THE FIELD TRIP PROJECT: USING ENVIRONMENTAL EDUCATION TO BRIDGE SCIENCE LEARNING ACROSS FORMAL AND INFORMAL KINDERGARTEN SETTINGS

Meg Gravil
University of Kentucky, meg.gravil@gmail.com
Author ORCID Identifier:
https://orcid.org/0000-0001-9542-1729
Digital Object Identifier: https://doi.org/10.13023/etd.2019.093

Right click to open a feedback form in a new tab to let us know how this document benefits you.
STUDENT AGREEMENT:

I represent that my thesis or dissertation and abstract are my original work. Proper attribution has been given to all outside sources. I understand that I am solely responsible for obtaining any needed copyright permissions. I have obtained needed written permission statement(s) from the owner(s) of each third-party copyrighted matter to be included in my work, allowing electronic distribution (if such use is not permitted by the fair use doctrine) which will be submitted to UKnowledge as Additional File.

I hereby grant to The University of Kentucky and its agents the irrevocable, non-exclusive, and royalty-free license to archive and make accessible my work in whole or in part in all forms of media, now or hereafter known. I agree that the document mentioned above may be made available immediately for worldwide access unless an embargo applies.

I retain all other ownership rights to the copyright of my work. I also retain the right to use in future works (such as articles or books) all or part of my work. I understand that I am free to register the copyright to my work.

REVIEW, APPROVAL AND ACCEPTANCE

The document mentioned above has been reviewed and accepted by the student’s advisor, on behalf of the advisory committee, and by the Director of Graduate Studies (DGS), on behalf of the program; we verify that this is the final, approved version of the student’s thesis including all changes required by the advisory committee. The undersigned agree to abide by the statements above.

Meg Gravil, Student
Dr. Jennifer Grisham-Brown, Major Professor
Dr. Ralph Crystal, Director of Graduate Studies
THE FIELD TRIP PROJECT:
USING ENVIRONMENTAL EDUCATION TO BRIDGE SCIENCE
LEARNING ACROSS FORMAL AND INFORMAL KINDERGARTEN SETTINGS

DISSESSATION

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the College of Education at the University of Kentucky

By
Meg Gravil
Lexington, Kentucky
Director: Dr. Jennifer Grisham-Brown, Professor of Interdisciplinary Early Childhood Education
Lexington, Kentucky
2019

Copyright © Meg Gravil 2019
https://orcid.org/0000-0001-9542-1729
ABSTRACT OF DISSERTATION

THE FIELD TRIP PROJECT:
USING ENVIRONMENTAL EDUCATION TO BRIDGE SCIENCE LEARNING ACROSS FORMAL AND INFORMAL KINDERGARTEN SETTINGS

The Field Trip Study was conducted in direct response to the emergence of scientific thinking as it relates to children’s cognitive abilities. The purpose of the study was to evaluate the effects of nature-based, experiential activities on children’s acquisition of science knowledge. A multiple treatments and controls with pretest research design was utilized to compare science knowledge acquisition between kindergarten children in four instructional conditions: 1) nature-based field trip plus extension activities from an environmental education curriculum, and corresponding book reading and activities, 2) nature-based field trips plus extension activities from an environmental education curriculum, 3) nature-based field trips plus corresponding book reading and book-related activities, and 4) nature-based field trip with business as usual instruction. Study teachers implemented activities from the Growing Up WILD curriculum and National Science Teacher Association children’s books. An age-appropriate science assessment and accompanying scoring rubric were created in correspondence with Next Generation Science Standards and piloted prior to use as the pretest and posttest for kindergarten children enrolled in the study. Children were interviewed in small groups to elaborate on assessment responses. Kindergarten teachers’ perceptions of using environmental education curricula as a part of field trip extension activities were assessed during a group interview. Gender, treatment condition, and pretest scores were predictors of children’s posttest scores. Children in condition 1 scored significantly higher on posttest mean scores than children in other groups. Teachers enjoyed using the environmental education curriculum and believed it made teaching NGSS accessible.

KEYWORDS: Science, Environmental Education, Early Childhood, Kindergarten, Field Trips, Nature-Based Learning

Meg Gravil
(Name of Student)

04/17/2019
Date
THE FIELD TRIP PROJECT:
USING ENVIRONMENTAL EDUCATION TO BRIDGE SCIENCE
LEARNING ACROSS FORMAL AND INFORMAL KINDERGARTEN SETTINGS

By
Meg Gravil

Jennifer Grisham-Brown
Director of Dissertation

Ralph Crystal
Director of Graduate Studies

04/17/2019
Date
DEDICATION

I dedicate this dissertation to my husband and my children. Bradley, thank you for walking this journey with me for so many years. Your patience and love kept me going, especially at the end. Bryce and Braxton, you were my biggest cheerleaders along the way. I love you both very much.
ACKNOWLEDGMENTS

The following dissertation, while an individual work, would not have been possible without the support of many professors, colleagues, friends, and my medical team. I am humbled by their confidence in me. First, I thank Dr. Jennifer Grisham-Brown for bringing me to UK to continue my career in early childhood research, and seeing me through the ups and downs of my time as a student. It is because of her I pursued my PhD in Interdisciplinary Early Childhood Education. Thanks to Dr. Brian Bottge for his empathy and understanding as I struggled with juggling treatment, work, and school. He was always available, no matter the time, and I knew it would be a fun day if he was in the office! I thank Dr. Rebecca Krall for helping me make sense of NGSS by literally deconstructing them with me. Your expertise and assistance in creating the assessment and rubric for this study were vital. Dr. Melinda Ault, thank you for taking time to discuss my doctoral student woes and being a great sounding board in regards to my study. Thanks you to Dr. Yash Bhagwanji, for serving as my outside reviewer and sharing your early childhood environmental education expertise with the College of Education as a Nietzel Distinguished Faculty member.

Additional thanks goes to Jackie Gallimore for collaborating with me on all the crazy ideas. I could not have pulled this off without you! Thanks to Danny Woolums for training study teachers, and Megan Jones for collecting data with me. Thank you, Samantha Ringl, for coding all those assessments, and Chunling Niu, for the stats expertise. And a special thanks to Dr. Linda Gassaway, for helping me navigate the crazy, have a lot of laughs, and for encouraging me to stick with it no matter how frustrated I became. You make TEB and the world a much better place. I must thank Dr.
A. Edward Blackhurst, Professor Emeritus, and Dr. Ellen Thacker Hill, who established the Arvle and Ellen Turner Thacker Research Fund, for funding the scholarships that supported my research, and the teachers, parents, and children who participated in my study.

A heartfelt thanks goes to my treatment team at the UK Markey Cancer center, for seeing me through cancer treatment (twice!) and beyond. My oncologists, Dr. Aju Mathew, Dr. Partick McGrath, Dr. Mark Bernard, and Kelly Hawthorne, APRN: thank you for answering my million questions per visit with patience as I dutifully took notes, and for humoring me when I brought in ‘research’ that challenged your prognosis. I honestly enjoyed our chats! Thanks to the radiation team for keeping me laughing, and to the chemo team for letting my daughter sneak into the treatment area. Thank you, Jenny Delap, LCSW, OSW-C, being the crusader in my fight and for being simply awesome. Lastly, thanks to Kelly Sampson, who was the first to tell me I would be OK.

Finally, I thank my family for their support through what have been some trying yet rewarding years. They have always encouraged me to pursue my dreams, regardless how crazy they thought those dreams were. Thanks to each of you for all your love and support. Kevin, what can I say? We’ve been through the extremes, and we always come out smiling. To say thank you for everything is an understatement. And Caroline, thanks for being you. You are my most favorite thing (but don’t tell Muppet!).

What a long, strange trip it’s been!
# TABLE OF CONTENTS

ACKNOWLEDGEMENTS ........................................................................................................ iii

LIST OF TABLES .................................................................................................................. viii

LIST OF FIGURES ............................................................................................................... ix

CHAPTER 1. INTRODUCTION ................................................................................................. 1  
  What is Science in Early Childhood? ................................................................. 3  
  Science as Part of an Integrated Curriculum ................................................. 4  
  Statement of the Problem ................................................................................. 5  
  Prevalence of Science in Early Childhood Education .................................. 5  
  Teachers’ and Children’s Attitudes Towards Science ..................................... 6  
  Theoretical Framework ....................................................................................... 8  
  Constructivism and Experiential Learning Theory ......................................... 8  
  Developmentally Appropriate Practices .......................................................... 9  
  Environmental Education ............................................................................... 12  
  Environmental education in early childhood ............................................... 15  
  Historical perspectives of field trips ............................................................... 17  
  Growing Up WILD curriculum ................................................................. 19  
  Combining existing crosswalks ................................................................. 20  
  Significance of the Study .............................................................................. 26  
  Study Objectives ............................................................................................... 28  
  Research Questions ............................................................................................ 29

CHAPTER 2. METHODOLOGY ................................................................................................. 30  
  Subjects .................................................................................................................... 30  
  Teachers .................................................................................................................. 30  
  Children ................................................................................................................... 31  
  Research Design .................................................................................................... 33  
  Procedures ............................................................................................................... 34  
  Growing Up WILD activities .............................................................................. 34  
  Book reading activities ....................................................................................... 35  
  Daily schedule of study activities ................................................................. 40  
  Field Trips ............................................................................................................... 43  
  Teachers’ perceptions of extension activities and field trip ......................... 44  
  Variables ................................................................................................................ 45  
  Independent variable ......................................................................................... 45  
  Dependent variables .......................................................................................... 45  
  Measures .............................................................................................................. 45  
  Science learning assessment ............................................................................ 45  
  Child assessment rubric ..................................................................................... 53
Implications for Research

- Multiple treatments plus control design .......................................................... 110
- Environmental education curricula ......................................................... 111
- Language development and science learning ........................................ 112

Implications for Practice ........................................................................... 113

- Teacher preparation ........................................................................... 113
- Cross-curricular connections ......................................................... 115
- Alternative assessments ................................................................. 116

Coda ........................................................................................................ 117

APPENDICES ......................................................................................... 120

- APPENDIX A. GROWING UP WILD ACTIVITIES USED IN THIS STUDY ........................................ 121
- APPENDIX B. NSTA BOOK ACTIVITIES ........................................................................ 126
- APPENDIX C. SAMPLES OF CHILDREN’S STEM DRAWINGS .................................................. 132
- APPENDIX D. KENTUCKY CHILDREN’S GARDEN FIELD TRIP LESSON PLAN ........................................... 134
- APPENDIX E. ASSESSMENT ADMINISTRATION PROTOCOL .................................................. 150
- APPENDIX F. CHILD SCIENCE ASSESSMENT ........................................................................ 153
- APPENDIX G. CHILD INTERVIEW PROTOCOL ........................................................................ 158
- APPENDIX H. CHILD ASSESSMENT SCORING RUBRIC .................................................. 160
- APPENDIX I. TEACHER INTERVIEW PROTOCOL ....................................................................... 168
- APPENDIX J. GROWING UP WILD ADMINISTRATION CHECKLIST ........................................... 170

REFERENCES ........................................................................................................ 173

VITA ..................................................................................................................... 190
## LIST OF TABLES

Table 1.1 Combination of Existing Crosswalks of Various Academic Standards...... 22
Table 2.1 Description of Children in Treatment and Control Groups..................... 32
Table 2.2 Multiple Treatments and Control with Pretest Design.......................... 33
Table 2.3 Timeline of Field Trips and Growing Up WILD Activities Across Groups 34
Table 2.4 Description of Growing Up WILD Activities Used in Study ..................... 36
Table 2.5 Daily Schedule of Study Activities in Kindergarten Classrooms.............. 42
Table 2.6 KCG Field Trip Education Stations and Activity Synopses .................... 44
Table 2.7 NGSS Alignment with Field Trips Study Assessment Questions ............... 48
Table 3.1 Non-parametric T-Test Statistics (Wilcoxon’s Test) or Pretest Posttest Comparison Across Four Study Groups............................................. 67
Table 3.2 Summary of Hierarchical Regression Analysis for Variables Predicting Children’s Science Assessment Total Scores........................................ 72
Table 3.3 Task 1 Correct Child Response Percentages...................................... 73
Table 3.4 Task 2 Correct Child Response Percentages...................................... 74
Table 3.5 Task 3 Scoring Rubric and Child Response Examples in Percentages..... 76
Table 3.6 Task 4 Scoring Rubric and Child Response Examples in Percentages..... 78
Table 3.7 Task 5 Correct Child Response Percentages................................. 80
Table 3.8 Task 6 Scoring Rubric and Child Response Examples in Percentages..... 82
Table 3.9 Task 7 Correct Child Response Percentages................................. 85
Table 3.10 Teacher Interview Themes and Supporting Statements...................... 96
LIST OF FIGURES

Figure 1.1  Cycle Showing Holistic Approach to Experiential Learning Theory ........ 9
Figure 2.1  NGSS K-LS1-1 From Molecules to Organisms: Structures and Processes 49
Figure 2.2  NGSS K-ESS3-1 Earth and Human Activity ...................................... 50
Figure 2.3  Overall Evaluation Rubric for Scoring Child Assessments .................. 55
Figure 3.1  P-P Plot of Regression Standardized Residual Showing Normal Distribution of Posttest Scores ................................................................. 69
Figure 3.2  Scatterplot of Dependent Variable (Posttest Total Score) Showing Assumption of Homoscedasticity ................................................................. 70
Figure 3.3  Example of Child’s Written Response and Typed Interpretation .......... 80
Figure 3.4  Example of Child's Response to Task 6 with a Score of 1 .................... 84
Figure 3.5  Example of Child's Response to Task 6 with a Score of 4 ................. 84
Figure 3.6  Child’s Habitat Drawing with Notated Clarifications ......................... 92
Figure 3.7  Child’s Drawing of Bird with Fish in Beak and Habitat ..................... 93
Figure 4.1  Common Core State Standards Correlated to NGSS Addressed in this Study ............................................................................................................ 116
CHAPTER 1. INTRODUCTION

Kindergarten programs have changed dramatically in the past two decades as national initiatives have delegated focus on “highly-prescriptive curricula” and academic attainment for test preparedness (Bassok & Rorem, 2014). The passage of No Child Left Behind in 2001 and, more recently, Common Core State Standards (2010) has resulted in learning benchmarks for children as young as kindergarten age. Resultant demands for accountability have been met by approaches to early childhood curricula that focus on rote instruction in basic numeracy, literacy, and language skills (Bassok & Rorem). This emphasis on high stakes testing has resulted in a trickle down effect in which primary educators are at risk for abandoning practices that nurture children’s development of critical thinking skills. Similarly, curricular changes resulting from accountability demands lose sight of one of early childhood education’s benchmarks of quality: the multidisciplinary nature of curriculum and instruction. For example, the Common Core State Standards provide learning standards in only English and Language Arts (ELA) and mathematics, with science and social studies embedded as part of ELA (National Governors Association Center for Best Practices, Council of Chief State School Officers, 2010). The direction of this movement is in sharp contrast to the guidelines recommended by the National Association of Young Children’s (NAEYC) influential Developmentally Appropriate Practices (DAP) handbook (Copple & Bredekamp, 2009), which advocates for child opportunities and experiences across all developmental domains. As DAP handbook authors state:
Standards overload is overwhelming to teachers and children alike and can lead to potentially problematic teaching practices. At the preschool and K-3 levels particularly, practices of concern include excessive lecturing to the whole group, fragmented teaching of discrete objectives, and insistence that teachers follow rigid, tightly paced schedules (Bredekamp, 2009, p. 4).

The DAP authors suggest that teachers may engage in age inappropriate practices to implement learning standards, and risk focusing only on mandated standards to the detriment of other learning domains. Because other content areas are not tested until fourth or fifth grades, language, literacy, and math are prevalent in early childhood curricula adherent to standards. Opportunities for social studies, art, and science are lacking in formal education for young children.

In a state-led effort, the Next Generation Science Standards (NGSS) were released in 2013 after 2 years of consideration. NGSS are science content standards for grades K-12. Twenty-six participating states, referred to as Lead States, partnered with the National Research Council (NRC), the National Science Teachers Association (NSTA), and the American Association for the Advancement of Science (AAAS) to revise existing standards set by the NRC and AAAS (The National Science Education Standards and Benchmarks for Science Literacy, respectively). Updated standards were designed to reflect the major advances in science since their inception in 1996. Importantly, adoption and implementation of NGSS is voluntary in states throughout the United States. Currently, 19 states and the District of Columbia have adopted NGSS, while 21 additional states have created standards influenced by the NRC’s Framework for K-12 Science Education.
The state of Kentucky was a Lead State and quickly adopted NGSS shortly after its release in 2013. NGSS was created in alignment with the English Language Arts and Mathematics Common Core State Standards. This design was purposeful to integrate science opportunities as part of a comprehensive curriculum. Educators of young children in Kentucky must now determine how to integrate science in a math, language, and literacy-laden curriculum. This prospect poses great rewards for young children in public school, while presenting challenges for those children’s educators who now must determine how to ‘do’ science in congruence with DAP.

**What is Science in Early Childhood?**

The term science inquiry has been subjected to myriad interpretations and definitions throughout the years. Educators often think of science as pertaining to content matter, such as learning moon phases or Newton’s law of gravity. Recent history has seen a shift in how science education is interpreted, with the focus less on content and more on the process of ‘doing’ science. In the 1960s, it became popular to break science inquiry down into discreet steps, or process skills, and entire elementary school curricula were designed to teach inquiry as such (Padilla, 2010). These skills, including observing, predicting, experimenting, and communicating, aligned closely with the scientific method steps (e.g., observing, describing, predicting, designing experiments, etc.). This approach remained prevalent until the 1980s, at which time the National Science Education Standards (National Research Council, 1996) introduced a more holistic approach to inquiry in science. While inquiry was arguably the central concept of the Standards, the National Research Council (2000) realized that a more representative definition of scientific inquiry required a description of what learners “do” during the inquiry process,
such as engaging in the composition of a scientific question, participating in the
procedural design, and connecting explanations to scientific knowledge.

More important than the somewhat abstract interpretation of what constitutes
science inquiry is the determination of who is actually carrying out the scientific work. If
students are behind the thinking, questioning, designing, collecting, and communicating,
it is highly likely that the process of inquiry is occurring. Such opportunities provide
children with critical thinking experiences that transfer across disciplines (Abbott, 2017)
and should be a component of an integrated curriculum in accordance with DAP. The
process of attaining science knowledge parallels the constructivist approach to learning in
early childhood. Children learn from direct experience, and science, specifically, is best
learned when children connect scientific activities to direct experiences involving
inquiry.

**Science as Part of an Integrated Curriculum**

Experiences in science learning have implications for development in other
areas of children’s academic learning and social-emotional development (Zembylas,
2004). Participation in open-ended, exploratory activities can foster children’s
attention, regulation, communication, and social skill development with peers. As
participant members of a peer group, children engaged in science activities are
compelled to practice self-regulation and attention management skills. The inherent
nature of experimentation necessitates problem-solving skills, which teachers can adapt
for children’s use when encountering interpersonal problems. In addition, collaborative
observation and experimentation necessitate children’s communication with each other,
an important component for language development.
To actually ‘conduct’ or ‘do’ science requires children to count, measure, and record findings. Comparisons of size, shape, and quantity are inherent in scientific thinking. In addition to introducing concrete math concepts, science-based activities require children to predict (how long will it take the ice cube to melt?) and/or estimate, (how many seeds are inside the apple?). Providing opportunities for children to record their findings using words, numbers, or pictures allows for the inclusion of additional language and literacy development through writing. Integrating science in the curriculum allows children to experience concept acquisition in different formats, which represents a holistic approach to learning as opposed to compartmentalizing play, academic, and routine activities.

Statement of the Problem

Prevalence of Science in Early Childhood Education

Formal education opportunities for teacher-supported discussions or inquiry related to science and open-ended explorations that promote children’s engagement in prediction, observation, and explanation of phenomena are lacking in primary education (Peterson & French, 2008). Research indicates this is especially the case for children of low socio-economic status, as these children are less frequently exposed to science activities than their peers of higher incomes (Eshach & Fried, 2005). Cultural differences and home life experiences minority children bring to the classroom may present barriers to their academic success. Lee (1992) reports in one article that knowledge brought from students’ home cultures provided a basis for making sense of school events and established a foundation for additional knowledge acquisition. Eshach and Fried (2005) state that children from low socio-economic backgrounds are at a cultural disadvantage when it
comes to achievement in school, particularly in regard to the acquisition of science knowledge. These children, already facing potential disadvantages as result of their backgrounds, are often further disadvantaged by the lack of opportunities to experience science activities in their primary classrooms.

**Teachers’ and Children’s Attitudes Toward Science**

There are myriad reasons behind the noted lack of facilitated science instruction and activities in classroom of young learners. In his examination of science education in the United States, Rudolph (2014) found that instruction and assessment in K-12 classrooms has primarily focused on content mastery, or focus on facts, rather than student understanding of the process of science. This is echoed by the work of Haymore-Sandholz and Ringstaff (2011), which examined the impact of professional development on science instruction for 44 K-2 teachers. Results from their research indicate the majority of teachers in their study focused on science content and few teachers emphasized learning science processes or inquiry skills. In addition, teachers of young children report feelings of low self-efficacy with respect to science teaching, lack of experience participating in science activities as students, and science anxiety as reasons for excluding regular science activities and instruction in daily classroom practices (Roehrig, Dubosardky, Mason, Carolson, & Murphy, 2011). The still-current emphasis on literacy and language instruction may promote teacher beliefs that development on those domains are more important than nurturing science learning in the classroom. Further research exploring primary teachers’ attitudes toward science indicates that pre-service and in-service teachers hold negative attitudes toward science and feel their teacher preparation programs were insufficient in incorporating scientific
content knowledge to inform classroom practices (Greenfield et al., 2009). The culmination of teachers’ beliefs and attitudes toward science and inquiry, their feelings of low self-efficacy in science instruction, and their perceived greater importance of other learning domains may point to a more systematic bias against including science in education for young children.

