = 1.50, p = .23, \eta^2 = .02$, or time, $F(1, 67) = 0.45, p = .83, \eta^2 = .001$. Also, there was no group by time by gender interaction, $F(1, 68) = 0.001, p = .98, \eta^2 = .001$. However, there was a trend toward main effect for gender,
$F(1, 67) = 3.31, p = .07, \eta^2 = .05$. While it was nonsignificant, gender demonstrated a medium effect size. This finding indicates that environmental perceptions among girls and boys in both groups remained the same over time, but girls scored higher than boys at both pre- and post-program (See Table 5).

Table 5

*Means and Standard Deviations in Environmental Perceptions by Group, Gender, and Age*

<table>
<thead>
<tr>
<th></th>
<th>Experimental Pre</th>
<th></th>
<th></th>
<th>Control Pre</th>
<th></th>
<th></th>
<th>Control Post</th>
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<td>$SD$</td>
<td>$M$</td>
<td>$SD$</td>
<td>$M$</td>
<td>$SD$</td>
<td>$M$</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Girls</td>
<td>38.0</td>
<td>5.0*</td>
<td>39.5</td>
<td>5.5*</td>
<td>39.6</td>
<td>5.1*</td>
<td>41.4</td>
<td>3.6*</td>
<td></td>
</tr>
<tr>
<td>Boys</td>
<td>36.5</td>
<td>5.8-</td>
<td>38.1</td>
<td>7.2</td>
<td>37.8</td>
<td>4.9</td>
<td>39.3</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Young</td>
<td>35.9</td>
<td>6.8-</td>
<td>36.3</td>
<td>6.2</td>
<td>37.4</td>
<td>5.1</td>
<td>39.8</td>
<td>4.5</td>
<td></td>
</tr>
<tr>
<td>Old</td>
<td>38.7</td>
<td>3.6*</td>
<td>41.0</td>
<td>5.7*</td>
<td>40.5</td>
<td>4.7*</td>
<td>41.6</td>
<td>3.9*</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* $*p < .05.$
Discussion

Changes in Environmental Knowledge

This study was the first experimental study to utilize the Environmental Knowledge scale to evaluate whether children retain information presented in an environmental education program. The results show that environmental knowledge increased significantly for boys in the experimental group with a medium effect size, compared to no significant change for girls or boys in the control group. Also, older children improved more than younger children, regardless of group, indicating the program may be more appropriate for children between four and a half to five and a half instead of three to four year olds.

The results of the current study partially support the hypothesis that predicted an increase in environmental knowledge among program participants. However, this finding is inconsistent with existing environmental education research with young children such as Gulay et al. (2010) and Hadzigeorgiou et al. (2011) who found effectiveness of single-topic environmental education programs for experimental boys and girls. Also, the current study is inconsistent with Larson et al. (2010) who evaluated the effectiveness of an experimental five-day multi-topic environmental summer camp program with children age six to thirteen and found that both boys and girls in the environmental program improved their environmental knowledge significantly. These results suggest that the environmental program used in the current study may not be effective in increasing all children’s environmental knowledge, but may work better for boys and may be best suited for relatively older children.
The medium effect size for boys in the environmental education group indicates a possible gender bias in the environmental program. Because the education program used a theme of environmental heroes, this might have attracted boys’ attention more than girls’. While gender has been studied little in environmental education research with preschool children, the current result contradicts Larson et al. (2010) who found no gender difference in environmental knowledge among children between six and thirteen who participated in a five-day environmental education program. These mixed results may reflect the differences in participant ages, program content, instructions, and evaluation methods. Future researchers should further explore gender in relation to program effectiveness. Educators using the current environmental education program are encouraged to modify the program in order to reduce possible gender bias.

Older children in the current environmental program increased their environmental knowledge over time more than younger children, regardless of group, with a medium effect size. This finding is consistent with Palmer & Suggate (2004) who found a relationship between age and environmental knowledge. Few studies have been conducted with very young children in environmental education. Future researchers are encouraged to conduct a longitudinal program evaluation to examine developmental changes in environmental knowledge by group.