Eshach and Fried (2005) summarize literature on students’ attitudes toward science and emphasize the importance of students’ attitudes toward subject matter and the relationship to cognitive development. These researchers indicate that educators’ interests and attitudes greatly influence students’ motivation and interest to learn any subject matter. Attitudes towards science begin to formulate as early as kindergarten, as does the extent to which children participate in science activities. Early exposure to science inquiry and scientific phenomena develops positive attitudes towards future science learning and can influence children’s future development of scientific concepts. This sentiment is echoed by Mantizicopoulos, Samarapungavan, and Patrick (2009), who state that familiarizing young children with science exploration in developmentally appropriate ways may lead to increased comfort with such inquiry and set the foundation for future learning.

Ultimately, children’s comfort with learning science has potential impacts for later outcomes and achievement. Teachers of young children have a significant influence on children’s attitudes toward science, and bear the responsibility of providing environments that foster children’s engagement in positive science experiences.
Theoretical Framework

Constructivism and Experiential Learning Theory

Constructivist theory suggests that knowledge is ultimately acquired through inference rather than simply observing events; that is, children use their own experiences to construct knowledge and understanding of the world. Constructivism, recognized as incorporating DAP for young children, is based on the premise that children interact with the environment in unique ways (Yoon & Onchwari, 2006). In science learning, constructivism posits that real learning involves a process of conceptual change as opposed to the accumulation of facts (Landry & Forman, 1999). Congruent with Vygotsky’s (1986) supposition that scientific knowledge is socially constructed, constructivism in learning science concepts allows ample time for meaningful investigations and reflection in a cooperative, social context (Shepardson, 1997). Such opportunities enable children to interact with the environment in distinctive and meaningful ways that are conducive to discovery. Mantzicopoulos et al. (2009) analyzed data from the Scientific Literacy Project, a federally funded project that gauged how and what children learn when kindergarten teachers use inquiry-based science instruction (referring to how scientists/students come to understand the natural world). Results from their study indicated that kindergarten children participating in collaborative, inquiry-oriented science activities were able to hypothesize, make predictions, and communicate their findings (Mantzicopoulos et al., 2009).

Building on the tenets of constructivism is experiential learning theory. Experiential learning theory posits that, in addition to learners taking an active rather than passive role, learners must reflect on their experiences and relate pre-constructed
knowledge in “…a contextual way to real life examples” (Wenger, 2009, p. 270). Kolb (1984) proposed this learning theory with heavy influences from the theories of Piaget and Dewey. This approach is holistic in that it considers environmental factors, cognition, experience, and emotion as influencing the process of learning (see Figure 1.1). Experiential and constructivist learning theories both emphasize “learning by doing,” which is age and developmentally appropriate for young children.

![Figure 1.1. Cycle showing holistic approach to experiential learning theory. Adapted from Experiential Learning: Experience as the Source of Learning and Development (p. 33), by D. A. Kolb, 1984, Englewood Cliffs, NJ: Prentice Hall.](image)

**Developmentally Appropriate Practices (DAP)**

The DAP handbook (Copple & Bredekamp, 2009) outlines current thinking regarding which practices best promote the development and learning of young children. The DAP handbook was designed by education professionals to serve as...
research-based guidelines to provide excellence and equity in early childhood education. DAP focus on improving teaching and implementation of comprehensive, integrated curricula in early learning environments. Subsequently, these practices impact child learning. The framework from which the complete DAP handbook is based includes three main areas of knowledge: 1) knowing about child development and learning, 2) knowing what is individually appropriate, and 3) knowing what is culturally important.

Consistent with constructivist thought is the fact that educators of young children must understand children’s developmental stages in order to provide optimal learning environments (Yoon & Onchwari, 2006). NGSS provide science topics appropriate for the developmental level of kindergarten-aged children, including life science, earth and space, science, and physical science. Furthermore, best practices allow for child-directed learning, the mainstay of constructivism. Curricula can be arranged to meet children’s interests and abilities. This is especially true in science, which offers myriad opportunities for child-driven discovery.

Through consistent observation and interaction, teachers can learn specific characteristics about children to refine classroom practices to meet the needs of individual children. Despite disagreement about individual learning styles (see Landrum & McDuffie, 2010; Mamchur, 1996), children have preferences regarding what they like to do. Seemingly simple science investigations can offer multisensory experiences to provide for the desires of different children. For instance, discovery of a beetle on school grounds offers numerous choices for children to pursue. One child may choose to touch the beetle and want to hold it, another child may seek additional
information about the beetle through a book or the internet, and a third child may wish to draw the beetle and label its parts.

The locale in which children reside can serve as a catalyst for ensuing science learning, as can children’s home environments. Awareness of children’s families and values can guide meaningful and appropriate learning experiences for children. Knowing if a household includes many reptiles as pets or if a family is fearful of reptiles are considerations that can guide teachers’ efforts with a particular child. Technology also has become a relied upon tool for learning in many classrooms, and can provide science learning opportunities with which children may not otherwise be comfortable.

Ultimately, evidenced based practices in early childhood education should include classroom experiences that stimulate children’s curiosity and promote critical and higher order thinking skills via experimentation, brainstorming, hypothesizing, and problem solving. Learning opportunities should integrate content subject matter, allowing for optimal skill development. Science learning facilitates children’s ability to make meaningful connections and gain new insights during hands-on applications, congruent with the constructivist and DAP approaches to early learning.

Because rich environments that facilitate child discovery are especially important in early childhood, use of the physical setting to facilitate learning has been the subject of research, specifically in regard to science learning (Rennie, Feher, Dierking, & Falk, 2003). Avenues for teachers to provide an environment encouraging hands-on, multi-sensory learning experiences for children include using environmental
education, embarking on field trips outside the classroom, and using experiential curricula.

**Environmental Education**

The concept of environmental education has undergone many iterations dating back to the 18th century, when influential scholars Jean-Jacques Rousseau and Louis Agassiz stressed the importance of nature and the environment in education (Eneji, Mbu, & Etim, 2017). The nature study movement gave way to conservation education in the 1930s as a rigorous study of science to combat issues of the time, including the Dust Bowl and the Great Depression. Shortly after, the content areas of nature study and conservation education were combined into teaching practices that became identified as outdoor education. This became a common public school experience in the years following World War I in what was known as “school camping” (Enji et al., 2017, p. 114). Aldo Leopold’s Sand County Almanac (1949) was published in this era, a seminal tenet of the entire environmental education movement. During the 1960s and 1970s, with the advent of the Civil Rights movement and the Vietnam War and the fallout of each, activists took center stage and garnered attention from the public. Rachel Carson’s Silent Spring (1962) and Stewart Udall’s The Quiet Crisis (1963) heightened awareness of environmental issues and the fallout from air pollution and varied chemical use.

The 1960s served as the springboard for environmentalist movement, and the 1970s followed with conferences and legislation solidifying environmental education as a trans-disciplinary means of preparing students for real world challenges. President Richard Nixon in 1970 signed into law the National Environmental Education Act
with the intent of incorporating environmental education into K-12 schools nationwide, and environmental education coordinators were placed within state school systems. The Belgrade Charter (United Nations Environment Programme, 1975) and then the Tbilisi Declaration (United Nations Environment Programme, 1977) outlined the role, characteristics, and objectives of environmental education in a document of guiding principles that remains internationally relevant to date (Enji et al., 2017).

Kentucky has historically been a leader in incorporating environmental education at the state level since the 1980s. Kentucky Statute KRS 157.905 states that environmental education is:

An education process dealing with the inter-relationships among the natural world and its man-made surroundings; is experience-based; interdisciplinary in its approach; and is a continuous life-long process that provides the citizenry with the basic knowledge and skills necessary to individually and collectively encourage positive actions for achieving and maintaining a sustainable balance between man and the environment (Kentucky Environmental Literacy Plan [KELP] Task Force, 2012, p. 3).

Though funding was turbulent in the 1980s and 1990s, the Kentucky Environmental Education Council (KEEC) was formed through legislation in 1990 and has remained active since 1995. KEEC is tasked with implementing a comprehensive environmental education agenda to create environmentally literate citizens. “Environmental literacy is the ability to recognize the components of healthy natural and man-made systems and the actions necessary to maintain, restore, or improve them” (KELP Task Force, 2012, p. 3). Experts in the field of education,
environmental education, and administration, to ensure that school-aged children in
the state are educated about the environment, created the Kentucky Environmental
Literacy Plan (KELP) in 2011. That same year, the Kentucky Board of Education
approved the KELP with support from the Education and Workforce Development
Cabinet, the Kentucky Department of Education, and KEEC. Environmental education
was cited in a corresponding press release as an educational framework that
incorporated all disciplines to promote academic achievement while positively
impacting the health and cognitive development of students (Commonwealth of
Kentucky Education & Workforce Development Cabinet Office of the Secretary,
2011).

Educators and administrators in Kentucky recognized the multi-faceted
benefits provided by environmental education in creating and adopting the KELP.
There exists a plethora of research on the positive impacts environmental education
has on academic attainment (Ghent, Trauth-Nare, Dell, & Haines, 2014; Jagannathan,
Camasso, & Delacalle, 2018; Sari, 2016) and social-emotional development (Faber
The concept of nature-deficit disorder was coined by Richard Louv to describe the
lack of nature-based experiences in children’s lives despite evidence that those
experiences are vital for children’s physical and emotional development (Louv, 2008).
The last decade has seen a resurgence of enthusiasm for nature-based learning as a
means to focus on the holistic development of children (Torquati, Cutler, Gilkerson, &
Sarver, 2013).
**Environmental education in early childhood.** While environmental education is based on knowledge of the natural environment, its multidisciplinary nature allows for the incorporation of emotions, relationships, and dispositions (North American Association for Environmental Education [NAAEE], 2010a), in addition to academics. Indeed, early childhood is the time during which children’s dispositions toward nature are formed (Chawla, 1998). Natural environments provide context for learning about systems and interdependence (components of environmental education) while developing social skills as children interact with each other, plants, and animals, and observe relationships between animals. Researchers in one study examined via surveys preservice teachers’ \( n = 195 \) and early childhood educators’ \( n = 162 \) perceptions of using nature, environmental education, and science in early childhood classrooms (Torquati et al., 2013). Study participants indicated that nature-based experiences provided children with the opportunity to explore with all their senses in hands-on activities, and allowed for questioning, observing, and the cultivation of curiosity (Torquati et al., 2013), which are exemplars of science facilitation.

Children’s exposure to nature and natural environments may also foster environmental stewardship and concern for the natural world (Sari, 2016).

Because of the multidisciplinary, experiential methodology of environmental education, The National Association for the Education of Young Children (NAEYC) published a collection of articles in *Spotlight on Young Children and Nature* (Shillady, 2011) that emphasized the contributions environmental education avails to educators of young children. The year prior, NAAEE published the Early Childhood Environmental Education Programs: Guidelines for Excellence (2010b). These two
publications provide strategies for successfully designing, implementing, and evaluating environmental education that is developmentally appropriate for young children. The emergent interest in environmental education in early childhood has prompted the publication of curricula for use in formal and informal education settings, including Project WILD (Council for Environmental Education, 2012), Project Learning Tree (American Forest Foundation, 2010), and My Big World of Wonder (Griffin, 2004), among others. In addition, the National Science Foundation funded a professional development program focusing on learning in nature with young children (Chalufour & Worth, 2003). A measurement tool also has been published to identify areas of strength and improvement specific to implementing environmental education (Bhagwanji, 2011).

Despite the growing body of research and resources available, early childhood educators lack confidence in facilitating nature-based learning activities just as they lack confidence in facilitating science (Torquati et al., 2013). Very few states require environmental education coursework for teacher certification (Archie, 2001; Torquati et al., 2013) and early childhood teachers rarely take science courses as part of their degree program (President’s Council of Advisors on Science and Technology [PCAST], 2010).

In addition to environmental education, another method for integrating nature-based learning activities and the natural environment is to take children on field trips. Field trips are class trips outside the classroom at experiential locations with the intent of connecting student empirical learning with educational purposes (Behrendt &
Franklin, 2014). These include trips to places such as arboretums, museums, science centers, and zoos.

**A historical perspective of field trips.** Field trips can provide children with direct experiences and authentic learning opportunities (Braund & Reiss, 2006), both tenets that align with the constructivist and developmentally appropriate approaches to young children’s learning. The National Science Teacher’s Association (NSTA) issued a position statement stressing the important role out-of-school settings can play in extending classroom learning (NSTA, 2012). Historically, the use of field trips has played a significant role in American schools and can have a positive, lasting impact on students, particularly those from disadvantaged backgrounds (Greene, Kisada, & Bowen, 2014). Such experiences are especially important for young learners, who are less likely than their older peers to have participated in culturally enriching experiences outside school or the home (Greene et al., 2014). Despite their potential benefits, the use of field trips in the United States is in decline due to budgetary constraints and the current emphasis on accountability (Behrendt & Franklin, 2014).

Learning benefits from field trips are not guaranteed, however, and they should not be regarded as stand-alone experiences. While they provide opportunities for short-term learning, it is imperative that teachers make a strong commitment to reiterate that learning back in the classroom. Without such reinforcement, knowledge acquisition obtained on a field trip may only be temporary, which does not necessarily constitute learning (Beherendt & Franklin, 2014). Field trip experiences should be revisited in the classroom through discussion, follow-up activities, and written reflections. Such reinforcement sets the foundation for continued interest and learning on behalf of
children. Perhaps most importantly, field trips should be connected to current classroom lessons and concepts (DeWitt & Storksdieck, 2015). This allows for a conceptual footing upon which connected experiential learning may be constructed.

Despite the literature indicating the importance of a teacher’s role in connecting field trip experiences with classroom learning, few teachers exert the effort to connect classroom learning with that acquired on a field trip (Beherndt & Franklin, 2014; DeWitt & Storksdieck, 2015). When researching previous studies examining field trip practices to natural areas, Tal, Alon, and Morag (2014) found limited preparation in school, and almost no negotiations between the school and environmental agency that provided the field trips, no discussion or presentation of goals, limited connection to the school curriculum or students’ everyday life, and limited purposefully planned social interactions to promote learning (p. 431).

Indeed, children may not even view a field trip as an educational lesson if it is not structured as such by teachers (Braund & Reiss, 2006). Teachers commonly use worksheets after a field trip, though their effectiveness as learning tools is dependent on their structure and teacher facilitation (DeWitt & Storksdeick, 2015). The most appropriate practices according to researchers for extended work leans towards more constructivist learning as opposed to the didactic nature of worksheets (Tal et al., 2014).

While teachers often struggle with methods to connect a field trip experience with classroom learning, curricula exist that conveniently bridge this gap, particularly in environmental education. The aforementioned Project WILD (Council for Environmental Education, 2012), Project Learning Tree (American Forest Foundation,
2010), and My Big World of Wonder (Griffin, 2004) are examples. Specifically designed for formal and informal educators of young children (i.e., educators who work outside the school setting), these curricula offer lessons and activities integrating science, art, math, social studies, and language arts.

**Growing Up WILD curriculum.** Project WILD is a conservation and environmental education curriculum that has gained widespread use in K-12 classrooms (Council for Environmental Education, 2012). Based on the premise that students and educators alike have interest in learning about the natural world, Project WILD instructional materials are intended for use in informal settings and classrooms. Growing Up WILD was first published in 2009 to make the Project WILD curriculum more accessible to early childhood educators. The most recent iteration (2011) includes correlations between Growing Up WILD activities and the National Association for Early Childhood Education’s (NAEYC) guidelines for developmentally appropriate practice ([DAP]; Copple & Bredekamp, 2009), and NAEYC standards. The curriculum and standards correlations were created with national input from educators and natural resource management personnel and complied by the Council for Environmental Education (2011). In addition, Growing Up WILD was created in accordance with the North American Association for Environmental Education’s (NAAEE) Early Childhood Environmental Education Programs: Guidelines for Excellence (2010b), which were created to gauge the merit of environmental education programming in early childhood education.

NAEYC accreditation is offered to early childhood education programs that meet specific health, safety, and education criteria. Growing Up WILD activities each address
one or more of the NAEYC Standard 2: Accreditation Criteria for Curriculum topic areas. The curriculum is designed to foster learning across the social, emotional, physical, language, and cognitive domains, which is consistent with NAEYC accreditation standards. In addition, the Growing Up WILD curriculum fosters basic skills in scientific thinking including observation, gathering evidence, hypothesizing, and drawing conclusions. Growing Up WILD provides opportunities within activities for children to think critically and scientifically in a way that is engaging, and promotes concept integration and real-world connections. All Growing Up WILD activities incorporate experiential learning in ways that are accessible to use in early childhood classrooms with children ages 3 to 7 years, and are commensurate with DAP and NGSS standards. Despite the curriculum incorporating recommended practices for teaching young children, the use of Growing Up WILD has not to date been researched in an empirical manner.

**Combining existing crosswalks.** A crosswalk is an alignment tool commonly used in education to compare different sets of academic standards. The basic chart structure of crosswalks allows flexibility to show alignment not only between sets of standards, but between specific activities and standards. The current study combined existing crosswalks to show correlations between each and included

- Next Generation Science Standards (NGSS; Next Generation Science Standards Lead States, 2013);
- Kentucky Academic Standards: Science (KAS:S; Kentucky Department of Education, 2013);
I combined these crosswalks into one document to illustrate correlation across all levels of learning standards and activities. The Growing Up WILD curriculum was selected for use in this study because of its high correlation with existing academic standards at the local, state, and national level, as described above. See Table 1.1 for the correlated standards and activities. All standards were specific to kindergarten or primary aged children. The expanded crosswalk illustrates the congruency of learning standards with the Growing Up WILD curriculum. The crosswalk also aided in the selection of curriculum activities for teachers to implement as part of this study.
Table 1.1.
Combination of Existing Crosswalks of Various Academic Standards

<table>
<thead>
<tr>
<th>Standards for Kindergarten</th>
<th>Kentucky Academic Standards: Science</th>
<th>Fayette County Public Schools District Curriculum Map for Science Supporting Standards</th>
<th>Selected Growing Up WILD Activities</th>
<th>Kentucky Children’s Garden Field Trip Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIFE SCIENCE Standard 1-1. (K-LS1-1) Use observations to describe patterns of what plants and animals (including humans) need to survive.</td>
<td>LIFE SCIENCE Standard 1-1. (K-LS1-1) Use observations to describe patterns of what plants and animals (including humans) need to survive.</td>
<td>TOPIC KD: LIFE SCIENCE STANDARD 1-C. Organization for Matter and Energy Flow in Organisms. (K-LS1)</td>
<td>LUNCH FOR A BEAR Children identify the kinds of foods that Black Bears eat by creating a plate of “bear food.”</td>
<td>WILDLIFE WATER SAFARI Explore the Children’s Garden searching for wildlife. Investigate the habitat to determine where those animals get their water.</td>
</tr>
<tr>
<td>TOPIC KD: EARTH SCIENCE STANDARD 3-A. Natural Resources. (K-ESS3-1)</td>
<td></td>
<td></td>
<td>WILDLIFE WATER SAFARI Children learn about and discover water sources for local wildlife through recollection and a walk around school grounds.</td>
<td>PLANTING STATION Learn what plants need to survive. Plant a seed to take home and learn how to care for that specific plant.</td>
</tr>
<tr>
<td>WILDLIFE IS EVERYWHERE! Children make observations and understand that wildlife is all around us.</td>
<td></td>
<td></td>
<td>WORM RACES Observe worms and learn that they are nature’s recyclers while playing a fun game.</td>
<td>BIRDS AND CATERPILLARS Children demonstrate their knowledge of how camouflage is used for protection and survival while playing a fun game.</td>
</tr>
<tr>
<td>Topic</td>
<td>Earth Science Standard</td>
<td>Description</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>------------------------</td>
<td>-------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOPIC KA: WEATHER &amp; CLIMATE</strong></td>
<td><strong>K-ESS2-1</strong></td>
<td>Use and share observations of local weather conditions to describe patterns over time.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOPIC KB: WEATHER &amp; CLIMATE</strong></td>
<td><strong>K-ESS2-1</strong></td>
<td>Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SIGNS OF SPRING**
Learn about and observe weather, plant, and animal patterns specific to the time of year.

**WORM RACES**
Observe worms and learn that they are nature's recyclers while playing a fun game.
Table 1.1 (continued)

| TOPIC KE: INTERDEPENDENT RELATIONSHIPS IN ECOSYSTEMS: ANIMALS, PLANTS, & THEIR ENVIRONMENT Earth Science Standard 2-E. Biogeology (K-ESS2-2) | WHO LIVES IN A TREE? Children develop an awareness of trees and some of the animals that call them “home” through a walk on school grounds. | WHO LIVES IN A TREE? Read aloud “Tall Oak Tree” poem and examine a tree to discuss what animals live in/around it. | WHO LIVES IN A TREE? Read aloud “Tall Oak Tree” poem and examine a tree to discuss what animals live in/around it. |
| EARTH SCIENCE Standard 3-1. (K-ESS3-1) Use a model to represent the relationship between the needs of different plans and animals (including humans) and the places they live. | | WILDLIFE WATER SAFARI Children learn about and discover water sources for local wildlife through recollection and a walk around school grounds. | WILDLIFE WATER SAFARI Explore the Children’s Garden searching for wildlife. Investigate the habitat to determine where those animals get their water. |
| EARTH SCIENCE Standard 3-1. (K-ESS3-1) Use a model to represent the relationship between the needs of different plans and animals (including humans) and the places they live. | | BIRDS AND CATERPILLARS Children demonstrate their knowledge of how camouflage is used for protection and survival while playing a fun game. | |

*Note.* Only GUW activities used in this study are included. The correlation of other GUW activities with standards is not listed in this table.
The NGSS were released in 2013 and have subsequently been adopted by 19 states, including Kentucky, and the District of Columbia. The standards list science and engineering competencies students are expected to attain in each grade. The learning targets of NGSS are based on the premise that learning is a process that engages students to participate in their knowledge acquisition. States that have adopted NGSS have typically aligned them with state standards, as in Kentucky. The KAS:S set minimum requirements that students must meet prior to graduation. They ensure commonality in academic standards throughout the Commonwealth. The wording of KAS:S matches that of NGSS, making the correlations foolproof. Kentucky’s standards are also structured exactly like NGSS. Fayette County Public Schools’ Office of Curriculum and Assessment has adapted the NGSS and KAS:S to create curriculum maps for each content area. These are designed to provide educators with standards-based, high quality instructional resources. The curriculum maps for science contain the same verbiage and reference the NGSS/KAS:S in each standard.

In 2017 the Growing Up Wild curriculum activities were correlated with the Performance Expectations (PEs) of the NGSS (Association of Fish & Wildlife, 2017). An evolving document, this crosswalk is a three-tiered scale indicating how well aligned each activity is with a standard. The lowest tier or level of alignment requires modifications to fully meet a standard. Only activities of the highest tier or alignment level were eligible for use in the current study. Each field trip station at the KCG has unique learning objectives that are aligned with NGSS and Growing Up Wild (University of Kentucky College of Agriculture, Food, & the Environment, n.d.). Complementary to
this document is a similar crosswalk that adds to existing information regarding activities at the KCG (Gravil & Reynolds, 2013).

**Significance of the Study**

The Field Trip Study focused on capitalizing on the experiential learning opportunities afforded by a field trip to the Kentucky Children’s Garden (KCG) at The Arboretum State Botanical Garden of Kentucky by connecting field trip learning objectives with classroom activities. Although some reports (e.g., Garrity, Pastore, & Roche, 2010; Malone, 2008; Nadelson & Jordan, 2012) describe the benefits of field trip experiences for older children, few studies have examined the effects of curriculum-guided field trips on the learning outcomes of kindergarten children. The Field Trip Study presents a novel approach in supporting field trips as an opportunity to supplement knowledge obtained within the classroom. The study is the first to examine the use of the Growing Up WILD curriculum as a method to link field trip and classroom learning. The curriculum appears in the literature in the context of available early childhood environmental education resources wherein the contents are described (Fortino, Gerretson, Button, & Masters, 2014). The Fortino et al. (2014) article serves as a “how to” for use of the Growing Up WILD curriculum across early childhood classroom formats. In addition, the curriculum was used in researching pre-service teachers’ comfort and confidence in implementing environmental education practices (Torquati, Miller, Hamel, Hong, & Sarver, 2017). Thus, the use of the curriculum in the context of this study was in a teacher preparation program and not in early childhood classrooms.

The use of environmental education in formal early childhood settings is uncommon outside of nature-based schools and forest kindergartens, or programming
held almost exclusively outdoors. Project WILD, from which Growing Up WILD was derived, was implemented in fifth grade classrooms as part of a research study examining student science learning (Powell & Wells, 2002). The Powell and Wells (2002) study used Project WILD as one of four experiential education curricula to supplement existing curricula as a means of meeting state science standards, and the researchers report it was effective in this objective. Environmental education occurs most frequently in the middle and high school years (James & Williams, 2017; Torquati et al., 2013). The Field Trip Study is the first to look at using environmental education in early childhood classrooms in an empirical manner.

Overwhelming evidence indicates that educators of young children do not feel adept at teaching science. Early childhood educators report minimal preparation for science instruction in their own teaching preparation programs and often experience anxiety when confronted with teaching science in their classrooms (Torquati et al., 2013). The Field Trip Study explores teachers’ perceptions of using a nature-based field trip and nature-based curriculum that is aligned with NGSS and other learning standards. This may have important implications for the preparation of future early childhood educators, as environmental education has been demonstrated to incorporate constructivist teaching (Klein & Merritt, 1994). Use of the Growing Up WILD curriculum and appropriately structured field trips can be utilized to integrate science learning within other developmental and learning domains in accordance with developmentally appropriate instructional practices.
**Study Objectives**

The primary purpose of this study was to test the effects of an environmental education unit and corresponding field trip on the science knowledge development of kindergarten children. Previous work aligned the KCG’s learning objectives with Kentucky Early Childhood Standards (KECS; Kentucky Department of Education, 2013b) and Next Generation Science Standards (NGSS; Next Generation Science Standards Lead States, 2013) via the creation of curriculum crosswalks (Gravil & Reynolds, 2016). The current research furthered those connections with the integration of standards-based extension activities linking classroom objectives with those of the KCG. Activities from the Growing Up WILD curriculum served as the primary component for making extension activities relevant and engaging for both teachers and children.

Objectives of the proposed research were multifold. One objective was to determine if science learning acquired during an outdoor field trip can be bridged with classroom learning through the use of extension activities that supplement existing curricula. Kindergarten teachers were trained to implement a nature-based, environmental education curriculum and/or read science content books and facilitated discussion with children in their classrooms. Additionally, science inquiry skills of primary children attending a field trip at the children’s garden were measured using a brief assessment of science skills. Research data were examined to determine if supplemental classroom activities in any of the study classrooms impacted children’s science knowledge. Informal interviews with participating primary teachers informed the researcher regarding teachers’ perceptions of field trip usage, ways to integrate experiential learning into existing curricula, and use of the Growing Up WILD curriculum in formal classrooms.
Research Questions

The Field Trip Study was conducted in direct response to the emergence of scientific thinking as it relates to children’s cognitive abilities. The purpose of the study was to evaluate the effects of nature-based, experiential activities on children’s acquisition of science skills. The Field Trip Study addressed gaps in existing research by exploring the following research questions:

1. How does science knowledge compare between kindergarten children in four instructional conditions: 1) nature-based field trip plus Growing Up WILD extension activities, 2) nature-based field trips plus Growing Up WILD extension activities and corresponding book reading, 3) nature-based field trips plus corresponding book reading and book-related activities, and 4) nature-based field trip with business as usual instruction?

2. What are kindergarten teachers’ perceptions of using field trip extension activities, such as those provided in the Growing Up WILD curriculum? Do teachers think students benefit from such activities? If yes, in what ways? If no, why?
CHAPTER 2: METHODOLOGY

Subjects

The nature of the study required two distinct samples to address the research questions. Appropriate sampling methods were applied to obtain participants of the requisite populations for data collection. A power analysis using the GPower computer program (Erdfelder, Faul, & Buchner, 1996) indicated a total sample of 80 children was needed to detect medium treatment effects (d=.50) with 80% power using a one-way ANOVA between means with alpha at .05.

Teachers. The use of convenience and purposeful sampling identified potential participants of kindergarten teachers for the Growing Up WILD training and field trip study components. Fayette County Public School teachers interested in KCG field trips sent electronic inquiries to the Education Coordinator at the Arboretum State Botanical Garden of Kentucky. The Education Coordinator sent those teachers a brief study description in addition to regular KCG program information. The Education Coordinator also sent e-mails with study information to all teachers who attended field trips at the KCG in the previous 2 years. One kindergarten teacher contacted the Education Coordinator for additional details about the study. The Education Coordinator forwarded my contact information to the kindergarten teacher, and specific study details were conveyed via e-mail (e.g., timeline, tasks required of teachers,). Upon preliminary assent of this teacher, I met with the principal of the elementary school to explain the study and obtain his permission for all teachers’ participation. I then sent study details to all five kindergarten teachers at the school. All five teachers agreed to participate in the study.
Participation of all kindergarten teachers in one elementary school comprised the unit sample and ensured relative homogeneity in the child sample. Simple random assignment using an online research randomizer appointed teachers to one of five groups. Children in Group 1 received the book readings and Growing Up WILD activities in conjunction with a field trip to the KCG; children in Group 2 received Growing Up WILD activities in conjunction with a field trip to the KCG. The children in Group 3 received book reading and book related activities in addition to a field trip. Group 4 served as the control group in which the teacher did not modify her regular instruction. All children with parental consent in Groups 1, 2, 3, and 4 completed the pre and post assessment. This assessment was piloted with children in Group 5. Teachers in Groups 3, 4, and 5 who did not receive Growing Up WILD training at the study’s onset were offered training upon study completion. All kindergarten teachers and children attended a field trip as part of their participation in the study.

Children. All children in kindergarten classrooms of teachers agreeing to participate in the study were eligible for study enrollment (N=81). Teachers in all classrooms sent informed consent papers and accompanying field trip permission slips home with children for parents’ review. Consent documents indicated that the children’s participation in the field trip was not contingent on study participation. Children who returned both signed study consent forms and permission slips were eligible for participation, and those children were enrolled in the study. A total of 80 children returned signed consent forms for a 98.8% return rate. Teacher and child participant demographics are summarized in Table 2.1.
Table 2.1

*Description of Children in Treatment and Control Groups*

<table>
<thead>
<tr>
<th>Student Characteristic</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>Group 4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>11</td>
<td>11</td>
<td>9</td>
<td>11</td>
<td>43</td>
</tr>
<tr>
<td>Female</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>9</td>
<td>37</td>
</tr>
<tr>
<td>Unknown</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Age (in months)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>73</td>
<td>74.42</td>
<td>73.26</td>
<td>77.05</td>
<td>74.43</td>
</tr>
<tr>
<td>Median</td>
<td>73</td>
<td>74</td>
<td>73</td>
<td>72.5</td>
<td>73</td>
</tr>
<tr>
<td>SD</td>
<td>3.11</td>
<td>4.93</td>
<td>4.16</td>
<td>3.79</td>
<td>.76</td>
</tr>
<tr>
<td>Range</td>
<td>69-77</td>
<td>68-81</td>
<td>68-81</td>
<td>68-84</td>
<td>68-84</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td>19</td>
<td>19</td>
<td>15</td>
<td>12</td>
<td>64</td>
</tr>
<tr>
<td>African</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Biracial</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Hispanic</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Asian American</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Unknown</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Attended preschool</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>17</td>
<td>17</td>
<td>8</td>
<td>7</td>
<td>49</td>
</tr>
<tr>
<td>No</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Unknown</td>
<td>2</td>
<td>2</td>
<td>11</td>
<td>13</td>
<td>28</td>
</tr>
</tbody>
</table>

At the time of the pre- and post-tests, verbal and/or nonverbal child assent was obtained. The teacher explained to children that they would be asked some questions...
about science and animals and be asked to draw some pictures. Children were told that their parents gave permission for them to participate in the study and work with me. Assent was evaluated by affirmative or negative verbal and non-verbal responses (e.g., head nodding, sitting down at the table, shaking his/her head “no”). No child refused to participate in the pre- and post-testing.

**Research Design**

This research required a mixed-methods design (McMillan & Schumacher, 2010) to address the research questions. A multiple treatments and controls with pretest research design was utilized to answer the first and second research questions (see Table 2.2). This design included three alternative treatments and one control condition. The variation in this design enabled comparison of three distinct treatments, \( X_A = \text{field trip}, \) \( X_B = \text{field trip plus Growing Up WILD unit of study, and book reading}; \) \( X_C = \text{field trip plus book and related activities}, \) with a no-treatment control that attended a field trip \( (X) \). This design also allowed for examination of possible differences between groups at post-testing (Shadish, Cook, & Campbell, 2002). A previous study examining effects of the Project WILD curriculum on fifth graders’ science knowledge utilized this research design, though only three treatment options were implemented in that study (Powell & Wells, 2002).

<table>
<thead>
<tr>
<th>Group</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>O</td>
</tr>
<tr>
<td>Group 2</td>
<td>O</td>
</tr>
<tr>
<td>Group 3</td>
<td>O</td>
</tr>
<tr>
<td>Group 4</td>
<td>O</td>
</tr>
</tbody>
</table>

**Table 2.2**

*Multiple Treatments and Controls with Pretest Design*

Note: \( O = \text{assessment} \)

\( X = \text{field trip} \)
I generated an assessment of seven questions that served as a pre- and post-test of science knowledge (O). The assessment was crafted to reflect themes addressed in Growing Up WILD activities and the books used for the study. Each item was aligned with the NGSS criteria it addressed. Change scores from pretesting to posttesting across groups were examined to determine if any groups’ outcomes improved. The teachers in Groups 3 and 4, who participated in the study but did not use the Growing Up WILD curriculum, and the teacher in the pilot classroom were offered Growing Up WILD curriculum training upon study completion for participating in the study and pretesting and posttesting or piloting the assessment with children. See Table 2.3 for a detailed timeline of activities.

Table 2.3

<table>
<thead>
<tr>
<th></th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>Group 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 1</td>
<td>Pretest</td>
<td>Pretest</td>
<td>Pretest</td>
<td>Pretest</td>
</tr>
<tr>
<td>Day 2</td>
<td>GUW/Book 1</td>
<td>GUW</td>
<td>Book 1</td>
<td>BAU</td>
</tr>
<tr>
<td>Day 3</td>
<td>GUW/Book 1</td>
<td>GUW</td>
<td>Book 1 Activity</td>
<td>BAU</td>
</tr>
<tr>
<td>Day 4</td>
<td>Field Trip</td>
<td>Field Trip</td>
<td>Field Trip</td>
<td>Field Trip</td>
</tr>
<tr>
<td>Day 5</td>
<td>GUW/Book 2</td>
<td>GUW</td>
<td>Book 2</td>
<td>BAU</td>
</tr>
<tr>
<td>Day 6</td>
<td>GUW/Book 2</td>
<td>GUW</td>
<td>Book 2 Activity</td>
<td>BAU</td>
</tr>
<tr>
<td>Day 7</td>
<td>Posttest</td>
<td>Posttest</td>
<td>Posttest</td>
<td>Posttest</td>
</tr>
</tbody>
</table>

Note: GUW = Growing Up WILD activity
BAU = Business as usual

Procedures

Growing Up WILD activities. Kindergarten teachers in Groups 1 and 2 were trained on the Growing Up WILD curriculum by a Certified Professional Environmental Educator in Kentucky certified to train educators on the curriculum. The trainer met with teachers at their school after child dismissal to facilitate the three-hour training. Teachers
were required to implement select Growing Up WILD activities as part of the training, one of which was implemented in the study. Using a checklist of steps for respective activities, I conducted fidelity checks on teachers’ implementation during training. Upon training completion and attaining 80% fidelity, teachers were given certificates enabling their use of the curriculum. Following training, teachers in Groups 1 and 2 were given the curriculum book.

Teachers in Group 1 and 2 implemented the Growing Up WILD activities for approximately ½ hour each day for 4 days during the study as part of the alternate treatment design. Select Growing Up WILD activities were identified based on their alignment rating with NGSS (Association of Fish & Wildlife Agencies, 2017) and alignment with field trip station activities. The Growing Up WILD activities selected for teacher use either elaborated on or were the same as the activities of KCG field trip stations (i.e., Wildlife Safari and Who Lives in a Tree). Growing Up WILD activities, used in classrooms for this study, are included in Appendix A in their entirety. See Table 2.4 for a brief description of activities selected for this study. Activity implementation occurred the 2 days prior to and the 2 days following the field trip to the KCG.

**Book reading activities.** Book reading and discussion activities served as an alternate treatment in this study design. Two different books were read and discussed with children in Groups 1 and 3 in the two days immediately prior to, and two days immediately following, the field trip to the KCG. The books, *Looking for Animals* (Lowery, 2015a), and *Our Very Own Tree* (Lowery, 2015b) focused on plant and animal
<table>
<thead>
<tr>
<th>GUW Activity</th>
<th>Objective</th>
<th>Materials</th>
<th>Synopsis</th>
</tr>
</thead>
</table>
| Lunch for a Bear      | Children identify the kinds of foods that Black Bears eat by creating a plate of “bear food.” | • “bear” food (e.g., berries, leaves, acorns, insects  
• copies of Food for Black Bear cards from back of book  
• paper bag “bear stomachs”  
• crayons, glue, paper plates | Children discuss what “bear” food they would/would not eat and discuss how bears are omnivores. “Bear” food cards are dispersed and are collected by children to the modified tune of “The Bear Went Over the Mountain.” Process is repeated with ½ of food cards to demonstrate food scarcity and discussion about what this might mean for bears. |
| Who Lives in a Tree?  | Children develop an awareness of trees and some of the animals that call them “home.” | • “Tall Oak Tree” poem in back of book  
• flannel tree sheet  
• felt props from poem (e.g., bat, nest, egg) | Children share their experiences with trees. Felt objects from “Tall Oak Tree” poem are distributed to children. Teacher reads poem and children place his/her object on tree as it is mentioned (children may also act out the animals described in the poem). Children are taken outdoors to examine tree(s) in search of signs of animals or animal habitats. |
| Wildlife Water Safari | Children discover water sources for local wildlife and create a field notebook. | • Children-made cardboard tube binoculars  
• Wildlife Water Safari Field Notebook from back of book  
• Pencil, paper, clipboards | Children take their safari materials on a safari walk around the school grounds looking for wildlife or clues that wildlife has been in the area (e.g., feathers, scat, tracks). Children draw animals they see in Safari Notebooks and are encouraged to add landscape elements. Teacher helps children look for water sources near the sightings to determine where the animal(s) obtains water. Children are encouraged to draw/write water source in the Field Notebooks. |
| Wildlife is Everywhere! | Children make observations and understand that wildlife is all around us. | • Selection of Animal Cards from back of book  
• Children-made safari hats  
• Paper, crayons, clipboard | Children share stories of animals they’ve seen then become ‘wildlife scientists’ to quietly explore signs of wildlife inside and outside their classroom. Children record observations and discuss findings as a group. Each child draws a picture of wildlife/sign of wildlife and a class book titled “Wildlife is Everywhere!” is produced. |
systems and paralleled content presented at the specific stations during the KCG field. The books also related to the themes of the Growing Up WILD activities selected for teachers in Groups 1 and 2 to implement in classrooms. Published by National Science Teachers Association Kids by award winning science educator Lawrence Lowery, the books were part of the *I Wonder Why* series. This series was written to spark children’s exploration of biology-related phenomena while encouraging them to become avid readers. Included in each book is a Parent/Teacher handbook with extension activities (see Appendix B).

The science processes of observation and comparison were emphasized in *Looking for Animals* (Lowery, 2015a). The book focuses on, and explained how, the protective coloration of animals serves them in their natural environments. Provided discussion prompts stressed the various functions of animal coloration. The concepts of predator and prey were discussed. The teacher in Group 3 implemented the extension activity in the back of the book, engaged children in a game exploring the effect of color during a predator/prey hunt. Colored pipe cleaner cuttings, equal amounts of each color, were dispersed throughout a grassy area near the school playground and children played the part of “birds” who fed on the “worms” in the grass by using their thumb and finger as a “beak.” The teacher was instructed to tally the number of each color of worms retrieved after 2 minutes, and discuss the results (e.g., What color of “worm” was most collected? Did color influence the survival of the worms?). The “hunt” was immediately repeated a second time with the results again tallied and discussed. This was the sole activity related to the *Looking for Animals* (Lowery, 2015a) book.
In *Our Very Own Tree* (Lowery, 2015b), two girls in an urban park select a tree to study over time. Their interest illustrates the importance of in-depth study in science. Observation is the focus, not only on the tree itself, but also on events occurring around and on the tree and seasonal variations, including the tree as a habitat. Discussion prompts provided in the book emphasized how some changes occur over long periods of time, while some occur more regularly. The idea of conservation and care of natural resources is introduced, as are child-friendly resources to expand knowledge including books and teachers. The back of book activity involved the exploration of different tree stems with magnifying glasses. I provided magnifying glasses and stems from several different trees. Enough materials were provided children to share in groups of two. Children examined the stem and discussed it with their partner, and then each child drew a picture of his/her stem and labeled the parts, guided by the teacher’s example (see a sample of children’s work in Appendix C). The teacher facilitated discussion about the various stem parts while children worked on their drawings. Children then compared their drawings with the different stems from other groups. As with the Growing Up WILD activities selected for use in this study, the books and activities reflected the learning objectives of field trip stations.

The classroom teachers in Groups 1 and 3 read the books to children during whole group time and elicited discussion about the content of the books using the Parent/Teacher handbook as a guide. In addition to reading the books, the teacher in Group 3 implemented the Parent/Teacher extension activities provided in the back of each book as described above. This distinguished Group 3 as an alternate treatment to
Groups 1 and 2, wherein Group 1 (A), Group 2 (B), and Group 3 (C). Group 4 served as the control group, and children in this class did not receive any special instruction.