Changes in Environmental Perceptions

This was the first study to examine whether environmental perceptions among preschool children changed upon participating in the environmental education program, utilizing the revised Children’s Attitudes toward the Environment Scale (CATES-PV-R).
Some individual items from each subscale were deleted to increase Cronbach’s alpha, as discussed in the results section. While low internal consistency of the scale was problematic, there were no other measures of preschool children’s environmental perceptions available.

Using this measure, it does not appear that the program was effective in promoting positive environmental perceptions, contrary to what was hypothesized. Overall, environmental perceptions began high, scoring at the top range of the perceptions scale, and remained positive over time. The current study was conducted in a fairly progressive part of the country where many families instill proenvironmental perceptions early on. Future researchers are encouraged to explore the extent of socioeconomic status and family practices in relation to environmental perceptions.

This result contradicts Larson et al. (2010) who found an increase in positive environmental perceptions with elementary school children. However, the results support a study conducted by Eagles and Demare (1999) who found that environmental perceptions did not change among sixth-grade students. They found that positive environmental perceptions were related to family interest in the environment and exposure to environmental films and books. These inconsistent findings may imply differences in assessment measures, children’s ages, populations selected, and curriculum content. Moreover, mixed results imply the need for further investigation into the development of environmental perceptions in childhood. Because past research has shown a general decrease in positive perceptions as children got older (Strife, 2012), programs such as the current one may serve to maintain the commonly found positive
perceptions of younger children. Future researchers are encouraged to conduct a longitudinal program evaluation in relation to age changes in perceptions.

Furthermore, in the current study, while there were no gender differences in change over time, there were gender differences in environmental perceptions as a whole with a medium effect size, with girls in general scoring higher than boys. This finding is consistent with Larson et al. (2010) and Eagles and Demare (1999) who examined environmental perceptions among elementary school students and reported no changes in environmental perceptions in relation to gender, but girls' environmental perceptions in those studies were higher than boys. This could be an indication of the beginning of gender differences in environmental perceptions. Future researchers are encouraged to study emerging gender differences in environmental perceptions and how to promote positive perceptions in boys.

**Limitations**

Participants in the current study were obtained through preschool programs that indicated their interest in environmental education. Many preschool programs contacted in the community declined to participate due to administrative reasons and lack of interest in a study conducted by a graduate student. Due to limited information on socioeconomic status such as education and income levels of families and schools, the study could not examine socioeconomic status in relation to program effectiveness, as was hypothesized. Future researchers are encouraged to include diverse preschool programs in order to tap into socioeconomic variables in relation to program effectiveness.
Because this was a pilot study, implementation of certain modules may have been less effective as the researcher had never taught the program before. The effect of the environmental education program may be improved by training program instructors and introducing multiple environmental activities such as art, music, and dance, as Gulay et al. (2010) did. Because classroom teachers have the ability to integrate different activities to introduce topics to children, future researchers are encouraged to study the effect of the environmental education program implemented by preschool teachers. An environmental education program like the current one may be used as a tool to train early childhood environmental educators. Classroom teachers who participated in this project shared their ideas and encouraged children to think about topics during group time. They may be important allies in environmental education research.

The current exploratory study is limited due to lack of available psychometrically sound measures. The Children’s Attitudes toward the Environment Scale (CATES-PV) is the only psychometrically tested scale in this area of study to date. The original scale showed an internal consistency of .68 and a correlation with age (Gulay et al., 2011; Musser & Diamond, 1999). Thus, the lack of significant findings in environmental perceptions in the current study can be partially attributed to the low internal consistency. Future studies are encouraged to develop better measures and utilize longitudinal designs that include follow-up measures, such as three-month and 12-month follow-ups, and as well as continued use of control groups.

Preschool environmental education has been researched very little due to limitations in verbal and written skills of young children (Davis, 2009). Thus, early
childhood education researchers often utilize qualitative research methods in order to illustrate processes and interactions happening among children (Berg & Lune, 2012). The presence of a research educator may have influenced the dynamics of and interactions among children and adults at each site in the current study. For example, the interviewers improved their skills over time and became more efficient toward the end of the study. Qualitative aspects of the learning environment should be monitored and assessed.

It is beyond the scope of the current study to identify what influenced the control group to increase in their environmental knowledge over time. However, it is possible that children at post-interview were more familiar with the tasks and interviewers. It is also possible that children in the control group were exposed to environmental activities at home and school after receiving the consent letter, which included types of environmental topics to be presented at group time. Similarity, it is possible that the presence of researchers influenced children, teachers, and schools to be more environmentally aware. Future researchers are encouraged to observe children and school environments as well as interviewing parents and teachers (Berg & Lune, 2012).
Conclusion

The current exploratory evaluation of an experimental environmental education program, Heroes of the Environment in Training, shows its potential to increase environmental knowledge among preschool children, especially for boys and perhaps best suited for older children. Along with Gulay et al. (2010) and Larson et al. (2010), this study contributes to the attempts at developing the appropriateness and effectiveness of environmental education in increasing environmental knowledge at the preschool level. Even though the results of this study suggest that the program did not change environmental perceptions regardless of group, gender or age, it revealed relatively positive proenvironmental perceptions in preschoolers, which may be maintained over time. Programs may be able to prevent the decline found in environmental perceptions in older children (Strife, 2012). In addition, it showed that girls had more positive environmental perceptions than boys. These findings support past research on young children’s environmental perceptions.

This study is important because it had adequate statistical power (Aberson, 2010), included the largest sample size from multiple sites ever examined, and used an experimental design with random assignment. These elements are rare within community-based environmental education research. While the program was not effective for all children, these results can inform educators about how to integrate developmentally and culturally appropriate environmental education at the preschool level. This study encourages early childhood educators to further integrate environmental education in order to prepare preschool children for elementary school by providing the foundations of
environmental education. Interdisciplinary research is needed to continue evaluating environmental education programs to increase environmental knowledge and promote positive perceptions among preschool children through empirically validated education programs.
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http://www.hhs.gov/ohrp/humansubjects/guidance/45cfr46.html


10.1080/00958964.2011.602131


Appendix A
Parental Consent to Participate in Research

Your child will participate in an environmental education program. This program focuses on issues around environmental sustainability and knowledge about the earth. In order to find whether the program is effective in teaching preschoolers about the environment, each child will be interviewed by researchers from Psychology Department at Humboldt State University before and after the program to see if they understood the lesson plans or if the lesson plans need improvement.

If you consent for your child to participate in interviews and activities, you need do nothing. If you do not want your child to participate, please return the attached form by _____.

What is involved? Children will be interviewed individually about animals, recycling, water saving, and energy saving. It will take about 15 minutes to complete the interview. Then, children will participate in interactive 15 minute group activities that explore natural environments, wild animals, recycling, and water and energy saving during their regular school day for four weeks. At the completion of the 7 activities, children will be interviewed individually to determine whether the program helped them gain environmental information.

The study will be scheduled so that your child’s routines are not disrupted. One possible benefit of being in the project may be that the group activities increase children’s knowledge related to environmental and sustainability issues. This research project will help teachers and parents better understand the effectiveness of an early environmental program for young children. The only downside is the time involved where children may miss other activities.

Participation is voluntary. The researcher will answer any questions you have concerning the program and the interview. Your child’s participation is entirely voluntary and he/she may decline or withdraw at any time without consequences. The researcher may ask your child to stop participating in the study at any time if necessary as well.

Information is confidential. The interview does not contain questions requiring identifying information about your child. All information will be strictly confidential and anonymous. Identification numbers, not personal information, will be used in data analysis. These interviews will be used only for research purposes and only trained researchers will see this information. All interviews will be securely stored in a locked filing cabinet in the Developmental Psychology laboratory at Humboldt State University and completely destroyed upon completion of the study. You may contact the researchers if you desire to know the combined study results for all participants (individual results will not be available as the interviews are anonymous).
If you have questions regarding the interview, curriculum, and/or your child’s participation, or desire a copy of the results, you can contact Suzuka Muraoka at sm140@humboldt.edu or 707-443-8322 x206 or the supervising professor Dr. Tasha Howe at th28@humboldt.edu or 707-826-3753.