**Daily schedule of study activities.** At the request of teachers, only 30 minutes of classroom time each day of the study was dedicated to research activities. The teacher in Group 1 read and discussed books with children on the same days as the Growing Up WILD activities. For example, on Day 2, the teacher in Group 1 spent approximately 10 minutes reading half of *Looking for Animals* (Lowery, 2015a) and then 20 minutes implementing the Growing Up WILD activity Who Lives in a Tree? Because of the 30-minute time constraint, book readings for Group 1 were split over 2 consecutive days. Group 2 on Day 2 for 30 minutes implemented the same Growing Up WILD activity as Group 1. Group 3 on Day 2 read *Looking for Animals* (Lowery, 2015a) in its entirety, and on this day Group 4 had business as usual instruction. On Day 3, the teacher in Group 1 spent 10 minutes reading the second half of *Looking for Animals* (Lowery, 2015a) and facilitated whole group discussion focused on the book. She then implemented the Growing Up WILD activity Lunch for a Bear in the remaining 20 minutes. The teacher in Group 2 spent 30 minutes on this day implementing the Lunch for a Bear activity. On Day 3, the teacher in Group 3 engaged children for 30 minutes in the Parent/Teacher extension activities provided in the back of *Looking for Animals* (Lowery, 2015a) book. Group 4 on this day again had business as usual instruction.

Teachers in all groups, including the pilot classroom, went on a field trip to the KCG on day 4. Upon returning to the classroom on Day 5, all groups resumed activities as described above (with new Growing Up WILD activities and books) through Day 6. This multiple treatments design allowed for the comparison of the
three separate treatments: field trip with book reading and Growing Up WILD ($X_A$), field trip with Growing Up WILD ($X_B$), and field trip with book reading and extension activities ($X_C$). The control, Group 4, received the KCG field trip without any special instruction or activities. In this design, teachers made learning connections both before and after the field trip. Table 2.5 details each group’s activities
Table 2.5

*Daily schedule of study activities in kindergarten classrooms*

<table>
<thead>
<tr>
<th>Group</th>
<th>Mon 5/7</th>
<th>Tues 5/8</th>
<th>Wed 5/9</th>
<th>Thurs 5/10</th>
<th>Fri 5/11</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8:30-9</td>
<td>10:00-10:30</td>
<td>10:00-12:00</td>
<td>11:00-11:30</td>
<td>8:30-9:00</td>
</tr>
<tr>
<td>Group 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• GUW “Who Lives in a Tree?”</td>
<td>• GUW “Lunch for a Bear”</td>
<td>• GUW “Wildlife Water Safari”</td>
<td>• GUW “Wildlife is Everywhere”</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Read ½ “Our Very Own Tree”</td>
<td>• Read second ½ “Our Very Own Tree”</td>
<td>• Read ½ “Looking for Animals”</td>
<td>• Read second ½ “Looking for Animals”</td>
<td></td>
</tr>
<tr>
<td>Group 1</td>
<td>11:00-11:30</td>
<td>9:30-10:00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 2</td>
<td>8:00-8:30</td>
<td>11:00-11:30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• GUW “Who Lives in a Tree?”</td>
<td>• GUW “Lunch for a Bear”</td>
<td>• GUW “Wildlife Water Safari”</td>
<td>• GUW “Wildlife is Everywhere”</td>
<td></td>
</tr>
<tr>
<td>Group 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Read “Our Very Own Tree”</td>
<td>• “Our Very Own Tree” back of book activity</td>
<td>• Read “Looking for Animals”</td>
<td>• “Looking for Animals” back of book activity</td>
<td></td>
</tr>
<tr>
<td>Group 3</td>
<td>10:30-11:00</td>
<td>1:30-2:00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 4</td>
<td>• Regular instruction</td>
<td>• Regular instruction</td>
<td>• Regular instruction</td>
<td>• Regular instruction</td>
<td></td>
</tr>
</tbody>
</table>

KCG Field Trip

8:30-9:00 | 8:00-8:30

10:30-11:00 | 10:30-11:00
**Field trip.** The KCG offers field trips each Wednesday during the spring and fall for children in kindergarten through second grade. Each trip can accommodate approximately 110 children and lasts 2 hours. Depending on the size of the attending group and the age range of attendees, the KCG hosts up to 11 different learning stations placed throughout the facility. The Education Manager oversees and facilitates each field trip with the assistance of trained volunteers. With the exception of two stations that are teacher-led, a KCG staff or volunteer facilitates all stations. Upon arrival, children are divided into groups with the assistance of classroom teachers, and all groups are then given a brief orientation to the field trip. The smaller groups then rotate through the stations, spending 7-15 minutes at each depending on the number of children in each group. A whistle is blown when it is time to rotate to the next station.

All five kindergarten classes from the study school went together on a May field trip to the KCG. I paid for all transportation costs and entry fees. Children, teachers, and chaperones arrived at the KCG at 9:45 a.m. and the field trip lasted until 12:00 p.m., at which time the group gathered for lunch on the greater arboretum grounds. The education stations available on this field trip included Wildlife Water Safari, Planting Station, Signs of Spring, Boat and Log Cabin, Worm Races, Who Lives in a Tree, Birds and Caterpillars, and Log Play. These specific activities were considered when the researcher selected Growing Up WILD activities for study use. Field trip education stations from the Growing Up WILD curriculum were selected for classroom implementation because of their alignment with the NGSS Performance Standards Kindergarten-Life Science Standard 1-1 (K-LS-1-1) and Kindergarten-Earth Science Standard 3-1 (K-ESS-3.1) that
were focused on in this study. See Table 2.6 for activities for each education station. The KCG lesson plan specific to the field trip for this study is Appendix D.

Table 2.6.

**KCG Field Trip Education Stations and Activity Synopses**

<table>
<thead>
<tr>
<th>KCG Education Station</th>
<th>Synopsis of Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wildlife Safari</td>
<td>• explore the KCG searching for wildlife or signs of wildlife</td>
</tr>
<tr>
<td><em>KCG led</em></td>
<td>• investigate animals’ habitats to determine a water source for those animals</td>
</tr>
<tr>
<td>Planting Station</td>
<td>• learn what plants need to survive</td>
</tr>
<tr>
<td><em>KCG led</em></td>
<td>• plant a seed to take home and care for</td>
</tr>
<tr>
<td>Signs of Spring</td>
<td>• learn about and observe weather, plant, and animal patterns connected to current season</td>
</tr>
<tr>
<td><em>KCG led</em></td>
<td></td>
</tr>
<tr>
<td>Boat and Log Cabin</td>
<td>• explore pond area from dock, boat, and land</td>
</tr>
<tr>
<td><em>Teacher led</em></td>
<td>• pretend to fish with poles and nets</td>
</tr>
<tr>
<td>Worm Races</td>
<td>• learn about and observe worms while playing a fun game</td>
</tr>
<tr>
<td><em>KCG led</em></td>
<td>• measure length of worms</td>
</tr>
<tr>
<td>Who Lives in a Tree</td>
<td>• read a poem, learn about and observe animals that live in a tree</td>
</tr>
<tr>
<td><em>KCG led</em></td>
<td></td>
</tr>
<tr>
<td>Birds and Caterpillars</td>
<td>• children demonstrate their knowledge of how camouflage is used for protection and survival while playing a fun game</td>
</tr>
<tr>
<td><em>KCG led</em></td>
<td></td>
</tr>
<tr>
<td>Log Play</td>
<td>• explore and climb upon giant logs</td>
</tr>
<tr>
<td><em>Teacher led</em></td>
<td></td>
</tr>
</tbody>
</table>

**Teachers’ perceptions of extension activities and field trip.** To address the second research question, qualitative data were gathered from all five teachers participating in the study, including the teacher in pilot classroom. Teachers debriefed about study activities in an informal interview format. I facilitated the informal interviews with the objective of eliciting teachers’ perceptions of the use of field trips for primary children, and methods of extending experiential learning acquired on a field trip
into the classroom. Teachers were asked to discuss the experience of implementing activities from the Growing Up WILD curriculum in classrooms. Information yielded from these interviews provided insights regarding best practices to bridge knowledge acquisition between formal and informal learning environments.

**Variables**

**Independent variable.** The alternate treatments study design lends to the identification of three distinct independent variables: use of the Growing Up WILD activities with book reading ($X_A$), use of the Growing Up WILD activities alone ($X_B$), use of book reading and activities ($X_C$), and the use of a field trip as a stand alone learning opportunity ($X$). While extraneous variables were considered when evaluating study data, the different interventions, or lack thereof as in the case of Group 4, were used to establish comparison groups.

**Dependent variable.** Study children’s performance on the science assessment was the dependent variable in this study. Administration of the assessment prior to and after the field trip, and implementation of supplemental activities, measured the differences in child outcomes between the children in Groups 1, 2, and 3. Data from these three groups were also compared to that from children in Group 4, the control group. Inherent in the research design implemented in this study was the ability to measure the dependent variable, or child outcome scores, both between and within groups. These data were collected at the individual level.

**Measures**

**Science learning assessment.** I assembled a brief assessment of science knowledge for primary children corresponding with field trip and Growing Up WILD
learning objectives. A Chronbach’s alpha was conducted to examine the internal consistency, or unidimensionality, of the scale. The Chronbach’s alpha was .64, indicating fair internal consistency. Each of the seven questions on the assessment was aligned with NGSS that were addressed (see Table 2.7) and focused on: reality and fantasy comparisons; the concepts of living, non-living, or once-living; the requirements of living plants and animals; and observations of animals and habitats. The assessment consisted of two matching questions, two questions on which children circled their answers, one question giving children the option to draw and/or write their answer, and one open response question. One assessment question required the children to: 1) draw a picture of an animal they have seen in the wild; 2) write its name; 3) indicate where the child believes the animal gets its water; and 4) what the animal eats. Content validity was ensured via an examination of the assessment and targeted learning objectives by the STEM Education professor and the teacher in the pilot classroom. The assessment method was similar to existing assessment procedures in kindergarten.

Teachers administered the assessment following a script I developed, and I collected simultaneously collected fidelity data on test administration. Each assessment task was read aloud and repeated as the teacher walked around the room while children worked. Para-educators worked with children as they would during regular work time. I met with small groups of children to discuss their answers after they completed the assessment. These conversations were audio-recorded for additional analysis upon study completion. The assessment was piloted with children in a fifth kindergarten classroom at the study school to assess construct validity and ease of administration. This fifth kindergarten classroom did not participate in other study activities, though these children
did attend the field trip with the four study classrooms. A rubric, also based on NGSS, was constructed to score assessments.
Table 2.7

**NGSS Alignment with Field Trip Study Assessment Questions**

NGSS K. Interdependent Relationships in Ecosystems: Animals, Plants, and Their Environment

<table>
<thead>
<tr>
<th>NGSS Performance Expectation</th>
<th>Key Concepts</th>
<th>Field Trip Study Assessment Question</th>
</tr>
</thead>
</table>
| K-LS-1-1 Use observations to describe patterns of what plants and animals (including humans) need to survive. | • Living vs nonliving  
• Reality and fantasy comparisons  
• Make and record observations | 1. Circle all of the things that are living or were alive at one time.  
2. Circle all of the animals that are not real.  
3. What things must animals have to survive? List or draw as many as you can. |

| K-ESS-3-1 Use a model to represent the relationships between the needs of different plants or animals (including humans) and the places they live. | • Observations about animals  
• What is food?  
• Habitats/environments  
• Simple systems | 4. Can a fish live on land? Write yes or not, then give some reasons.  
5. Draw a line to connect the animal to the food it eats.  
6. Draw an animal in its natural habitat. Draw other animals and plants that live there.  
   a. what is the name of this animal?  
   b. where do you think this animal gets its water?  
   c. what do you think this animal eats?  
7. Draw a line to connect each animal to its habitat. |

Children with parent consent completed the science learning assessment at two times during the study. The assessment measured children’s understanding of NGSS Performance Standards Kindergarten-Life Science Standard 1-1 (K-LS-1-1) and Kindergarten-Earth Science Standard 3-1 (K-ESS-3-1; see Figures 2.1 and 2.2 for the complete Standards), and was administered by teachers in a whole group format. The assessment was administered prior to implementation of study activities and again after
the field trip and completion of study activities. Teachers followed an administration protocol (see Appendix E) and read each question out loud to the children. Children who typically had support from a para-educator or teaching assistant had this support during the assessment. In some instances if the child’s writing or drawing was illegible, the teacher asked the child about his/her answer and wrote the child’s response on the assessment next to the child’s written or drawn response. Teachers gave children ample time to write or draw their answers before moving forward to subsequent questions. For example, approximately 1 minute was allotted for tasks requiring children to match or circle pictures. Children were given five minutes to complete task six and draw an animal in its habitat. Two to three minutes were given for children to write or draw in response to tasks three and four. The assessment took approximately 25 minutes to administer on each of the pre- and post-test days, depending on classroom schedules.

Students who demonstrate understanding can:

**K-LS1-1. Use observations to describe patterns of what plants and animals (including humans) need to survive.** [Clarification Statement: Examples of patterns could include that animals need to take in food but plants do not; the different kinds of food needed by different types of animals; the requirement of plants to have light; and, that all living things need water.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

<table>
<thead>
<tr>
<th>Science and Engineering Practices</th>
<th>Disciplinary Core Ideas</th>
<th>Crosscutting Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyzing and Interpreting Data</td>
<td>LS1.C: Organization for Matter and Energy Flow in Organisms</td>
<td>Patterns</td>
</tr>
<tr>
<td>Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.</td>
<td>• All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow. (K-LS1-1)</td>
<td>• Patterns in the natural and human designed world can be observed and used as evidence. (K-LS1-1)</td>
</tr>
<tr>
<td>Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. (K-LS1-1)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Students who demonstrate understanding can:

K-ESS3-1. Use a model to represent the relationship between the needs of different plants and animals (including humans) and the places they live. [Clarification Statement: Examples of relationships could include that deer eat buds and leaves, therefore, they usually live in forested areas; and, grasses need sunlight so they often grow in meadows. Plants, animals, and their surroundings make up a system.]

The performance expectation above was developed using the following elements from the NRC document A Framework for K-12 Science Education:

<table>
<thead>
<tr>
<th>Science and Engineering Practices</th>
<th>Disciplinary Core Ideas</th>
<th>Crosscutting Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developing and Using Models</td>
<td>ESS3.A: Natural Resources</td>
<td>Systems and System Models</td>
</tr>
<tr>
<td>Modeling in K-2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, storyboard) that represent concrete events or design solutions.</td>
<td>* Living things need water, air, and resources from the land, and they live in places that have the things they need. Humans use natural resources for everything they do.</td>
<td>* Systems in the natural and designed world have parts that work together.</td>
</tr>
<tr>
<td>* Use a model to represent relationships in the natural world.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Conception of the assessment was based on factors including content and modality of administration (e.g., orally, whole group). Children who received modifications in the classrooms received those same modifications during the assessment. Tasks requiring a mixture of written and drawn responses were created to elucidate children’s thought processes. This was especially important considering the young age of the child participants. The combination of a drawing and supplemental written response has been used previously to collect reliable data without the need for student interviews (Weber, Duncan, Dyehouse, Strobel, & Diefes-Dux, 2011). Using drawing as a means of assessment has been used with children of various ages (see Chang, 2012; Green, 2017; Jose, Patrick, & Moseley, 2017). Drawing permits children to illustrate concepts that they may be unable to explain verbally, and it is an age appropriate activity for kindergarteners. In addition, drawing allows children to present
information unique to their personal interpretation of knowledge and processes (Cronin-Jones, 2005).

The North American Association for Environmental Education’s (NAAEE) Excellence in Environmental Education: Guidelines for Learning (K-12; NAAEE, 2010a) and the EQuIP Rubric for Lessons and Units: Science (NGSS, 2016) provided parameters for creating the assessment tasks to be used in this study. The NAAEE Guidelines, currently under revision, set forth recommendations for evaluating both existing environmental education materials and the generation of new ones. The NGSS EQuIP Rubric for Lessons and Units: Science was designed to assess lessons, activities, and assessments that span more than one class period. In addition to these guidelines, a STEM professor versed in NGSS assisted me in deconstructing the standards to identify the knowledge and skills kindergarten-age children should have according to NGSS K-LS-1-1 and K-ESS-3-1 (i.e., what animals must have to survive, living versus nonliving, observations and comparisons, etc.).

Feedback from the STEM Education professor was integrated in assessment drafts, and it underwent significant revisions before piloting to capture children’s understanding of standards-based concepts. Modifications redirected the focus from vocabulary to conceptual understanding. Additional revisions included the images used to portray habitats and food sources for matching questions. After creation of the scoring rubric, the assessment was piloted in a fifth kindergarten classroom at the study school that otherwise did not participate in the study (though the class did attend the field trip). I met with the teacher after piloting the assessment to debrief its use and obtain her
feedback. A minor wording change was made to task four. The child assessment in its entirety is in Appendix F.

After all children completed the assessment, one small group of 3-4 children in each classroom met with me for approximately 15 minutes to share thoughts about assessment answers. Children were selected by each teacher. Small group settings give children the opportunity for social interactions, and can enhance positive attitudes towards learning and mutual support among children. Results from previous studies indicate collaborative learning, or group work, plays a critical role in children’s engagement in and understanding of science process skills (see Howe et al., 2007; Kempa & Ayob, 1995). The more intimate setting offered in small groups also gives less verbal children a space in which their ideas are given equal importance as those of more vocal children. One example of an assessment administered in this format is Lederman & Bartel’s *Young Children’s Views of Science Questionnaire* (YCVS; Lederman, 2009). The YCVS is an oral protocol developed specifically for young children and other students who are unable to express themselves in written formats. The protocol is comprised of questions related to Nature of Science and Science Inquiry and is administered to small groups of three to four children. Results from one study show use of the YCVS elicited science knowledge children obtained outside the classroom, particularly children with disabilities (Lederman & Bartels, 2018). The oral component for the Field Trip Study child assessment included five scripted questions that were followed with each group of children. See Appendix G to view the child interview protocol.
**Child assessment rubric.** With guidance from the STEM Education professor proficient in working with rubrics, I designed a rubric to score children’s responses on the assessment. Scoring rubrics are especially helpful in assessing drawings, as adherence to the rubric focuses on specific components of the drawing to minimize subjectivity on behalf of the scorer (Cronin-Jones, 2005). The rubric designed for this study was loosely modeled after that used by Saka, Cerrah, Akdeniz, and Ayas (2006), which was used to score drawings of science and biology teachers based on observable criteria for each assigned level of understanding. The scoring rubric was based on deconstructing the NGSS Kindergarten Living Science (K-LS) and Earth Science (K-ES) Learning Standards (NGSS, 2016). The NGSS provide a list of observable learning targets specific to the different needs between plants and animals and their habitats, which paralleled the content in the assessment. Tasks 1, 2, 5, and 7, which included correct, incorrect, and possible but not probable answer choices, were scored on a scale of 0 (no score) to 3 (scientifically accurate). Tasks that were open response or required children to draw were scored on a scale of 0 (no understanding) to 5 (scientific with justification). The wording and criterion on each rubric were specific to each task. An overall rubric depicting children’s levels of science knowledge provided additional overall guidance in scoring tasks. The final rubric in its entirety is Appendix H.

A doctoral student of STEM Education was trained to score the assessments. In addition, a graduate of the Master’s of STEM Education program was trained to co-score 20% of the assessments for reliability purposes. I met with each of the co-scorers and five assessments were simultaneously scored and discussed using the rubric revised from the pilot study. Each scorer then individually scored five pretests and five posttests. I then
completed a reliability check by determining the number of compatible scores across each of the seven tasks. Inter-rater reliability was calculated by dividing the number of scores in agreement by the number of total scores. Three-way inter-rater reliability at this checkpoint was 87.5%. I met with the two scorers again to debrief the latest round of scoring and discuss differences. Ten additional assessments were scored and I conducted a second reliability check. Three-way inter-rater reliability at this checkpoint was 93.7%. Because the inter-rater reliability goal of 90% was achieved, we de Briefed via electronic mail. The STEM doctoral student then scored the remaining assessments. Three-way reliability for the 20% of assessments scored was 95.9%. Two-way inter-rater reliability for all assessments was 94.2%. The overall rubric for scoring assessments is visible in Figure 2.3.
<table>
<thead>
<tr>
<th>Level of Knowledge</th>
<th>Overall Evaluation Rubric</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low level knowledge</td>
<td>Numeric score and Level of understanding</td>
<td>Scoring Criteria</td>
</tr>
<tr>
<td></td>
<td><strong>0 - No Understanding</strong></td>
<td>no response, unclear response, or no explanation given for answer choice. Hard to analyze understanding</td>
</tr>
<tr>
<td></td>
<td><strong>1 - Incorrect/ Scientific Misconceptions</strong></td>
<td>very basic/vague content knowledge and still incorrect</td>
</tr>
<tr>
<td></td>
<td><strong>2 - Partial Scientific with misconceptions /Nonscientific Fragment</strong></td>
<td>basic/vague content knowledge with some misconceptions, but correct (scientific fragments/ facts)</td>
</tr>
<tr>
<td>Developing knowledge</td>
<td><strong>3 - Partially Scientific Notion</strong></td>
<td>vague but correct response showing incomplete knowledge with no connections.</td>
</tr>
<tr>
<td></td>
<td><strong>4 - Scientific minor justification</strong></td>
<td>correct response but provides minor explanation/ justification with no misconceptions</td>
</tr>
<tr>
<td>In depth knowledge</td>
<td><strong>5 - Scientific with justification</strong></td>
<td>response contains all parts of a scientific answer</td>
</tr>
</tbody>
</table>

*Figure 2.3. Overall evaluation rubric for scoring child assessments*
**Piloting.** The complete child assessment was piloted with 20 children prior to use in study classrooms. Children who participated in the pilot were from the kindergarten classroom not participating in the larger study, though in the same school as study classrooms. Minor edits to the wording of two questions were completed after piloting the assessment for clarification. The piloting process allowed for the establishment of construct validity and the identification of any errors in the protocol. Ease of administration and engagement of children were also evaluated. The child interview protocol was not piloted prior to its use in the study. Child data from the pilot study was not included in research results. All children in the pilot study classroom were provided a field trip to the KCG along with the other kindergarten classrooms.