If you have questions regarding your child’s rights as a participant, any concerns regarding this project, or any dissatisfaction with any part of this study, you may report them confidentially, to the Dean for Research & Sponsored Programs, Dr. Rhea Williamson at Rhea.Williamson@humboldt.edu or (707) 826-4189.

*Please keep this page for your records*

I have read the attached parent al consent form. I understand that by signing below I indicate that I DO NOT CONSENT to my child participating in the research interview or the seven sessions about the environment.

Parents who will allow their child to participate **do not need to** return this form.

__________________________  _____________________________
Parent/Legal Guardian/Primary Caregiver Name Printed  Name of Child Participant

__________________________  _____________________________
Parent/Legal Guardian/Primary Caregiver Signature   Date
Appendix B

Environmental Perceptions Scale

An interviewer will show each child two alternative picture cards for each item illustrating environmental or non-environmental actions. Children will be asked to choose which picture is most like what they usually do. Then children will be asked to choose whether they are a lot or just little like that picture by pointing to big or little circles for each interview item. The script shown below will be read to children.

Interview Items:

1. Some children leave the water running when they brush their teeth. Some children turn the water off while brushing their teeth. Which child is most like you? Point at a big circle if you are a lot like the child or point at a little circle if you are little like the child.

2. Some children think we should recycle things. Some children think we can throw things away when we are done using them. Which child is most like you? Point at a big circle if you are a lot like the child or point at a little circle if you are little like the child.

3. Some children like to look at plants and bugs outside but never bring them home. Some children like to bring home plants and bugs they find outside. Which child is most like you? Point at a big circle if you are a lot like the child or point at a little circle if you are little like the child.

4. Some children like to feed the birds. Some children don’t like to feed the birds. Which child is most like you? Point at a big circle if you are a lot like the child or point at a little circle if you are little like the child.

5. Some children think people and animals are both important. Some children think animals aren’t as important as people. Which child is most like you? Point at a big circle if you are a lot like the child or point at a little circle if you are little like the child.

6. Some children like play outside. Some children like to play inside. Which child is most like you? Point at a big circle if you are a lot like the child or point at a little circle if you are little like the child.

7. Some children don’t pick up trash when they see trash on the ground. Some children pick up trash and throw it away when they see trash on the ground. Which child is most like you? Point at a big circle if you are a lot like the child or point at a little circle if you are little like the child.
8. Some children sort their bottles and cans and recycle them. Some children throw bottles and cans into a trash bin. Which child is most like you? Point at a big circle if you are a lot like the child or point at a little circle if you are little like the child.

9. Some children think that people need to help wild animals. Some children think people don’t need to help wild animals. Which child is most like you? Point at a big circle if you are a lot like the child or point at a little circle if you are little like the child.

10. Some children leave the lights on when they leave a room. Some children turn the lights off when they leave a room. Which child is most like you? Point at a big circle if you are a lot like the child or point at a little circle if you are little like the child.

11. Some children think it is important to save water. Some children think that it is not important to save water. Which child is most like you? Point at a big circle if you are a lot like the child or point at a little circle if you are little like the child.

12. Some children think it is important to turn the lights off. Some children think it is not important to turn the lights off. Which child is most like you? Point at a big circle if you are a lot like the child or point at a little circle if you are little like the child.
Appendix C

Environmental Knowledge Interview

An interviewer will show a picture card with four different illustrations for each interview item. Children will be asked to choose a correct picture to each question.

1. Point at a wild animal.
2. Point at a natural environment.
3. Point at where you can find the most water in the world.
4. Point at a compost Critter.
5. Point at a place where electricity is made.
6. Point at the recycling sign.
Appendix D
Lesson Plans

Lesson 1: Introduction: What are environments?

Objectives: To explore characteristics of natural and human-made environments on the earth.
Time Expected: 15 minutes

Materials:
- Small mats for children to sit on
- Earth Ball (inflatable or model) & a sheet that covers the earth ball
- Giant post its & markers for the instructor.
- Pictures of natural and human-made environments
  (Ocean, river, forest, farm, home, school, city)
- A tote for keeping materials
- Earth shaped stickers

Preparation:
1. Cover the earth ball and place landscape pictures in a tote.
2. Draw a chart on the giant post it and set aside markers in the tote.
3. Locate mats at a story area

Procedures:
1. Invite children to the circle.

2. Introduction
   “Hello, my name is Sue and this is (research assistant). We are happy to be here at (name of the cite). We are here to talk about a place called the earth.” Uncover the earth ball.

   “It is a big place, but if we shrunk everything very tiny, this is what the earth would look like. This is a place all the people, animals, and plants live.”
   Show them where they live in.
   “Which part do you think is the ocean? The ocean is one kind of environment. Is it a big or small environment? What animals can we find in the ocean environment? Is this a natural or human-made environment?”
There are many places we call environments on the earth. Environments are our surroundings with living things and non-living things and natural and human-made things. It can be very small or very big. Today, we will talk about different environments.

3. **Discussion: Exploring Environments**

Show a picture of the **city**.

“This is a different kind of environment from the ocean. What kind of environment do you see? What living things can we find in this environment? Is this a natural or human-made environment?”

Write down children’s responses on the paper.

Show a picture of a **river**.

“What kind of environment do you see? What living things can we find in this environment? Is this a natural or human-made environment?”

Show a picture of **preschool**.

“What kind of environment do you see? What living things can we find in this environment? Is this a natural or human-made environment?”

Show a picture of the **garden/farm**.

“What kind of environment do you see? What living things can we find in this environment? Is this a natural or human-made environment?”

Ask if children can think of any other environments.

4. **Review Question**

“We found that there are different kinds of environments on the earth. Some environments are natural and some are human-made. Which environment do you like?”

5. **Preview**

“We will learn more about the environment and ways children and adults can be heroes of the environment for next few weeks. We will be back to your school to talk more about important things heroes need to know about the environment. We will see you next time!”
Lesson 2: A drop in the Hand: Water Heroes Save Water

Objectives: To demonstrate availability of fresh water on the earth and discuss water saving.

Time Expected: 15 minutes

Materials:
- □ Small mats
- □ Earth Ball
- □ Giant post it & markers
- □ Props for a Drop in the Hand demonstration
  - ▪ A picture of glacier
  - ▪ 1 liter jug
  - ▪ 1 medium-size clear and small-size cup
  - ▪ A table spoon & a teaspoon
  - ▪ 1 eye dropper
- □ Water drop puppets

Preparation:
1. Set up the giant post its. Display the chart from the lesson 1.
2. Cover the earth ball.
3. Locate mats at a story area

Procedures:
1. Invite children to the circle time.
2. Recap

“Hi, children. We are glad to be back here at (site name). Last time we talked about different environments.” Show the chart on the giant post it from Lesson 1.”

3. Introduction to Water
“Today, we will talk about the mystery of water. Last time, we saw that the most water is in the ocean. But, we can find water in different places. Where can we find water around us? There is also water in rivers and lakes. There is frozen water called glaciers. And, we can get water from the faucets at home and school.
4. Demonstration: A Drop in the Hand
   a. “Now we will do an experiment. Let’s pretend that we have all the water in the world from the ocean, ice caps, rivers, lakes, swimming pools, bathtubs, and kitchen in this jug. We know that the most water is in the ocean.”
   b. Scoop 2 table spoons of water into a cup.
      “The water left in the jug shows all the water in the ocean.”
      Sprinkle salt into the original jug.
      “Because this water is salty, you cannot drink it.”
      In this small cup, it shows how much fresh water we have in the world. Fresh water is not salty, so people, animals, and plants can use it.
   c. “But, most of the fresh water on earth is frozen in glaciers and ice caps in the North Pole and South Pole. (Show pictures glaciers & where the poles are on the earth ball). Only a tiny amount of earth’s water is not frozen. I will scoop a teaspoon of water into a dish.”
   d. “On the dish it shows how much fresh water we have. And, most of the fresh water is hidden deep under the ground, so we cannot use that water. Here is an eyedropper. In this eyedropper, there is all the water we have on earth for drinking, washing, swimming, growing vegetables and fruits, and doing all other things that needs water.”
   e. “Hold your hand out so that you can see a drop of water.” Use an eyedropper and put a drop of water on child’s hand

5. Discussion
   “There is much more water in the real world because we pretended that we have all the earth’s water in a big jug. But you can see that we share a very tiny amount of water with many people, animals, and plants. Many people think about ways to save water. What can we do to take care of our water so there will be enough water for everyone?