The graduate of the Master’s in STEM Education program and I together scored and discussed 10 assessments from the pilot data. The scoring rubric underwent multiple changes as a result of the pilot study and scoring process. Revisions to the rubric were made to include more specific criterion for each level of understanding on the tasks requiring children to draw. For example, the criterion “must be drawn somewhat accurately, e.g., animal with two legs instead of four,” was added to achieve a score of 3 “partially scientific notion” to differentiate it from a score of 4 “scientific with minor justification” in which animals “must be drawn accurately, e.g., four legs.” Additional clarifications were made to discern how to score incorrect information and instances in which information was lacking. We met again and scored an additional five assessments with the revised rubric. Minor additional changes were made to the wording of criterion for three tasks.

**Teacher interview protocol.** An informal group interview with teachers in all
study groups, in addition to the teacher in the pilot classroom, was conducted at the school upon conclusion of the study. The objectives of the interviews were explained (i.e., to discuss connecting field trip activities to classroom learning, perceptions of using the Growing Up WILD curriculum), and teachers were encouraged to speak freely about their experiences participating in the research. The interview lasted approximately 20 minutes. Audio of the interview was digitally recorded, allowing me to converse with teachers without distraction of extensive note taking.

The teacher interview protocol consisted of five main questions designed to facilitate discussion about the use of field trips with primary students and how they might be made more beneficial. Each question contained sub questions to further explore the main topics. Teachers were asked about their perceptions of taking children on a field trip and asked to identify their expectations of a field trip. Several questions were specifically designed to elicit information regarding methods participants have used to integrate field trip learning into the classroom. Teachers also were asked to discuss the use of the Growing Up WILD curriculum in their classrooms and comment on whether or not they feel the curriculum increased science knowledge for children. The informal, conversational climate of the interviews allowed for discussion yielding substantial content for bridging learning between the informal field trip environment and that of the classroom. The complete teacher interview protocol is located in Appendix I.

**Data Collection**

Data collection occurred over the course of seven instructional days. The study classrooms were randomized into one of five groups: Group 1, Group 2, Group 3, Group 4, and pilot classroom. Classroom level data were collected in each of the four
intervention groups or classrooms. Data collection included teacher fidelity on implementation of study activities, implementation of assessment administration, and child outcome data. Upon completed collection of these data, an informal group interview was scheduled with teachers. Refer to Table 2.3 for a timeline and description of research activities across classrooms.

**Classroom level data.** After classrooms were randomized, the pretest was administered to all children in each of the four study classrooms (Day 1). Study activities lasted approximately 30 minutes and were staggered across groups, with children in Group 1 receiving both Growing Up WILD activities and a related book reading on Days 2 and 3. Teachers used Growing Up WILD activities only with children in Group 2 on these days, while instruction in Group 3 included reading the assigned NSTA book and completing the back of book activities. Group 4, the control, remained Business As Usual (BAU). On Day 4 children in all groups embarked on a field trip to the KCG. Upon returning to the classroom, teachers in Group 1 revisited Growing Up WILD with additional lessons and different book reading on Days 5 and 6. Group 2 again participated in Growing Up WILD activities in the classroom on these days, while instruction in Group 3 included an additional NSTA book reading and book activities. Group 4 remained BAU. During my 4-day observation window, the teacher in Group 4 incidentally used science as a teaching tool when she placed the butterfly hatchery on the overhead projector for children to reference during a math activity. Children in all three groups will on Day 7 took a post-test using the same assessment administered on Day 1.

I collected observational data in each classroom while the assessments were administered and study activities occurred. Thirty minutes of regular instruction was also
observed in the control classroom. Observational data collected included teachers’
alignment to warm-up activities in activity, alignment to primary activities, and level of
child engagement. A doctoral student in Special Education who was trained on the
observation tool collected reliability data across classrooms on 20% of observations.

Child assessments. A task analysis or checklist was created for observing
teachers’ administration of the assessments (Appendix J). All pre- and post-testing
sessions were observed in each classroom. Each teacher in a whole group format
administered the assessment. Children sat in their regular seats and had access to pencils
and crayons. Assessments were passed out to all children and the teacher read aloud each
task giving several minutes between tasks for children to complete their work. The
teacher answered child questions with encouragement or general praise without providing
help to complete tasks. The teacher collected all assessments upon completion and gave
them to the researcher. I then briefly reviewed the assessments and asked for clarification
if answers were illegible. Fidelity was calculated by dividing the number of tasks
correctly completed by the total number of tasks. Teachers adhered to the steps of child
assessment administration with 97.3% fidelity. There were three instances in which
teachers did not write the start and end times for assessment administration. Otherwise,
all steps were followed.

Post-assessment discussions with small groups of children in each classroom
were digitally audio recorded. Teachers selected four children to meet with me at a table
in the classroom. Upon obtaining verbal assent, I proceeded to ask each child to think of
an animal name for his/herself for use during the discussion. I explained that I wanted to
learn more about children’s assessment responses and talk about animals and habitats.
The children were then asked the first of seven of questions, with several minutes allowed for discussion. This was the protocol for the remaining oral component of the discussion. Children were given prompts including, “tell me what you think when I say ‘wild animal’” and “where do those animals get their water?” among others. Children also were asked to explain their responses to three of the assessments tasks. The child discussions occurred after the posttest sessions only. Time constraints due to standardized testing schedules prohibited me from meeting with groups of children after the pre-test.

**Teacher interview.** An informal group interview using the “interview guide approach” (McMillan & Schumacher, 2010) with all five study teachers concluded data collection. This format, in which the researcher selects interview topics in advance, is relative to participants’ thoughts, experiences, and knowledge of the content matter. The semi-structured interview lasted approximately 20 minutes was scheduled directly after school at the teachers’ convenience and took place in one of the study classrooms. The interview also served to assess the social and face validity of the study activities and assessment. Teachers were asked a series of question stems to elicit discussion regarding the use of field trips, commentary on extension activities to expand upon field trip learning opportunities, and perspectives on using the Growing Up WILD curriculum with kindergarten children. Feedback on general participation in the research study was elicited from teachers. Teacher demographic information, including education, total number of years teaching, and number of years teaching kindergarten, and was collected at this time.

**Fidelity data.** Implementation checks were performed via in-person observation each time teachers facilitated the Growing Up WILD and/or book reading activities.
Fidelity data measured to extent to which teachers implemented each step of the curriculum and/or book activities, with ratings of “All,” “Most,” “Some,” or “None.” This resulted in four implementation fidelity checks for each teacher during instruction and two during assessment administration times. Teacher fidelity of implementation across groups was 78.2%. A Special Education doctoral student familiar with the observation protocol and study activities collected inter-rater reliability data on 20% of both instructional observations and testing observations. Inter-rater reliability on instructional observations and testing administration was 100%. Fidelity observations occurred across teachers and conditions, including the BAU, or control group, classroom. I observed and collected data on each teacher during all study components. The checklists used for collecting observational and test administration data were used for collecting fidelity data.

**Data Entry and Analysis**

**Quantitative data analysis.** A doctoral student in Quantitative and Psychometric Methods completed quantitative analyses with study data. I entered child outcome scores into Excel software with child identifiers removed. Ten percent of the data were randomly selected and re-entered by the STEM graduate student to identify and reduce errors in data entry. SPSS software was utilized to analyze outcome data. Analysis of covariance (ANCOVA) was used to determine if gain scores on the child assessment differed significantly between the three treatment groups, and between the treatment and control group. The use of ANCOVA adjusts post-test scores according to differences that may exist between groups on pre-test scores. Elimination of this concomitant variable allowed for more accurate examination of relationships between assessment scores of
treatment and control group children. Additionally, because of the relatively small sample size, use of ANCOVA increased the power or probability of finding significant differences on the statistical test.

**Qualitative data analysis.** The group teacher interview and child interviews were recorded with a digital audio recorder and analyzed via a multistep process. The analysis procedures followed the various steps suggested by Creswell (2009) and McMillan & Schumacher (2010). First, the audio was transcribed and notes taken during the interviews were incorporated into a Word document. The Arboretum Education Coordinator and I again listened to the interview in its entirety while following along with the transcription. We independently identified and coded themes with descriptive words for brevity upon comparison. Emergent themes were then examined and ordered in a logical manner. I then checked for inter-coder agreement, or crosscheck to determine if the analysts coded similarly. We achieved 92% consistency in coding, which indicated good reliability. Employment of these procedures served to check the accuracy of findings for qualitative validity. Themes were examined for overlap and examined holistically to determine what, if anything, the data revealed about the study as a whole. This method also reflects the use of systematic grounded method of analysis. Grounded theory “…involves the building up inductively a systematic theory that is grounded in observations” (Schutt, 2018, p. 341). This type of analysis includes observation, interviewing, and reflection in order to refine indicators that can then be checked for frequencies.

Data from the child interviews were viewed in relation to their posttests, as children were asked to discuss their answers and/or drawings to three of the assessment
tasks. As with the teacher interview data, emergent themes were coded and ordered according to corresponding assessment tasks, if possible. The child interview data were used to expand upon knowledge acquired from the paper assessment, and were not analyzed for scoring purposes.

Several assessment open response tasks or those asking children to draw specific things were also analyzed qualitatively. Frequencies of specific responses were calculated and then examined for commonalities. For example, on task three, multiple children listed specific shelters and/or foods required by some animals. Common answers were organized and the results were listed in tables. This step was important to describe the variance in child responses and how those responses were scored using the rubric. Examining this data qualitatively also more closely examines children’s answers than simple score assignment.
CHAPTER 3: RESULTS

The purpose of this study was to examine the effects of a packaged intervention on kindergarten children’s science knowledge related to NGSS Kindergarten Life Science Standard 1-1 and Earth Science Standard 3-1. The intervention package consisted of activities using an environmental education curriculum and books in three kindergarten classrooms, a field trip, plus business as usual activities in a fourth control classroom. The environmental education instruction was the independent variable. The secondary purpose of the study was to explore teachers’ perceptions of using the Growing Up WILD curriculum as a way to make a field trip to the Kentucky Children’s Garden more meaningful. Results include quantitative and qualitative examination of child data, and qualitative examination of teachers’ perceptions of using the Growing Up WILD curriculum in conjunction with a nature-based field trip.

Child Assessments

Study children enrolled in each of the four classrooms completed a seven-task assessment of science knowledge at the beginning and end of the study period. Each task aligned with the NGSS K-LS1-1 and K-ESS3-1. These standards focus on using observations to describe what living things needs to survive and understanding relationships between the needs of plants and animals and the places they live. Analysis of child outcome data addressed the first research question:

1. How does science knowledge compare between kindergarten children in four instructional conditions: 1) nature-based field trip plus Growing Up WILD extension activities and book reading; 2) nature-based field trips plus Growing Up WILD extension activities; 3) nature-based field trips plus corresponding book
reading and book-related activities, and 4) nature-based field trip with business as usual instruction?

**Quantitative analysis.** The assessment data were regarded as ordinal data since they were scored on a Likert-type scale. Even though the aggregate total scores might possess increased variability as the summed value of the seven task scores, severe deviations from normal distribution were detected for both the pretest and posttest total scores. Due to the normality concerns of the total scores, the regular statistical methods to compare group means measured on continuous variables, such as ANOVA and ANCOVA for repeated measures became irrelevant.

**Wilcoxon Test.** A non-parametric alternative to paired sample *t* test, Wilcoxon single-rank test, was utilized to examine the pretest to posttest changes in children’s item level and total scores. Unlike a paired-sample *t* test, Wilcoxon test does not assume any distribution of the data to be analyzed, and the non-normality in the data distribution was no longer a concern. However, to perform Wilcoxon test, three assumptions had to be met: 1) data are paired and come from the same population; 2) each pair is chosen randomly and independently; and 3) within-pair comparisons of the data measured are on an interval or ordinal scale (Wilcoxon, 1945). Data in this study met all three assumptions.

Comparing the overall pretest-posttest total score changes across the four treatment conditions revealed Group 4 as the only group that experienced a notable drop in the mean total scores (*M* _diff_ = -.68), while Group 1 achieved a growth of .75 in the mean total scores, approaching the statistical significant threshold with _p_ = .05 (see Table 3.1). Compared to Groups 1 and 2, Group 3 showed less growth and a larger decrease in
mean item scores over time, but none of the changes reached a statistically significant level. Group 4, the control, however, experienced a statistically significant drop of .74 in the item mean score on Task 3: What things must wild animals have to survive?, $z = -2.56$, $p = .01$.

At the item level, Group 1 saw various degrees of growth on a seven tasks except for a slight drop on Task 2: Circle all of the animals that are not real ($M_{diff} = -.05$), and an increase of .30 in the mean scores on Task 1: Circle all of the things that are living or were alive at one time was deemed statistically significant at the $p < .05$ level, $z = 2.45$, $p = .01$. Group 2 displayed a pattern similar to that of Group 1: a statistically significant increase of .70 was found on Task 3: What things must wild animals have to survive?, $z = 2.33$, $p = .02$, though the sole decrease on one item, Task 4: Can a fish live on land?, was comparatively more prominent than that of Group 1 ($M_{diff} = -.30$).
Table 3.1

Non-Parametric Paired t-Test Statistics (Wilcoxon Test) or Pretest and Posttest Comparisons Across Four Study Groups

<table>
<thead>
<tr>
<th>Item Scores</th>
<th>Pretest vs. Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group 1 (N = 21)</td>
</tr>
<tr>
<td></td>
<td>M Diff</td>
</tr>
<tr>
<td>Total AQ</td>
<td>.75</td>
</tr>
<tr>
<td>AQ1 alive</td>
<td>.30</td>
</tr>
<tr>
<td>AQ2 real</td>
<td>-.05</td>
</tr>
<tr>
<td>AQ3 survive</td>
<td>.15</td>
</tr>
<tr>
<td>AQ4 fish</td>
<td>.20</td>
</tr>
<tr>
<td>AQ5 food</td>
<td>.05</td>
</tr>
<tr>
<td>AQ6 draw</td>
<td>.05</td>
</tr>
<tr>
<td>AQ7 habitat</td>
<td>.05</td>
</tr>
</tbody>
</table>

Note. Two children in Group 3 were not present for the posttest. One child’s data in Group 4 was discarded to prevent skewed results. *p < .05.
Hierarchical multiple regression. The use of ANCOVA was replaced by hierarchical multiple regression because of the normality concerns of pretest and posttest data. Hierarchical multiple regression is an alternative way to determine the unique contributions of treatment conditions to the variances in the posttest scores after controlling for a series of confounding variables. However, regression analysis also assumes normal distribution of the data, apart from linearity, homoscedasticity, and absence of multi-collinearity.

It is important to partial out the possible confounding effects in experimental and quasi-experimental research. In this analysis, the normality assumption against the unstandardized residuals after regressing the children’s posttest scores on the four treatment conditions was tested, a method commonly recommended in inferential statistics (Jarque & Bera, 1987). The unstandardized residuals of the posttest scores against the treatment conditions were approximately normally distributed with only one outlier, as shown in Figure 3.1. A closer look at this child’s scores indicates that he/she has unusually high item scores across all seven assessment tasks. This single outlier was dropped from analysis to avoid unstable regression results.
Homoscedasticity refers to whether the regression residuals are equally distributed, or if they tend to bunch together at some values and at other values spread far apart (Jarque & Bera, 1987). To test the homoscedasticity assumption, a scatterplot was created with the predicted values on the X axis and residuals on the Y axis. The data can be assumed homoscedastic if it looks like a shotgun blast of randomly distributed data. The opposite of homoscedasticity is heteroscedasticity, wherein a cone or fan shaped distribution might be found for the data. As displayed in Figure 3.2, data for this study can be regarded as homoscedastic since it does not have an obvious pattern, there are points approximately equally distributed above and below zero on the X axis, and to the left and right of zero on the Y axis.
Figure 3.2. Scatterplot of dependent variable (posttest total score) showing assumption of homoscedasticity. PostAQ_total refers to total posttest scores.

The multi-collinearity assumption refers to when predictor variables are highly correlated with each other (Cohen, 2003). This presents an issue, as the regression model then cannot accurately associate variance in the outcome variable with the correct predictor variable, leading to unclear results and incorrect inferences. To test against this assumption, the correlation matrixes of all the predictors in the model were examined and none of the pair-wise correlation coefficients was greater than .80; the largest correlation coefficient was $r = .36$ between Child Gender and Group 1. In addition, all the Variance Inflation Factor (VIF) values were less than 5, with the largest VIF = 1.57. Higher variation indicates an unreliable model, with high multi-collinearity assumed if VIF > 10. It was concluded that the study data met the assumption of absence of multi-collinearity among the multiple predictors.

The regression results reveal that at Step 1, children’ pretest total scores
contributed significantly to the regression model, and accounted for 34% of the variation in their posttest total scores \[ F(1, 71) = 36.37, p < .001 \]. Adding the demographic variables to the regression model explained an additional 4.5% of variation in children’s posttest total scores. The change in \( R^2 \) was not significant \[ F(2, 70) = 2.51, p = .089 \]. After the treatment conditions were added to the regression model, an additional 8.4% of variation in children’s posttest total scores was accounted for above and beyond both the pretest scores and children’s demographic variables. The change in \( R^2 \) was significant \[ F(3, 69) = 3.44, p = .022 \] this time.

When all four independent variables were included in stage three of the regression model (pretest total scores, child age, child gender, and treatment group), pretest total scores, which explained 34% of the variation, became the most significant predictor of children’s posttest scores. Treatment Group 1 and child gender followed, accounting for 13% and 7% of the variation, respectively. Specifically, higher pretest scores predicted higher posttest scores by an increase of .49 in the posttest mean total scores. Thus, compared to other groups, being in Group 1 predicted an increase of 1.57 in the posttest mean total scores. Lastly, girls tended to have lower posttest mean total scores compared to boys by .89. Combined, the four independent variables accounted for 47% of the variance in children’s posttest scores. In sum, their pretest scores largely influenced children’s posttest scores. Additionally, being in Group 1 positively influenced posttest scores, as did being of male gender. See Table 3.2 for a summary of the hierarchical regression analysis.
Table 3.2.

Summary of Hierarchical Regression Analysis for Variables Predicting Children’s Science Assessment Total Scores (N=72).

<table>
<thead>
<tr>
<th>Predictors</th>
<th>β</th>
<th>t</th>
<th>sr²</th>
<th>F</th>
<th>R²</th>
<th>∆R²</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PreAQ_total(centered)</td>
<td>.59</td>
<td></td>
<td>.34</td>
<td>36.37***</td>
<td>.34</td>
<td>.34</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PreAQ_total (centered)</td>
<td>.63</td>
<td>6.36***</td>
<td>.36</td>
<td>14.32***</td>
<td>.39</td>
<td>.05</td>
</tr>
<tr>
<td>Child Age in Months (centered)</td>
<td>-.02</td>
<td>-.17</td>
<td>&lt;.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>-.22</td>
<td>-2.21*</td>
<td>.07</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>Reference</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PreAQ_total (centered)</td>
<td>.60</td>
<td>5.96***</td>
<td>.35</td>
<td>9.65***</td>
<td>.47</td>
<td>.08*</td>
</tr>
<tr>
<td>Child Age in Months (centered)</td>
<td>-.01</td>
<td>-.06</td>
<td>&lt;.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>-.21</td>
<td>-2.23*</td>
<td>.07</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>Reference</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treatment Conditions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 1</td>
<td>.34</td>
<td>3.06**</td>
<td>.13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 2</td>
<td>.19</td>
<td>1.67</td>
<td>.04</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 3</td>
<td>.08</td>
<td>.68</td>
<td>.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 4</td>
<td>Reference</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* *p < 0.05; **p < .01; ***p < 0.001

**Qualitative analysis.** Child data were examined qualitatively to explore patterns in child responses. The nature of the assessment lends to this type of analysis due to the open-ended format of several tasks. The results add insight into children’s thinking and common misconceptions they may have regarding the science concepts focused on in this study. Qualitative data for each assessment task are presented in the order they appear on the assessment.

**Task 1: Circle all of the things that are living or were alive at one time (NGSS K-LS1-1).** Answer choices included simple pictures of a dog, pig, rocks, and dinosaur.
Circling the dog, pig, and dinosaur and not circling the rock was required to receive the maximum point value (3). A score of 2 was given if at least one of the correct answers was circled. Table 3.3 shows the distribution of children’s correct answers. Across all groups, nine children on the pretest did not circle the dinosaur, and eight children did not circle the dinosaur on the posttest. In the current study, the first task used the wording ‘were alive at one time’ in an attempt to further simplify the concept. In contrast, nine children on the pretest and two children on the posttest circled only the dinosaur. This task was not debriefed with children during group interviews so one can only surmise reasons for this error.