Write down children’s ideas on the post it.
(Some ideas: You can turn the water off while brushing your teeth. You can collect rain water for water play. You can take quick showers. You can make sure that faucets and pipes are not leaking.)

6. Ending
   “We have learned a lot about water today. Be sure to tell your families your ideas about ways to save water.”
Lesson 3: Wildlife Rescues

**Objectives:** To examine wild and non-wild animals and to discuss how people can help wildlife.

**Time Expected:** 15 minutes

**Materials:**
- □ Small mats
- □ Giant post it & markers
- □ Pictures of wild animals and not wild animals
- □ Pictures of wild animals at Wildlife Care Center
- □ A picture of animal rescue by Russel
- □ Scotch tape
- □ Wildlife stickers

**Preparation:**
1. Cut out wild/not wild animal pictures.
2. Set up the giant post it. Display children’s ideas from Lesson 2.
3. Locate mats at a story area.

**Procedures**
1. Invite children to the circle time

2. Recap
   “Last time we learned that there is lots of water in the ocean but there is little fresh water. Fresh water is not salty, so people, animals, and plants can use it. We talked about how we can save water.”
   Restate children’s ideas about ways to save water from the chart.

3. Introduction to Animals: What is Wild Animal?
   “Today, we will talk about wild animals. Wild animals live in the natural environment and find their own food and shelter in their natural environments. I have pictures of wild and not wild animals here. Let’s find out which animals are wild and which ones are not wild?”
   Show assorted pictures of wild and domesticated animals and ask children which ones are wild and not wild. Attach each picture on the post it.

4. Activity 1: Story of Wildlife Care Center
   “Now, I will tell you a story about a friend of mine who saves and helps wild animals.”
You may have seen wild animals. Sometimes, wild animals get lost, sick, or hurt like people. One day, my friend, Russel, found a baby harbor seal when he was walking on a trail by the beach. He thought that a seal mother was gone fishing for the baby, but the mother seal never came back. He knew that some wild animals need help and people at a wildlife care center can rescue wild animals. He called the wildlife care center, and he was able to bring the seal to the center. At the care center, animals will get physical examinations, food, and medicine if needed. They will stay at the center till they are ready to go back to their home. The wildlife care center is like a hospital for wild animals. The baby seal stayed at the center and practiced how to catch fish for 3 months. When the baby seal was ready to go back to the ocean, Russel went to the beach and watched the baby seal go back to the ocean. (Show a picture of Russel rescuing a seal). The wildlife care center helps other wild animals like baby skunks, porcupines, owls, and eagles. Many of them had broken legs and wings. The wildlife care center will take care of them and help animals go home in their natural environment. (Show pictures of rescued wildlife)

5. Review
“We have learned a lot about wildlife and how people can rescue and save them. If you see any wild animals in need of help, make sure you ask adults to call the wildlife care center. This way you can be heroes of wild animals. What is your favorite wild animal?”
Write down children’s responses.

6. Ending
“Next time, we will talk more about how people can be superheroes of the environment”
Lesson 4: Superheroes of the Underground: The Compost Critters

Objectives: To introduce roles of decomposers and learn about composting.

Time Expected: 15 minutes

Materials:
- Small mats
- Giant post it & markers
- Sample of leaves with holes
- Soil in a clear tub
- Pictures of compost critters, earthworm anatomy, and compost ingredients
- Pictures of compostable and not compostable food
- A small compost bin

Preparation:
1. Put leaves and soil in a clear tub.
2. Locate the giant post it. Display the page from Lesson 3.
3. Locate mats at a story area

Procedures
1. Invite Children

2. Recap
“Last time we talked about wildlife animals like seals, raccoons, and eagles. We talked about how people can rescue them if wild animals need help. You call the wildlife care center if you find wildlife animals.”

3. Introduction
“Today, we will talk about wildlife but they are the superheroes of the underground.”

4. Activity 1: Earth Worms: The Compost Critter Picture Story
“I brought leaves from a forest floor. You can see that there are holes and some are big.”

   Show the samples.

“Those holes were made by the compost critters. These are pictures of some compost critters. What do you see? Creatures like earthworms, slugs, roly pollies, slugs, and snails that eat leaves like these in the forest. The compost critters eat leaves and branches that fell from trees and they make soil by pooping so that plants can grow. It sounds funny but this is very important.”
One of very important compost critters is earthworms. You may have seen it in the gardens, under logs, or sidewalks after the rain. They live under the ground, making long tunnels eating through the dirt and leaves on the ground. They may look different from people, but like us an earthworms has muscles to move their bodies; mouth, throat, and stomach inside of their bodies for eating and digesting food; and brain and heart. They are different from people because they do not have eyes, ears, teeth. They like dark places and like to move around at night. At night, they wiggle out of their tunnels and pull leaves down into their tunnel so that they can eat. They actually know how to pull leaves into their tunnels by the skinniest end firs.

They can eat lots of things as long as they are plant-based. They can help people too because they can eat kitchen scraps like vegetable and fruit peels, leaves from trees, and even small pieces of paper and cardboard boxes because paper is made from trees. This is called composting. In fact, some people have compost piles or bins so that they can give earthworms leftovers. Earthworms can eat up vegetable scraps and paper, and make soil to grow vegetable and fruits. Compost systems can look different but they all make soil in the end.

Show a card of sample compost system

5. Review
“I have 2 pictures of bins here. One bin has earthworms in it. We will practice putting things we can put in the compost bins. Remember earthworms like to eat vegetables but not meat. I will show you some pictures of food. You can tell me if we can put the food or not.”
Show children food pictures (fruit peels, meat waste, plastic, grass clippings, paper).

6. Ending
“We have learned a lot about earthworms. They are wiggly superheroes of the underground. You can start a compost system at home and school so that we can make soil to grow vegetables and plants. Next time, we will come back and talk more about heroes of the environment.”

Each child gets an earthworm puppet.
Lesson 5: Recycling: Minor Actions of Heroes

Objectives: To identify the recycling sign and to learn about recycling processes.
Time Expected: 15 minutes

Materials
- Small mats
- Giant post it & markers
- Samples of assorted recyclables (cans, plastic bottles, paper, cardboard boxes, books)
- 3 paper bags
- Diagram of Paper Recycling and Life-Cycle of the Aluminum Can
- Recycling stickers

Preparation
1. Put sample recyclables in a tub.
2. Attach recycling labels on paper bags.
3. Locate the giant post it & mats at a story area

Procedures
1. Invite Children

2. Recap
   “Last time we talked about compost critters. Compost critters are small animals like earthworms. They can help people because when people have left overs of vegetables, earthworms can eat them up and make soil by pooping.”

3. Introduction to Recycling
   “Today, we will talk about ways people can be superheroes at home and school. Many of you and your families may already do this, but this happens when we are dealing with trash and garbage. Have you seen this sign?” Show the recycling sign.

   “This is a recycling sign. Recycling is a superhero action because we can make new stuff from old stuff. There are lots of things you throw away can be recycled. Paper, plastic bottles, soda cans, batteries, and electronic equipment like cell phones and computers.

   Let’s find out how paper gets recycled. Recycling trucks will pick them up and drive them to recycling centers. Old paper is dumped in a big tab and washed with soapy water to remove inks, staples and glue. Old paper is mixed with water and different chemicals. Then the new paper is spread using large rollers into long thin sheets. The paper is left to
dry, and then it is rolled up ready to be cut and sent back to the shops. Why do you think it is important to recycle paper? What do we need to make brand new paper? Trees! Recycling paper is a helpful action because fewer trees will be cut to make new paper.

Similar things happen to empty cans too. Recycling trucks collect cans and bring them to a recycling center. Cans are crushed and flattened into big blocks called bales. Bales get shredded, melted, and made into large blocks called ingots. Ingots are rolled out to make thin sheet. Then, the sheet is shaped into new aluminum cans. Cans are 100% recyclable and can be re-used forever! A used can can be recycled into a new can filled with drink within 60 days! (Show Life-Cycle of the Aluminum Can).