Table 3.3.

Task 1 Correct Child Response Percentages

Task 1: Circle all of the things that are living or were alive at one time:

<table>
<thead>
<tr>
<th>Answer choice</th>
<th>Group 1 Pre</th>
<th>Post</th>
<th>Group 2 Pre</th>
<th>Post</th>
<th>Group 3 Pre</th>
<th>Post</th>
<th>Group 4 Pre</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dog</td>
<td>81 N=21</td>
<td>100 N=20</td>
<td>85 N=21</td>
<td>89 N=20</td>
<td>85 N=19</td>
<td>100 N=18</td>
<td>100 N=19</td>
<td>100 N=20</td>
</tr>
<tr>
<td>Pig</td>
<td>86 N=21</td>
<td>100 N=20</td>
<td>75 N=21</td>
<td>84 N=20</td>
<td>85 N=19</td>
<td>100 N=18</td>
<td>95 N=19</td>
<td>95 N=20</td>
</tr>
<tr>
<td>Rocks</td>
<td>100 N=21</td>
<td>100 N=20</td>
<td>100 N=21</td>
<td>95 N=20</td>
<td>90 N=19</td>
<td>95 N=18</td>
<td>79 N=19</td>
<td>100 N=20</td>
</tr>
<tr>
<td>Dinosaur</td>
<td>95 N=21</td>
<td>100 N=20</td>
<td>90 N=21</td>
<td>95 N=20</td>
<td>85 N=19</td>
<td>84 N=18</td>
<td>74 N=19</td>
<td>80 N=20</td>
</tr>
</tbody>
</table>

*Note.* Correct answer includes circling dog, pig, and dinosaur. Percentages were based on number of children who completed this task.

**Task 2: Circle all of the animals that are not real (NGSS K-LS1-1).** Answer choices included a unicorn, raccoon, dragon, and cow again in simple pictures. Circling the unicorn and dragon yielded the maximum points (3), and 2 points were scored if children circled at least one correct animal. Table 3.4 shows the distribution of correct children’s scores across groups for Task 2. On the pretest, two children did not circle the unicorn and on the posttest, 2 children did not circle the dragon. One child circled the unicorn on
the posttest. Two children on the pretest and three children on the posttest indicated the cow was not a real animal. Table 3.4.

**Task 2 Correct Child Response Percentages**

Task 2: Circle all of the animals that are not real:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Unicorn</td>
<td>95</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>95</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Raccoon</td>
<td>100</td>
<td>95</td>
<td>100</td>
<td>95</td>
<td>95</td>
<td>95</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Dragon</td>
<td>100</td>
<td>90</td>
<td>100</td>
<td>95</td>
<td>95</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Cow</td>
<td>100</td>
<td>90</td>
<td>95</td>
<td>95</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

**Note.** Correct answer includes circling unicorn and dragon. Percentages were based on number of children who completed this task.

**Task 3: What things must animals have to survive? List or draw as many as you can**

(NGSS K-LS1-1). Children were given a large, blank space on the assessment to write or draw responses for Task 3. This task was scored on the 0- (no understanding) to 5- (scientific with justification) point rubric to reflect the variation in responses and children’s level of understanding about what living things need to survive. The most common child responses and where they fit on the scoring rubric are in Table 3.5.

Teachers in each class clarified indecipherable written and drawn responses for children requiring modifications with whom they regularly worked. As teachers would not divulge disability status of children, there are no details regarding modifications other than what was observed, which included the teacher assisting one child with staying on task. One of the scorers and I together examined additional written answers that were unclear, and conclusions were made. Similarly, both individuals simultaneously examined children’s drawings to
make common conclusions. These conclusions were typed on an electronic version of the assessment for reference when scoring. For example, children commonly drew two cups, bowls, or plates, one with small circles or other shapes drawn inside; the other with wavy lines drawn inside. These were interpreted as food and water, respectively. Several children drew fish and vegetables within a circle; this also represented food. Consistency in scorers interpreting children’s responses was achieved in this way.
Table 3.5

Task 3 Scoring Rubric and Child Response Examples in Percentages

Task 3: What things must animals have to survive? List or draw as many as you can.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Level of Understanding</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 1 – No Understanding</td>
<td>1 – Incorrect/ Scientific Misconceptions/ Incorrect, but understandable</td>
</tr>
<tr>
<td></td>
<td>2 – Partially Scientific with Misconceptions/ Non-scientific Fragment</td>
</tr>
<tr>
<td></td>
<td>3 – Partially Scientific Notion</td>
</tr>
<tr>
<td></td>
<td>4 – Scientific Minor Justification</td>
</tr>
<tr>
<td></td>
<td>5 – Scientific with Justification</td>
</tr>
<tr>
<td></td>
<td>Food or water or other need; includes incorrect information</td>
</tr>
<tr>
<td></td>
<td>Food or water or other need; may include specific shelter; no incorrect information</td>
</tr>
<tr>
<td></td>
<td>Must include 3 of 4 needs: water, food, shelter, air; must include some justification (i.e. from the environment)</td>
</tr>
<tr>
<td></td>
<td>Food from other animals/plants; water from environment; shelter for protection; air/space to breathe</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Child Responses</th>
<th>No response</th>
<th>Indistinct drawing or writing</th>
<th>Animals/horse/ cat</th>
<th>Exercise</th>
<th>Bone</th>
<th>Shade</th>
<th>Fish</th>
<th>Flowers</th>
<th>Owners</th>
<th>House</th>
<th>Water (only)</th>
<th>Food (only)</th>
<th>Grass</th>
<th>Reproduce</th>
<th>Food</th>
<th>Water</th>
<th>Air/oxygen</th>
<th>Shelter/barn/cave</th>
<th>Sunlight</th>
<th>Habitat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>4.8</td>
<td>9.5</td>
<td>9.5</td>
<td>76.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre: N=21</td>
<td>0</td>
<td>5.0</td>
<td>10.0</td>
<td>85.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post: N=21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 2</td>
<td>23.8</td>
<td>0</td>
<td>23.8</td>
<td>52.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre: N=21</td>
<td>0</td>
<td>10.0</td>
<td>25.0</td>
<td>65.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post: N=20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 3</td>
<td>15.8</td>
<td>31.6</td>
<td>5.3</td>
<td>47.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre: N=19</td>
<td>22.2</td>
<td>22.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post: N=18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 4</td>
<td>5.3</td>
<td>5.3</td>
<td>21.1</td>
<td>68.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre: N=19</td>
<td>20.0</td>
<td>15.0</td>
<td>20.0</td>
<td>45.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post: N=20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. Percentages were based on number of children who completed this task.
**Task 4: Can a fish live on land? Write yes or no, then give some reasons (NGSS K-ESS3-1).** Children were given four blank lines upon which to write their responses to Task 4. Like Task 3, Task 4 was scored with the 0- (no understanding) to 5- (scientific with justification) point rubric to reflect the variation in responses and children’s level of understanding about what a specific animal, in this case fish, need to survive. Common child responses and their percentages, and where those responses fit on the scoring rubric are in Table 3.6.
Table 3.6
Task 4 Scoring Rubric and Child Response Examples in Percentages.
Task 4: Can a fish live on land? Write yes or no, then give some reasons.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Level of Understanding</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – No Understanding</td>
<td>1 – Incorrect/ Scientific Misconceptions</td>
</tr>
<tr>
<td>No</td>
<td>Does not include water or no appendages; only ‘no’; incorrect information</td>
</tr>
<tr>
<td>Indistinct writing</td>
<td>Can survive</td>
</tr>
<tr>
<td>Yes</td>
<td>Can’t</td>
</tr>
<tr>
<td>Humans eat fish</td>
<td>Won’t survive</td>
</tr>
<tr>
<td></td>
<td>Need oxygen</td>
</tr>
<tr>
<td>2 – Partially Scientific with Misconceptions/ Non-scientific Fragment</td>
<td></td>
</tr>
<tr>
<td>Water or no appendages; some portion correct; incorrect information; vague, basic</td>
<td></td>
</tr>
<tr>
<td>Can’t live on land</td>
<td></td>
</tr>
<tr>
<td>It will die</td>
<td></td>
</tr>
<tr>
<td>3 – Partially Scientific Notion</td>
<td></td>
</tr>
<tr>
<td>Water or no appendages; no incorrect information; may list characteristic that make fish appropriate for water</td>
<td></td>
</tr>
<tr>
<td>Can’t breathe on land</td>
<td></td>
</tr>
<tr>
<td>Can’t move/swim on land</td>
<td></td>
</tr>
<tr>
<td>No legs</td>
<td></td>
</tr>
<tr>
<td>Need water</td>
<td></td>
</tr>
<tr>
<td>Will get dehydrated/dry up</td>
<td></td>
</tr>
<tr>
<td>Has gills or fins only</td>
<td></td>
</tr>
<tr>
<td>4 – Scientific Minor Justification</td>
<td></td>
</tr>
<tr>
<td>Both water and no appendages; 1+ characteristics that make fish appropriate for water</td>
<td></td>
</tr>
<tr>
<td>5 – Scientific with Justification</td>
<td></td>
</tr>
<tr>
<td>Both water and no appendages; 2+ characteristics that make fish appropriate for water</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Group 1</th>
<th>Pre: N=21</th>
<th>Post: N=20</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4.8</td>
<td>19.0</td>
</tr>
<tr>
<td></td>
<td>9.5</td>
<td>66.7</td>
</tr>
<tr>
<td></td>
<td>20.0</td>
<td>75.0</td>
</tr>
<tr>
<td>Group 2</td>
<td>Pre: N=21</td>
<td>Post: N=20</td>
</tr>
<tr>
<td></td>
<td>14.3</td>
<td>19.1</td>
</tr>
<tr>
<td></td>
<td>9.5</td>
<td>57.1</td>
</tr>
<tr>
<td></td>
<td>35.0</td>
<td>40.0</td>
</tr>
<tr>
<td>Group 3</td>
<td>Pre: N=19</td>
<td>Post: N=18</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>21.1</td>
</tr>
<tr>
<td></td>
<td>36.8</td>
<td>42.1</td>
</tr>
<tr>
<td></td>
<td>11.0</td>
<td>61.1</td>
</tr>
<tr>
<td>Group 4</td>
<td>Pre: N=19</td>
<td>Post: N=20</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>15.7</td>
</tr>
<tr>
<td></td>
<td>21.1</td>
<td>63.2</td>
</tr>
<tr>
<td></td>
<td>10.0</td>
<td>60.0</td>
</tr>
</tbody>
</table>

*Note. Percentages were based on number of children who completed this task.*
Teachers again helped children receiving regular modifications with their written answers. In some instances, the teacher wrote down on the assessment what the child said was written. The main scorer and I reviewed all answers together and made common inferences about children’s responses when the writing and/or spelling were difficult to interpret. For example, ‘wodr’ was interpreted as water, and the reversal of letters (e.g., b and d) was accounted for. These conclusions were typed onto the electronic copy of the assessment for reference when scoring. The context of the question was helpful in deciphering children’s writing. For example, the response, “No bekus it dusit hav lagse” was interpreted as “No because it doesn’t have legs.” See Figure 3.3 for an example. There were no instances in which the scorers could not interpret children’s writing, though several (n = 5) children did not respond to this task.

Basic answers such as, “it will die”, “can’t live on land”, can’t breathe” that were similar were differentiated with use of the rubric. For instance, the answer “it will die” received a score of 2 because, though this is correct, it is a very basic, vague response. The response “it can’t breathe”, however, received a score of three because it indicates some knowledge of a characteristic (gills) that prohibits fish from surviving on land as other animals. No children in any group scored above a three on this task. A score of four required a response referring to fishes’ need for water, lack of appendages, and inclusion of a characteristic that make fish appropriate for water (e.g., fins, gills).
4. Can a fish live on land? Write yes or no, then give some reasons.

Figure 3.3. Example of child’s written response and typed interpretation.

**Task 5: Draw a line to connect the animal to the food it eats (NGSS K-ESS3-1).**

Animals pictured on this task were a squirrel, fish, frog, and bee. Food choices listed in an adjacent column to the animals included acorns, flower, tiny fish, and fly. Connecting the squirrel to acorns, fish to tiny fish, frog to fly, and bee to flower yielded the maximum points (3), and 2 points were scored if a child made at least one correct connection.

Answers that were possible were also given a score of 2 points, such as the fish connected to the fly. Similarly, the bee connected to the fly received a two point score.

Though not a probable food source for a bee, insects resembling bees such as wasps and cicada killers do feed on other insects, so this was deemed a possible, though not probable, response. A distribution of children’s scores for Task 5 across groups is in Table 3.7.

**Task 5 Correct Child Response Percentages**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Squirrel</td>
<td>Acorns</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>95</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Fish</td>
<td>Flower</td>
<td>95</td>
<td>100</td>
<td>90</td>
<td>100</td>
<td>95</td>
<td>95</td>
<td>95</td>
<td>100</td>
</tr>
<tr>
<td>Frog</td>
<td>Small fish</td>
<td>95</td>
<td>95</td>
<td>90</td>
<td>100</td>
<td>95</td>
<td>95</td>
<td>95</td>
<td>100</td>
</tr>
<tr>
<td>Bumblebee</td>
<td>Fly</td>
<td>95</td>
<td>95</td>
<td>100</td>
<td>100</td>
<td>95</td>
<td>95</td>
<td>95</td>
<td>100</td>
</tr>
</tbody>
</table>

*Note.* Maximum point answers include squirrel to acorns, fish to small fish, frog to fly, and bumblebee to flower. Percentages were based on number of children who completed this task.
**Task 6: Draw an animal in its natural habitat. Draw other animals and plants that live there (NGSS K-ESS3-1).** This stem for Task 6 was at the top of a blank page leaving children plenty of space to draw their responses. The bottom quarter of the page included three additional questions with a blank line below each question: 1) What is the name of this animal?; 2) Where do you think this animal gets its water?; and 3) What do you think this animal eats? Task 6 was scored with the 0- (no understanding) to 5- (scientific with justification) point rubric to reflect the variation in children’s responses and levels of understanding about habitats and needs specific to each animal. Table 3.8 shows a sampling of child responses, and the distribution of scores on the rubric across groups.

As with other tasks, the scorer and I together examined each child’s drawing to ensure that consensus was reached on what was included. Clarifying text was typed onto electronic copies of assessments when necessary. This was done to ensure reliability in scoring. Variation in children’s drawings was great, and scores ranged from 0 to 4 points on the 5-point scale. The majority of children included some aspects of a habitat with their drawings, including caves, grass, lake/ocean or trees. Less frequently included was the source of food for the animals drawn, though foods were indicated in children’s written responses. This is an integral component understanding the concept of a habitat, as NGSS for kindergarten requires children to connect food sources to the specific places that animals inhabit. See Figures 3.4 and 3.5 to view a Task 6 response with a score of one and another response with a score of four.
### Table 3.8.

**Task 6 Scoring Rubric and Child Response Examples in Percentages**

Task 6: Draw an animal in its natural habitat. Draw other plants and animals that live there.

- a) What is the name of this animal?
- b) Where do you think this animal gets its water?
- c) What do you think this animal eats?

<table>
<thead>
<tr>
<th>Criteria</th>
<th>0 – No Understanding</th>
<th>1 – Incorrect/Scientific Misconceptions</th>
<th>2 – Partially Scientific with Misconceptions/Non-scientific Fragment</th>
<th>3 – Partially Scientific Notion Animal must be drawn somewhat accurately (2 legs instead of 4); food source drawn; no inaccurate information</th>
<th>4 – Scientific Minor Justification Animal must be drawn accurately; 1 other plant &amp; 1 other animal that would live in that environment</th>
<th>5 – Scientific with Justification Animal must be in authentic environment where it lives; sun drawn; 2+ other animals &amp; 2+ other plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child Responses</td>
<td>No response</td>
<td>Bear (only)</td>
<td>Camel, habitat, food source &amp; plants &amp; animals in that environment</td>
<td>Dolphin, habitat, food source, plants &amp; animals in that environment</td>
<td>Fish, habitat, food source, plants &amp; animals in that environment</td>
<td>-</td>
</tr>
<tr>
<td>Child Responses</td>
<td>Scribble only</td>
<td>Fish (only)</td>
<td>Giraffe, habitat, food source</td>
<td>Giraffe, habitat, food source</td>
<td>Giraffe, habitat, food source</td>
<td>-</td>
</tr>
<tr>
<td>Child Responses</td>
<td></td>
<td>Unicorn</td>
<td>Jaguar, habitat</td>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>-------</td>
<td>-----------</td>
<td>------------</td>
<td>-----------</td>
<td>------------</td>
<td>-----------</td>
<td>------------</td>
</tr>
<tr>
<td>1</td>
<td>4.8</td>
<td>0</td>
<td>14.3</td>
<td>10.0</td>
<td>36.8</td>
<td>22.2</td>
</tr>
<tr>
<td></td>
<td>57.1</td>
<td>70.0</td>
<td>23.9</td>
<td>10.0</td>
<td>63.2</td>
<td>61.1</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>10.0</td>
<td>0</td>
<td>20.0</td>
<td>0</td>
<td>16.7</td>
</tr>
<tr>
<td>2</td>
<td>4.8</td>
<td>5.0</td>
<td>14.3</td>
<td>5.0</td>
<td>36.8</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>66.7</td>
<td>70.0</td>
<td>19.0</td>
<td>20.0</td>
<td>63.2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>36.8</td>
<td>0</td>
<td>36.8</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>63.2</td>
<td>22.2</td>
<td>0</td>
<td>16.7</td>
<td>63.2</td>
<td>22.2</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>0</td>
<td>15.0</td>
<td>0</td>
<td>42.1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>60.0</td>
<td>15.0</td>
<td>20.0</td>
<td>5.0</td>
<td>60.0</td>
<td>15.0</td>
</tr>
</tbody>
</table>

Table 3.8 (continued)
Figure 3.4. Example of child’s response to Task 6 with a score of 1.

Figure 3.5. Example of child’s response to Task 6 with a score of 4.
**Task 7: Draw a line to connect each animal to its habitat (NGSS K-ESS3-1).** Task 7 was scored with the 3-point rubric similar to those for Tasks 1, 2, and 5. The animals listed in the first column for this task included a frog, a deer, and bee, and a horse. Habitats shown in the opposing column included a flower field, a pond, a fenced pasture, and a wooded area. Connecting the frog to pond, deer to wooded area, bee to flower field, and horse to fenced pasture was required for that maximum of 3 points. At least one correct connection was required to earn two points. Possible, but not probable, answers also received a score of 2 points. For example, frogs may be seen in the forest and a deer may be seen in a flower field, yet those spaces do not reflect each animal’s natural habitat. Habitat was a concept included throughout study activities, as was indicated by the high percentage of correct scores shown in Table 3.9.

Table 3.9.

**Task 7 Correct Child Response Percentages**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Frog</td>
<td>Flowers</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>95</td>
<td>95</td>
<td>95</td>
<td>95</td>
</tr>
<tr>
<td>Deer</td>
<td>Pond</td>
<td>95</td>
<td>100</td>
<td>95</td>
<td>100</td>
<td>90</td>
<td>89</td>
<td>90</td>
<td>95</td>
</tr>
<tr>
<td>Bee</td>
<td>Fenced pasture</td>
<td>95</td>
<td>100</td>
<td>95</td>
<td>100</td>
<td>85</td>
<td>83</td>
<td>95</td>
<td>100</td>
</tr>
<tr>
<td>Horse</td>
<td>Wooded area</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>95</td>
<td>89</td>
<td>95</td>
<td>95</td>
</tr>
</tbody>
</table>

*Note.* Maximum point answers include frog to pond, deer to wooded area, bee to flowers, and horse to fenced pasture. Percentages were based on number of children who completed this task.

**Child Interviews**

Four children from each of the four study classrooms were selected by teachers to participate in the group interview. This was not considered random selection, as the
teachers were not given parameters regarding the selection process. Group interviews occurred upon completion of the posttest and took place in study classrooms. The purpose of the group interviews was to gain additional insights into children’s knowledge of the themes under study: living, non-living, and once living; what animals need to survive; and habitats. Children also were given the opportunity to elaborate on their responses to three tasks on the assessment, including what animals need to survive (Task 3), why a fish can or cannot live on land (Task 4), and the animal and habitat they drew on Task 6. Each child chose a pseudo name, most of which were animals, to be used during the interview. The interviews were recorded and transcribed. The transcriptions were analyzed according to each question across groups, and grouped according to themes. Themes included living, non-living, and fantasy, animal needs for survival, and habitats. Excerpts of child answers were incorporated to the thematic groupings and reported in aggregate. Results are presented in order questions were asked.

**Question 1: What do you think of when I say ‘wild animals’?** Children were eager to share the names of wild animals they knew, including bears, alligators, tigers, lions, foxes, cheetahs, sharks, and squirrels. One child stated that a Tyrannosaurus Rex was a wild animal, which prompted another child to respond that a Tyrannosaurus Rex was not an animal, but a dinosaur. One child stated, “I think of animals that are in the wild, like outside.” An additional prompt by the researcher, “What does it mean to be wild?” led children to share what characteristics wild animals shared. Children responded with, “it would be wild,” “crazy and dangerous,” “lives alone in the wild,” and “umm….it when, umm, animals try to find their own food and own drink.” The following interaction in one group led to deeper insights on the topic:
Gravil: What does it mean to be ‘in the wild’?
Spikey: That means they’re not a house owner pet.
Green: Because they live in the wild.
Gravil: They don’t live with people?
Green: They don’t live with people and they might get hurt…they might hurt people.
Spikey: Yeah, ‘cause that’s why they don’t live with people.
Green: And they’re really dangerous.
Sam: And they blend in sometimes.
Green: A cheetah!
Gravil: What makes a cheetah wild?
Green: Because it runs super fast.
Sam: No, because it…
Green: It does run super fast, but it also blends in with trees and stuff and when it sneaks up on its predator it can blend in so the predator doesn't see.