4. Practice Sorting Recyclables
“Recycling starts with sorting. Some places and families have different ways of sorting recyclables, but we will practice sorting paper, plastic, and aluminum today. I have a tub with recyclable items. Here, I have 3 bags. One for paper recycling, one for plastic recycling, and one for aluminum. Let’s practice recycling. Raise your hand if you want to take a turn to practice.”

5. Ending
“You can help your family and school to recycle. Be sure to tell your families that we can recycle many things we put into the trash!”
Lesson 6: Electric Power and Energy Savors

Objectives: To introduce where the electric energy comes from.
Time Expected: 15 minutes

Materials:
- Small mats
- Giant post it & markers
- Book: Magic School Bus and the Electric Field Trip
- The Easy Energy Action Plan poster

Preparation:
1. Set up the post it. Show the recycling sign from Lesson 7.
2. Locate mats at a story area

Procedures:
1. Invite children to the circle time
2. Recap
   “Last time we talked about this sign. Who remembers what this sign is called?”
3. Introduction: Electric Energy
   “Today, we will talk about electric energy. Electricity is an invisible power that turns electric equipment on around us. For example, when we turn the light on, we are using electricity. Can you think of other things that use electricity?”
   Write down children’s ideas.
4. Activity 1: Magic School Bus and the Electric Field Trip, pp 16-31
   Have you wondered where does electricity we use at home and school come from? We get electricity from electric lines that connect home and power lines outside. You may have seen electrical workers fixing power lines before. If you follow the power line, you will arrive at a power plant. Inside the power plant, there is equipment that makes electricity.

Most power plants use heat to make electricity. They burn fuels like coal, oil, or natural gas. Fuels are burnt in a boiler and heat a metal pipe with water in it. The fire makes the water to boil and steam. The steam travels inside the steam pipe to a room with an enormous machine called a turbine. It has blades like a fan and the steam spins the turbine around. The turbine is connected to a shaft that is connected to a generator- a part of the power plant that makes electricity. Electricity leaves power plant and travels inside of a power line all the way to the city, school, and home so that you can watch TV, use computers, and turn the light on.
Power plants are not the only way of making electricity. You may have seen solar panels on roofs. Solar power uses heat from the sunlight to make electricity. You can also use giant wind mills to make electricity.”

Show pictures of alternative energy sources.

6. Review
“We have learned that electricity we use at home and school is made at power plants. When we use our fingers to turn the light off, you save electric energy. What are some ways to use less electric energy and save energy? I have some energy action plan.”

Write down children’s ideas & share the list.

7. Ending
“We have seen where electricity we use comes from and ways to save our electric energy. Saving energy is a superhero action. Be sure to tell your families that we can save energy by turning lights off! Next time will be our last day of our training, so we will celebrate our success!”
Lesson 7: The Last Lesson: Review

Objectives: To review environmental concepts and celebrate accomplishments.
Time Expected: 15 minutes

Materials:
- Small mats
- Earth Ball
- Giant post it & markers
- Post it posters from previous lessons
- Recognition awards with earth ball picture

Preparation:
1. Set up the giant post it. Display the book from Lesson 6.
2. Locate mats at a story area

Procedures:
1. Invite children

2. Recap
   “Last time, we talked about electric power and the energy saving. We learned that electric energy we use to turn the light on came from the power plant. We also found why we make sure to turn the lights off when we do not need the light on to save energy.”

3. Introduction to the Last Day
   “Today is the last day for me and (research assistants) to visit your school. We talked about many things so that we can be the heroes of the environment. Let’s go over what we have accomplished. When we first met, we talked about different environments on the earth such as the natural environment like oceans, mountains as well as human-made places like cities. We also talked about how to save water because we actually have little water we can use. What was one thing we can do to save water? We talked about wildlife animals and animal rescue. Then, we talked about compost critters like earthworms. They live underground and love to eat vegetables and fruits, but not meat and fish. We learned about recycling. Why was it important to recycle paper?

4. Ceremony
   “Now is our time to finish our training. I hope that you know more about actions and how to be the heroes of the environment. I have awards for everyone to celebrate our training. We had so much fun coming to your school. Good bye children!” Each child gets certificate of award.