This is an example of verbal exchanges with minimum adult prompts can facilitate child discourse with the purpose of reaching a conclusion. Also interesting is that the final statement by Green broaches topics of predation and camouflage. NGSS does not address camouflage as a part of cause and effect relationships. While the terms ‘predator’ and ‘prey’ are used in standards for younger children, predatory interactions are not discussed as part of an interdependent relationship in ecosystems until middle school (MS-LS 2). This is evidenced by Green’s lack of reference to ‘prey’ in his last statement. Predation was also brought up in a second group:
Gravil: Tiger, what do you think of when you hear ‘wild animal’?

Tiger: I think when a wild animal, I think when a wild animal is like, hunting for food and finds a buffalo and then it tries to eat it and then a cheetah comes in and picks his food from it.

**Question 2 (Task 3): What do wild animals need to survive?** Children were referred to their drawn and/or written responses to Task 3 of the assessment when addressing about this question. Child responses on the pencil/paper assessment included specific shelters, such as caves and barns, to non-necessities like bone and cats. A minimum of ‘food’ and ‘water’ are required to meet NGSS K-LS1-1, yet across all groups only two children in interviews mentioned water and three children mentioned food. Shelter was discussed across groups as a necessity for animal survival. Children stated that animals needed shelter for protection from storms, floods, predators, and to serve as a home. Oxygen or air was another need chatted about in one group, as was sunlight: “They need oxygen and they need sometimes they need lots of water and sometimes they need a little bit of sunlight so they can be a little hot.” One child said animals need to reproduce, which he also wrote on his assessment for this question.

**Question 3 (Task 4): Can a fish live on land? Write yes or no, then give some reasons.** For this question, children were again referred to their written responses on the assessment. While very few children on the assessment indicating that a fish could survive on land, the logic behind this assumption varied greatly, with answers ranging from simply, “it will die,” to mention of physical characteristics of fish that make them inappropriate for land life, including fins and gills. Common responses across groups to this interview question were “because it will die,” “it won’t breathe on land,” “it won’t
89

survive,” and “fish breathe water.” More information was sought with the following prompt:

Gravil: Is there anything else that makes fish different from other animals?

Unicorn: So, fishes cannot breathe they can only breathe under water and wild animals don’t live in water. They can survive on land. Like bears.

Sammy: Because a fish doesn’t have to hold its air, it doesn’t have to hold its air in the water but we do because then we’ll get water in our mouth…

The mention of fins was brought up in three groups. This correlates with assessment responses stating that fish couldn’t move on land and that they do not have legs. Statements from the interview include, “They only have fins and they can’t move around,” “Because they have like fins and they’re slippery and they can’t move on land,” and “…fishes need water to survive so because they need to swim in water.” While no children said the term ‘gills’ during the interview, they were alluded to in multiple groups. For example, “because they have things that need to live in the water,” “…they need water because, because for that little air thing,” and “…they die because, like, um, the stuff inside them like to stay under water.” This is consistent with the many assessment responses indicating that a fish needs water survive.

This discussion elicited higher order responses for several children than they wrote on the assessment. One child, for instance, wrote, “No it cannot live on land because it will die!” for Task 4 yet during the interview she indicated that a fish couldn’t live on land because it did not have legs. Similarly, another child indicated on the written task that a fish could not live on land “Bykus it wod not srvive.” During the discussion, however, she said that a fish could only survive in water “because that's how they
breathe.”

**Question 4 (in reference to Task 6): Can you tell me what your animal is and talk about its habitat?** This task received the most variation in child responses as it enabled children to draw their answers. Children were asked to draw an animal in its natural habitat and draw other plants and animals that would live there. The pictorial responses lent to possible subjectivity on behalf of the scorers, though a well-designed rubric, calibration between scorers, and discussion about drawings prior to scoring were steps enacted to combat that possibility. Discussion with individual children about their drawings, however, provided information that was not ascertained by concerted visual examination alone. As with interview Question 3, children provided information beyond that provided in their actual assessment.

One child’s drawing was comprised of an animal sketched in pencil with nothing else around it. Upon discussing his picture, however, he stated that it was a zebra, and that zebras must live where grass is because they eat grass. No information on the written assessment indicated where the zebra obtained food or water, but in conversation the child explained both. He informed the group that the zebra got its water from a watering hole. Similarly, another child’s drawing included a bee and a flower. His written responses indicated that the bee got water from a flower and ate honey. During the interview the child stated that the bee ate honey, to which another child exclaimed that bees made honey from nectar rather than ate it. The child elaborated about his drawing: “…bees get water from the flowers because the flowers got rained on. They get wetness on the flower and drink it.” Hearing this in the child’s own words provided insightful pieces of information regarding his understanding of a bee’s habitat and source of water.
Another example of this extra information gathered from child interviews came from a girl whose picture included a cheetah drawn between two trees. Through discussion, the group learned how cheetahs obtained food in their habitat. The concept of camouflage was again brought up, as was the predator and prey relationship. Her drawing did not portray this information.

Gravil: Unicorn, tell me about your animal and its habitat.

Unicorn: So, this is a cheetah, and they live in Africa. And also they can blend in with grass ‘cause they have little spots. So they can hide from their prey.

Gravil: Oh, remember that big word that describes how an animal can blend in…

Unicorn: Camouflage!

Gravil: And what do cheetahs eat?

Unicorn: They eat meat.

Gravil: And where do they get meat?

Unicorn: From animals. They kill their food.

Gravil: What else would you like to tell us about your wild animal?

Unicorn: So, they get their meat from other animals and they kill their prey.

Gravil: And eat it?

Unicorn: Yeah.

In addition to collecting information that expanded upon children’s drawings, the interview clarified objects within drawings that the scorers misinterpreted. The best example of this is Figure 3.6, which depicts what appears to be a water-based habitat. What scorers interpreted as an illustration of the sun turned out to be a blowfish. A purple blob in the sky was indecipherable, and a blue object hovering over purple/blue water
was correctly assumed to be a fish. During the interview, the child who drew this picture explained that she drew a fish, a blowfish, and an octopus. She referred to the purple blob above the water as the octopus. What scorers assumed was a sun in the sky was actually the child’s rendition of a blowfish. While this would not have impacted her score on this question, it demonstrates the quality of information collected through different modalities.

A different example is shown in Figure 3.7. This drawing includes a bird, baby birds in a nest, and two trees. A blue object is drawn attached to the adult bird’s beak. The writing below the picture denotes that the bird’s water source is puddles. The interpretation of the blue object was at question when examined by scorers. The object looked like water
dripping from the beak. When examined in context, however, it was determined that the bird held a fish in its beak. There are clearly drawn baby birds in a nest, and the adult bird is perched just above them. It was construed that the adult bird was feeding the baby birds. The child who drew this picture confirmed this during the small group interview.

Figure 3.7. Child’s drawing of bird with fish in beak and habitat.

**Question 5. What is camouflage? Tell me about an animal that is well camouflaged.**

Camouflage, as part of a cause and effect relationship, is not directly included in NGSS until 3-LS4 Biological Evolution: Unity and Diversity. However, studies have shown that children as young as four years of age have some grasp of camouflage as a means of protection for animals (Emmons, Lees, & Kelemen, 2018; Ganea, DeLoache, & Ma, 2011). Camouflage was included in the child interviews because it was a theme included
in Growing Up WILD activities, book, and field trip stations in this study.

Children in each group identified animals that are well camouflaged. These included, cheetahs, moths, snakes, baby deer, butterflies, beavers, tigers, and Stegosaurus. Children stated that camouflage meant blending in with the surroundings. For example, one child said that, “Cheetahs can camouflage with grass and their prey can’t see them and also it looks just like grass and then, um, it pounces.” Another child shared that a beaver sitting on a log blends in because both are brown. One child explained his example of a baby deer:

Gravil: OK, Sam, tell me about an animal that you think is really well camouflaged.

Sam: So, a baby deer can, it there’s a dog that’s trying to chase it it can camouflage in the leaves because it has spots on it and cover and and it will think it’s just a log…that has like white petals on it or something.

Gravil: or maybe like, you know how the sun comes trough the leaves and makes spots…

Sam: Yeah, makes spots on something, that’s why a baby deer can camouflage.

When asked why animals might need to blend in with their surroundings, children alluded to the need for protection from predators. Children responded, “Because if somebody was trying to catch them, it would help them to not catch them.”

Another example:

Dog: Because, like, maybe because like if the animals are big and they came at little other animals then they can be scared and the animals can blend in and that’s how they can be sure the other animals can’t eat them, because
they’ll never survive.

There were misconceptions about camouflage, however. One child insisted that a snake could shed its skin to turn different colors, and another child stated that a Stegosaurus could change the color of its scales depending on how mad it was. This same child stated, “Where it goes, you can’t see it because it’s connected with the color that it’s standing on.”

**Teacher Interview**

The group teacher interview did not yield as much information as anticipated, so individual teacher responses were not analyzed. Interview data was group in to six categories: 1) perceptions of environmental education curriculum and books used in study; 2) bridging learning standards with study materials; 3) field trip; 4) bridging learning standards prior to this study; 5) child assessment; and 6) perceptions of using environmental education outside of this study. Teachers’ statements were organized into respective categories and shortened for clarity in reporting. This is consistent when using grounded theory analysis as described by Schutt (2018). Table 3.10 displays teacher interview data organized into categories and supporting teacher statements. Overall, teachers reported both they and their children enjoyed the activities provided by the Growing Up WILD curriculum and NSTA books. Teacher responses were in agreement across all domains, and were thus reported in aggregate.
Table 3.10

**Teacher Interview Themes and Supporting Statements**

<table>
<thead>
<tr>
<th>Categories (conceptualized)</th>
<th>Supporting Statements</th>
</tr>
</thead>
</table>
| Teachers and children enjoyed the Growing Up WILD curriculum and NSTA book activities      | • It was so fun and engaging  
• It was very hands on  
• We were never doing worksheets or anything  
• It was so age appropriate  
• I really enjoyed the book about camouflage  
• They were able to connect the book with the activity they did  
• They were outside looking for things; they loved it  
• There was singing, dancing                                                                 |
| Study activities bridged learning standards and field trip learning objectives              | • Sometimes with science standards its so hard to water it down for them; this was perfect  
• A lot of kids used the animals we talked about on the field trip or in books (on assessment Task 6)  
• I feel like it really helped them on the field trip  
• It helped them have a little bit of background knowledge  
• It absolutely incorporated science standards                                                                 |
| Teachers and children enjoyed the field trip to the Kentucky Children’s Garden             | • It was so much fun  
• They loved it  
• It was the perfect amount of time  
• I don’t think we were at the stations too long or too little  
• I liked the hand-on stations  
• The ones without plans were a little rough because the kids were playing outside  
• The planting, fishing, worms, and the noodles went much smoother  
• They were moving and sort of playing; they didn’t know they were learning  
• Playing on the logs was their favorite  
• They talked about it afterwards |
### Table 3.10 (continued)

| Teachers had their own methods of incorporating field trip learning in the classroom | • After the pumpkin patch, we planted pumpkins  
| • We read aloud books  
| • We do writing about our field trip  
| • We did ‘show what you know’  
| | Teachers thought the assessment was appropriate | • I liked it  
| • I liked how you have some writing, some matching, just different types of assessment  
| • It’s age appropriate  
| • I think for this time of the year with writing it’s age appropriate  
| • I like it better than other types of assessment  
| • It’s spot on  
| Teachers: | b) supported its use after the study | • I think it would be great to implement into the curriculum  
| • It has really come in handy for our animal unit  
| • I am not doing specific lessons, but am supplementing different pieces and parts  
| • We have used bits and pieces of it  
| • We have tied in a few of the lessons that correlate with our reading themes  
| • I think it is very kid friendly and engaging  
| • The lessons and activities are so fun and they love them  
| • It was very child friendly and fun for them  
| a) were not familiar with Environmental Education |
| c) felt there is little time to use it | • I would love to have more time to do so  
• Unfortunately, since we are on such a strict time schedule, it is hard to fit in extra things  
• If I had more time, I would love to use it regularly  
• I think it would be hard to follow the program religiously  
• Since we are required to use the Wonders curriculum for our ELA/Science and Social Studies lessons, we would have to supplement with the EE activities |
CHAPTER 4: DISCUSSION

The purpose of the Field Trip study was twofold. The first research question explored the effects of an environmental education curriculum in conjunction with a nature-based field trip on children’s science knowledge acquisition. The science content measured was congruent with national, state, and county level science standards for kindergarten children. Specifically, excerpts from the NGSS Kindergarten Life Science Standard 1-1 (From Molecules to Organisms: Structures and Processes) and Kindergarten Earth Science Standard 3-1 (Earth and Human Activity) were included as learning objectives in this study. The second research question involved surveying kindergarten teachers’ perceptions of using environmental education and a nature-based field trip to bridge science learning between informal and formal settings. Four kindergarten classrooms from one public elementary school in Kentucky participated in the study, with a sample of 80 children and four teachers. Classrooms were randomly assigned into one of four groups, wherein each teacher was trained to implement unique study activities: 1) Group 1: Growing Up WILD, NSTA book reading, and field trip; 2) Group 2: Growing Up WILD and field trip; 3) Group 3: NSTA book reading and book activities and field trip; and 4) Group 4: control classroom with business as usual instruction and field trip.

A seven-task assessment was created which teachers administered to measure children’s understanding of themes embedded in the NGSS science standards, including living, non living, and once living, animal needs for survival, and habitats. The assessment was administered at the study’s inception and re-administered at the conclusion of study activities and field trip. One group of four children selected by teachers in each classroom participated in a group interview upon completion of the
posttest. This gave children the opportunity to elaborate on assessment drawings and responses. The four study teachers and pilot study teacher were interviewed in a group format to understand their thoughts about using the Growing Up WILD curriculum in conjunction with a field trip. Additional data collected included limited teacher and child demographics, and fidelity of implementation.

**Summary of Findings**

When comparing child science assessment pretest and posttest scores within and across groups, the findings were mixed. Children in Group 1 had higher overall posttest scores at the threshold of significance ($p = .05$) than other groups’ scores. Overall posttest scores for children in Groups 2 and 3 showed insignificant growth, and posttest scores were lower than pretest scores for children in Group 4, the control classroom, though not significantly. At the task level, scores for children in Groups 1 and 2 were significantly higher on Task 1: Circle all the things that are living or were alive at one time, and Task 3: What things must animals have to survive?. Conversely, scores on Task 3 for children in Group 4 decreased significantly. Children in Group 3 saw no significant changes from pretesting to posttesting at the item level.

Group child interviews gave children the opportunity to talk about their assessment responses. Generally speaking, children in these groups provided additional details regarding their assessment responses than what was originally learned through their written and drawn responses. Discussions about animals and camouflage revealed children’s preconceptions about the cause and effect relationship associated with camouflage. A group interview with study teachers discerned that teachers enjoyed employing the Growing Up WILD curriculum and NSTA books with kindergarten
children, and believed the use of both helped them incorporate learning specific to science standards. While teachers stated they would like to continue use of the curriculum, they felt hindered by time constraints. Teachers also indicated they knew little about environmental education prior to the study. After implementing it with their children, teachers stated that environmental education was an appropriate way to incorporated standards in a way that both they and the children enjoyed.

**Interpretation of findings.** The findings from this study support the hypothesis that implementation of an early childhood environmental education curriculum bookending a field trip would have a positive impact on kindergarten children’s science outcomes. This is in light of teachers achieving 75% fidelity in implementation of study activities. This is discussed further in the limitations section; however, it is noteworthy that outcome scores increased regardless of mediocre implementation of the Growing Up WILD curriculum and NSTA book activities. Furthermore, teachers in study classrooms spent only 30 minutes on each of 4 days implementing study activities, at different times each day. It was unexpected to find significant outcome differences with the limited, short-term intervention used in this study. These procedural issues thought to encumber the results apparently did not have a negative effect. Because growth was observed in all three intervention classrooms, implementation of the curriculum is the logical explanation. This is supported by the fact that child scores in Group 1 increased significantly compared to all other groups, as the teacher in Group 1 implemented both the curricular and book activities. This is despite higher implementation fidelity by the teacher in Group 3 (87.5%). Additionally, outcome scores for children in Group 4 decreased. This teacher proceeded with business as usual instruction during the study.
The caveat to the interesting outcome findings described above is viewing them in regard to teacher education level and years teaching. The teacher in Group 1 held a Master’s degree in elementary education, while teachers in all other groups held Bachelor’s degrees in elementary education. An analysis of data from two studies, the Early Childhood Longitudinal Study program: the Birth Cohort (ECLS-B) and the Kindergarten Class of 2010-11 (ECLS-K: 2011; Herzfeldt-Kamprath & Ullrich, 2016), examined, among other variables, the impacts of teacher education related to child outcomes for a combined sample of 34,000 children in early childhood through elementary settings. These authors indicate that while the literature describes mixed results, it is generally agreed upon that children have better academic outcomes when teachers have more years of education in child development and instruction.

In addition to teacher education level, first year teachers are generally less effective than teachers who have been in the classroom for several years (Herzfeldt-Kamprath & Ullrich, 2016). In the current, the teacher in Group 1 had 15 years experience teaching kindergarten. This was the first year in the classroom for all other study teachers. These extremes in the teacher sample were unavoidable, as the sampling unit was the kindergarten program in one elementary school. The study findings should not be disregarded in light of these variables, however, as children in Groups 1 and 2 who participated in study activities did achieve growth on the outcome measure. This growth was significant on the third task inquiring what animals needed to survive.

**Findings in context.** It is difficult to examine certain particulars of this study in the context of existing literature, as it the first to use the Growing Up WILD curriculum in a research setting. Similarly, the science knowledge assessment created specifically for
this study has not been used elsewhere. However, this study does add to the growing body of literature examining how environmental education impacts student learning. The study also offered promising strategies for bridging learning objectives between informal and formal learning environments. Other interesting aspects of this study that deserve further consideration include the children’s understanding of the physical world, children’s experiences outside the classroom, and gender differences.

**Children’s understanding of the physical world.** As part of his cognitive-developmental theory, Piaget believed that children through experiences outgrow the concept of animism, wherein they view physical objects as living and feeling (Crain, 2016). Between the approximate ages of 6 and 8 years, children become more discriminatory and attribute life to objects that move. Consider the following excerpt from a conversation observed in one classroom:

Tr: Who can tell me what is living on the tree?

Ss: spider, squirrel

Tr: Who can tell me what is non-living?

Ss: spider web, plant

Tr: Uh-oh, plants are living, just different. They can’t walk and talk.

In this exchange it is the teacher correcting the child through the age-appropriate lens of animism. The concept of living and nonliving continues to challenge children as old as 9 years of age, particularly in regard to plants (Association for Psychological Science, 2008). While primary teachers are expected to teach children about the characteristics of living things and delineate those with non-living things, young children often have difficulty discerning a ‘living thing’ from a ‘dead thing’ (Legaspi & Straits,
Discussions in their research with children in first grade on living versus nonliving led these researchers to re-categorize ‘dead thing’ as ‘once living’ as a means to scaffold the distinction for child learning. For Task 1 in the current study, the terminology ‘are alive’ or ‘were living’ was used in an attempt to further delineate the concepts of living, nonliving, and once living. In light of the research and children’s stages of development, it is interesting that children in this study, with the exception of those in Group C, made gains on Task 1 regarding living things.

**Children’s experiences.** Though the child sample for this study was relatively homogenous, the variance in children’s out-of-school experiences cannot be discounted. For example, two children on both the pretest and posttest indicated that a raccoon was not a real animal. Consistent with the constructionist view, children’s previous knowledge is key to purposeful learning in the future (Powell & Wells, 2002). Use of the Growing Up WILD curriculum provided opportunities for teachers and children alike to draw on previous experiences in relation to the content of study activities. For example, the following statements were heard during one classroom observation during the Wildlife is Everywhere! activity:

S: When I was in Florida I saw lizards everywhere

Tr: This reminds me of a trip my family took to North Carolina. We went to an island with wild horses on it

S: I found a nest with living babies in it when I was playing near the sandbox

Similarly, children’s responses on the assessment and during group interviews must be examined within the context of children’s experiences. For example, assessment
Task 7 asks children to match an animal to its habitat. Interestingly, after the maximum point answer indicating an animal was match to its correct habitat, the most common connection made was bee to wooded area. This finding is comparable to that of another study, however, in which a similar proportion of 5-6 year old children included trees when asked to draws bees in their natural habitat (Rodriquez-Lionaz, Toral, & Palacios-Agundez, 2018). There are certain bee and wasp species nest in hollowed wood or dead trees. Children may have encountered bees in such an area, and this answer was not considered incorrect.

Making school to home life connections is a major tenet in DAP. Children learn best when they can make meaningful connections between new and existing knowledge (Copple & Bredekamp, 2009). Sharing life experiences in the context of learning new information also support children’s sense of belonging (Sari, 2016). The Growing Up WILD curriculum promotes knowledge transfer from children’s classrooms to their homes with suggested family activities incorporated in each lesson.

**Gender and science learning.** Of particular importance with the current focus on STEM learning was the study finding that gender was a predictor of children’s performance on the science assessment, with boys scoring higher than girls. Despite increasing gains in girls’ achievement in science, the most recent data from the 2015 Programme for International Student Assessment (PISA) indicates that boys still outperform girls in science throughout the world (Organisation for Economic Co-operation and Development (2019). Gender was a statistically significant predictor of children’s science performance in another study analyzing the Early Childhood Longitudinal Study-Kindergarten data (Sackes, Trundle, & Bell, 2013). A different study
examined same-sex peer collaboration and conceptual change in science learning for elementary children. These study authors report that boys used more conceptual-level language within peer groups that girls, and only boys showed growth on conceptual development at the time of posttesting (Leman, Skipper, Watling, Rutland, 2016).

Considered in aggregate, results from these studies are especially concerning when viewed in the context of other literature regarding adult biases towards girls learning science and science learning in general. Newall et.al. (2018) gave adult study participants a fictional profile of an 8-year-old child and tasked them with teaching science content over Skype. Fictional profiles were experimentally manipulated for gender, and results revealed that participants delivered less scientific information when they believed they were teaching girls, rated girls as less academically capable in physics than boys, and perceived gender stereotypical girls as less likely to enjoy science than boys.

Such data provide evidence for the importance of providing science learning opportunities, for girls especially, beginning at a young age. As discussed previously in this paper, children’s attitudes towards science form as early as kindergarten, and they are largely influenced by their educator’s attitudes towards science (Eshach and Fried, 2005; Mantizicopoulos et al., 2009). Looking at this study’s outcome data in the context of existing literature indicates that educators of young children must provide rich environments and foster positive attitudes towards science learning.

Limitations

**Internal validity.** Internal validity refers to how much extraneous and confounding variables are controlled within a study, or the degree to which causation can
be inferred (McMillan & Schumacher, 2010). Threats to internal validity are expected with research conducted in school environments. A control group was added to this study to compensate for these threats, and scores from both pretests and posttests were examined. Threats of history, or threat of concurrent events, and maturation were also minimized due to the short duration of this study. Attrition was not an issue with this study. Construct validity remained a threat in this study, although the addition of child interviews to the assessment helped to counterbalance this. Interviewing all participating children would be preferred in futures studies of this nature.

The primary threats to internal validity in this study were participant selection and implementation fidelity, the latter of which is discussed in a separate section of this paper. Teachers self-selected to participate in this study, and this may have influenced the dependent variable (children’s science outcomes scores). While demographics of the children were relatively homogenous across groups, the teacher in Group 1 held a Master’s degree and 15 years teaching experience. This is in contrast to the other three teachers, who each held a Bachelor’s degree and were in their first year of teaching. Subject effects also were present, as at least one child complained about having to complete the assessment, while others talked out loud and shared answers. In addition, the teacher interview protocol included questions to which only teachers who implemented the Growing Up WILD curriculum could respond. As a result, the teachers in Groups 1 and 2 spoke the majority of the interview time.

**External validity.** External validity refers to how study results can be generalized to the greater population (McMillan & Schumacher, 2010). A main threat to the external validity of this study was the lack of existing literature available to draw upon for
establishing an appropriate sample size. No published research was found that used the Growing Up WILD curriculum as an intervention. In addition, the child assessment was specifically created for this study. The small sample size limits the generalizability of results, as does the child sample. The study did, however, include multiple classrooms.

Teachers refused to provide demographic information for children aside from age, gender, and ethnicity. Disability and free-reduced lunch status were pertinent variables missing from the analysis. Information that teachers did provide was sufficient to realize the relative homogeneity of child participants. While representative of the study school, child demographics that were included are not representative of the population at large.

The short length of the study and ecological external validity are also limitations. Study activities occurred over the course of seven consecutive weekdays (with weekends after the pretest day and before the posttest day). Study teachers implemented activities for just 30 minutes each of those days. Additional time and resources would be required to conduct this study on a grander scale. Ecological factors that threatened external validity include the time of year the study was conducted, the school grounds, and novelty effects. A winter field trip and accompanying curriculum would likely yield different results. The study school was fortunate enough to have a creek running through the property, which was used as part on one activity. Lastly, the field trip and curriculum were exciting for the children, and their increased interest may have impacted outcome scores.

**Measurement.** Chronbach’s alpha is a commonly used test to measure the internal consistency of scale or set of test items, and is often quoted by authors in science studies (Taber, 2017). High alpha scores indicate that items on a scale or test reflect the
same construct, or the degree of interrelatedness of the items. The assessment created for this study included three constructs: 1) living, non-living, and once living; 2) animal survival needs; and 3) habitats. This contributed to the lower than acceptable alpha level of .70. In addition, fewer test items produce lower alpha scores. The assessment for this study included only seven tasks, which likely contributed to the alpha .64.

**Implementation fidelity.** It should be noted that fidelity of implementation of the Growing Up WILD curriculum was not part of the research questions, and strict measures were not employed. In addition, the activities can be implemented in a variety of ways, which may differ from teacher to teacher. However, observational data collected while assessments were administered and during implementation of study activities served as fidelity data. Only fidelity of assessment administration was collected on the teacher in Group 4, as she did not implement other study activities. Fidelity was scored on a scale of zero (no steps implemented) to four (all steps implemented), with four points indicating 100% fidelity. Each Growing Up WILD activity included a short warm up or introduction. Fidelity on use of warm up activities was 75% for teachers in Groups 1 and 2. Fidelity for the Group 3 teacher was 100%.

There was greater variation in how the two teachers using Growing Up WILD implemented the curriculum activities. While the main steps in each activity were adhered to, there were inconsistencies between teachers’ implementation that could have compromised the integrity of the activity. For example, two Growing Up WILD activities required teachers to take children outside. Both teachers neglected to do so during one of those activities. In addition, neither teacher completed part of one activity that demonstrated food scarcity. One teacher discussed the term omnivores with the children
as denoted by the curriculum, and the other omitted this. On the one- to four-point scale fidelity was 66.7% for alignment to the main activities in the curriculum, with equal fidelity between the two teachers. Compromised implementation fidelity in science teaching was discussed in another study by Sackes et al., (2013), in which a large number of teachers did not teach the targeted science concepts that they were expected to teach.

The teacher in Group 3 achieved 87.5% fidelity in implementing book reading and end of book activities. She neglected to compare different tree stems with children as part of the activity related to Our Very Own Tree (Lowery, 2015b). While engaging in the caterpillar hunt, she allowed children to search for caterpillars until all were found rather than stopping the hunt after 2 minutes. The results of the activity were impacted by this error, diminishing the opportunity to demonstrate the cause and effect relationship of camouflage. Implementation fidelity rates for this study are similar to those in other studies in which teachers implemented curricula as part of a study (see Kulo & Cates, 2013; Lindsay, Davis, Stephan, Proger, 2017; Russell, 2005).

Implications for Research

**Multiple treatments plus control design.** These studies both utilized the multiple treatments and multiple treatments plus control research designs. Sometimes referred to as a dismantling study, this research design allows for the examination of multiple treatments in a way that shows which part, or treatment, contributed most to the outcome (Shadish et al., 2002). The use of multiple treatment levels also can detect effects that may be overlooked with examining only a single treatment level. This research design has successfully been applied in education settings in an efficient and timely manner, despite the challenges to conducting research in public schools. The
current study adds to the literature of research methodologies in education, as the multiple treatments design is infrequently employed in the science education literature.

**Environmental education curricula.** This study is the first to assess implementation of the Growing Up WILD curriculum and its impacts on student learning. A study using activities from the Project WILD curriculum in classrooms of fifth graders used a similar research design (Fortinl, Gerretson, Button, & Masters, 2014) though no control group was included. Results from both studies have two important implications: 1) environmental education curricula can successfully help teachers meet learning objectives related to state and national science standards, and 2) experiential activities, such as those included in environmental education curricula and field trips, increase student knowledge in science. In addition, teachers during interviews in the current study indicated that they enjoyed using the curriculum. They stated that it provided opportunities to integrate NGSS in an age appropriate manner that children enjoyed, and that they would continue using the curriculum in some manner in their classrooms.

All mean scores for 4th through 12th grade students were below the ‘proficient’ level on the Nation’s Report Card in Science for 2015 (NCES; National Center for Education Statistics, 2015). Sixty-six percent of eighth grade students with disabilities (SWDs) scored at the ‘below basic’ level with mean scores significantly lower (34 points) that their peers without disabilities. At the fourth grade level, mean scores for SWDs were at the basic level, yet 25 points below students without disabilities. There is a similar differential in mean scores for students eligible for the National School Lunch Program and those who are ineligible (NCES, 2015). The current methods behind science
instruction contribute to low performance in science achievement for SWDs (Taylor, Tsend, Murillo, Therrien, & Hand, 2018). Recent literature includes promising academic outcomes for these populations in studies with older children who participated in school-based, outdoor education (James & Williams, 2017; Szczytko, Carrier, & Stevenson, 2018). This research needs to be furthered with younger children, including those in inclusive preschool classrooms and Head Start programs, when children first enter formal learning settings.

**Language development and science learning.** A future examination on the use of Growing Up WILD in conjunction with Classroom Assessment Scoring System (CLASS: Pre-K; Pianta, La Paro, & Hamre, 2008) may yield empirical evidence to support the prevalence of oral language use as part of environmental education. Notes taken during classroom observations in this study revealed significant verbal exchanges occurred during implementation of Growing Up WILD and book activities. Teachers were observed posing open-ended questions to children, asking them “how” and “why” to draw expanded responses from children. Examining teacher-child interactions as a measure of classroom quality and their relationship to child outcomes has become increasingly common in preschool settings, though not so much in K-12 classrooms. Specific CLASS indicators include concept development, quality of feedback, and language modeling, examples of which were all observed with frequency during implementation of the Growing Up WILD curriculum. Such supportive interactions “…have significant positive effects on children’s academic achievement and classroom behavior within and across elementary grades” (Herzfeldt-Kamprath & Ullrich, 2016, p. 3). Study teachers were observed introducing and explaining new vocabulary as part of
the activities, and the experiential nature of the activities prompted spontaneous child-
teacher and child-child conversation.

Implications for Practice

Teacher preparation. There exists a plethora of emerging research examining
the benefits of including nature-based education for young children, and entire online
depositories are dedicated to making them accessible (see
https://www.childrenandnature.org/research-library/,
https://naaee.org/eepro/research/library, and http://www.informalscience.org/news-
views/knowledge-base). While there are vast opportunities for teachers to facilitate
nature-based learning, many do not feel competent doing so (Becker et al., 2016).
Preparation and facilitation on behalf of teachers is required to ensure opportunities
offered by a field trip are realized. Findings from the current study and one by Alon and
Tal (2015) indicate that classroom preparation before and after a field trip was associated
with increased cognitive learning. However, often teachers do not provide this support
(Center for Advancement of Informal Science Education, 2016). Educators of young
children have ample opportunities to provide nature-based learning, yet need help with
the tools and curricula in order to do so successfully (Becker, Brink, & Marks, 2016).

The early childhood education program at the University of Nebraska-Lincoln
includes four courses that specifically integrate environmental education, student
teaching experiences are designed to include nature-based learning. After receiving
training to implement the Growing Up WILD curriculum, student ratings in confidence in
planning and implementing environmental education for all domains increased
substantially (Torquati, et al., 2017). Constructivist pedagogy is a critical component of
early childhood teacher preparation, and the current study indicates that teachers can impact children’s academic outcomes with experiential learning activities. Children in this study enjoyed such activities, as they were engaged and participatory according to classroom observation data. This is consistent with current literature examining child engagement and nature-based learning (Kuo, Barnes, & Jordan, 2019; Kuo, Browning, & Penner, 2018; Szczytko et al., 2018). Contrary to the belief that novel, experiential opportunities leave children too keyed-up to focus, lessons using nature can have positive impacts on attention and child engagement. This persists even as children are learning the material at hand.

One strategy for integrating nature into classrooms is to bring natural materials indoors. A study of leaves could integrate art, science, language arts, and writing. Caring for classroom plants can translate into lessons in math, science, language arts, and art. Sand and water tables are common examples of bringing natural materials indoors for children to explore. Taking children outside for certain lessons is another strategy for integrating environmental education and nature learning. School gardens and outdoor classrooms have gained popularity across the nation as a way to increase child engagement while incorporating learning standards. Results from a recent study indicate that children were increasingly able to engage in indoor lessons after completing a lesson outdoors as opposed to a lesson indoors (Kuo et al., 2018). These implications also coincide with several Early Childhood Environment Rating Scale-3 (ECERS-3; Harms, Clifford, & Cryer, 2014) indicators, including Nature/Science, Free Play, and Staff-Child Interactions. The ECERS-3 is a commonly used measurement of structural quality in early childhood classrooms. In the current study, however, study teachers twice did not
take children outdoors as indicated by activity instructions. Teachers must commit to providing children with opportunities for interacting with the natural world both inside and outside.

**Cross-curricular connections.** Educators are tasked with implementing curricula adhering to district, state, and national standards and learning objectives. While this study focused solely on science connections, the Growing Up WILD curriculum enables connections to Common Core State Standards. Alignment exists between the curriculum and NGSS K.LS1-1 and NGSS K.ESS3-1, and between these NGSS and Common Core State Standards. Included as part of each lesson are activities specific to math, language, and literacy. The figure below shows how the two NGSS standards addressed by the four Growing Up WILD study activities meet Common Core State Standards for English Language Arts/Literacy and Mathematics (Figure 4.1). Use of environmental education in formal education settings provides hands-on opportunities for children to learn across curricular domains (Commonwealth of Kentucky Education & Workforce Development Office of the Secretary, 2011).
Alternative assessments. The use of drawing as a means of assessment has been frequently used in research with preschool and school-age children (Cronin-Jones, 2005; Green, 2017; Jose, Patrick, & Moseley, 2017; Rodriguez-Loinaz et al., 2018). As with the current study, results from other studies indicate that using drawings as assessment can demonstrate science and environmental learning. Drawing gives children the opportunity to share their knowledge unconfined from limited writing abilities. Other studies combined the use drawing as assessment with accompanying child interviews or discussions (Anderson, Ellis, & Jones, 2014; Jensen, 2014). This was especially important in the current study, wherein children clarified and expanded upon their assessment responses when given the chance to talk about them. Oral debriefing also
gives children the opportunity to expand upon teleological explanations, which are common when young children discuss natural phenomena (Halls, Ainsworth, & Oliver, 2018). The choice of question wording on assessment tasks can influence children’s tendency to use teleological explanations. Task wording on the assessment in the current study steered away from leading questions, which often elicit teleological responses from young children (Halls, Ainsworth, Oliver, 2018). Attention to question wording, using drawing as an assessment tool, and exploring child responses via informal interviews yielded data providing deeper insights into children’s understanding of the science related tasks. The use of alternate assessments should be implemented in formal learning environments for young children, particularly those with children of varying abilities. Doing so is congruent with developmentally and age appropriate practices.

**Coda**

The present study adds to the growing body of literature supporting environmental education as a viable means to impart science learning to young children. The combination of low science achievement scores for older children and the lack of experiential science instruction for the youngest learners are indicators that current science instructional methods do not hold promise for future science achievement. It is time for educators to think outside the box when it comes to science education with young children. I intentionally state *with young children* as opposed to *for young children*, for science learning at this age is based on child engagement in hands-on activities.

Authors from one study state that a sample of 1,456 parents of preschool children prioritized eight academic content areas in descending order (Sackes, 2013). Science was
the least preferred content area, with only 6% of parents ranking it in their top three choices. This sentiment is echoed by teacher attitudes towards science (Roehrig, et al., 2011). The teachers in the current study reported enjoying using the Growing Up WILD activities, and stated the curriculum made NGSS accessible for use in their classrooms. Similarly, teachers and children alike enjoyed the field trip to the Kentucky Children’s Garden, and teachers felt the curricular activities bridged science learning between the two environments. With preparation, teachers can create out-of-school educational opportunities that children will recall years later (Farmer, Knapp, & Benton, 2007).

Despite the positive reception of study activities by teachers and children, there was reluctance on behalf of both to go outside and use the school grounds as a space for learning. Teachers in Groups 1 and 2 neglected to take children outside to implement study activities on two occasions. The study school has a creek running through its grounds, yet one teacher informed me they did not take children there. Observed comments by some children suggest that they were not accustomed to spending much time outside, either. Upon completion of a ten-minute outdoor activity, one child stated, “My legs hurt so bad,” to which another exclaimed, “Every part of my body, even my spleen, is hurting!”

Considering the potentially limited time that children and young adults have spent outdoors in nature, outdoor learning opportunities must be provided to increase their comfort level and engagement with the natural world as a teaching and learning tool. The present study provided a means of doing just that. Contemplate another child’s musings upon participating in an outdoor study activity: “It’s a beautiful wind today!”
investigative learning opportunities posed by that statement could comprise a unit of study. Such are the offerings afforded by the natural environment.
Lunch for a Bear

Children identify the kinds of foods that Black Bears eat by creating a plate of "bear food."

Quick Facts

Black bears are quiet, shy animals that can be found throughout much of the United States and Canada and in parts of Mexico. These bears may be black, brown, cinnamon, black or blue-gray in color.

Black bear omnivores, which means they eat both plant and animal matter. Most of their diet is made up of a variety of plants and plant parts like leaves, berries, and nuts.

What Black Bears eat depend on where they live and what is available at that time of year. In early spring, they eat grasses, shoots, and other greens. They will also eat insects, moss, and sometimes the carcasses of dead deer or other animals. In late spring and early summer, they eat honey, berries, and leafy plants, as well as ants, wasps, and other insects. Occasionally, they will eat small animals such as mice, squirrels, fish, and birds and larger ones such as elk calves and fawns. In late summer and early fall, they eat more berries, nuts, and acorns. Among all these, bear bears need to eat berries, nuts, or other sources of water for drinking and cooling. They prefer forests and shrubs as cover for hiding and for keeping warm. In winter, Black Bears need a den, which may be a hollowed-out tree cavity, a hollow under a log, or a small, covered or unheated, and simply a shallow depression in the ground.

Resources

Non-Fiction

Animal Tracks by Arthur Dobson
Bear by BR Publishing
Welcome to the World of Bears by Diane Swensson
Bicycles for Bears by Anne Blackwell
The Biggest Bear by Hy Land
Black Bear Cub by Alan Stievater
Our Bear by Robert McCloskey
City of Animals: The Bears by Jim Arnosky
We Are Bears by Mary Dunmen and Linda Weston
Who's Doing on a Bear Night? by Michael Rosen and Helen Oxenbury

Show Me Wildlife

http://www.animalbase.org/animalbase/animal-base-black-bear
http://www.animalbase.org/animalbase/animal-base-grey-bear
http://www.animalbase.org/animalbase/animal-base-brown-bear
http://www.animalbase.org/animalbase/animal-base-american-black-bear
http://www.animalbase.org/animalbase/animal-base-bear-sleuth

Materials and Prep

- assortment of "bear food" and a tray that will fit into a large container (boxes, bowls, baskets, etc.)
- beans, rice, cereal, and other small items
- construction paper, markers, and scissors
- black bears and/or bear pictures
- copies of Food for Black Bears (page 12)
- envelopes and paper bags "bear stickers"
- crayons, glue, and paper clips
- "Lunch for a Bear" template

Instructions

1. Draw a large circle on construction paper to make the "bear's head."
2. Add a "bear's face" using the "bear's head" as a guide for the size of the head.
3. Add "bear's ears" using the same construction paper.
4. Add "bear's body" using the same construction paper.
5. Cut out the "bear's feet."
6. Glue the "bear's feet" to the bottom of the "bear's head."
Who Lives in a Tree?

Children develop an awareness of trees and some of the animals that call them "home."

Quick Facts
A tree is "home" for many different animals. Some, such as butterflies, ants, worms, and spiders, may spend their entire lives in and around single trees. Others, such as squirrels, raccoons, opossums, or frogs may use one tree as a home base shelter, but venture out for water, food, or mates. Still others, like birds, deer, or bats, may use a given tree only for nesting, temporary shelter, or as a rest area.

Animals provide food and shelter in many ways. Various animals may eat a tree's fruits, seeds, buds, flowers, leaves, bark, and even its wood. The tree's leaves can serve as shelter from weather and from predators. Its branches and the hollows in its trunk may make good nesting sites. The soil and roots of its base may provide places for burrowing. Even a dead tree may give shelter and food to insects, bees, and other animals.

Like many animals, people also rely on trees for both food and shelter. Fruits such as apples, pears, peaches and cherries come from trees, as do nuts such as walnuts, hazelnuts, and pine nuts. And, although most people actually live in trees, many of us live in wooden houses made from trees.

Even with all the animal activity and in and around a tree, it is quite possible to miss seeing any animals on a particular visit to the tree. Many times, the animals are quite small and go unnoticed. Other times, the animals may be hiding or out looking for food somewhere else. If they are not visible, look for clues that animals were or are near the tree. Clipped leaves, empty nests, or abandoned spider webs are all signs that animals live there.

Wild Wonderful Words
- Feat
- Last
- Nest
- Branch
- Trunk
- Canopy
- Nest

Materials and Prep
- Tree poem character: page 79 (optional)
- Felt board (optional)
- Set (optional)
- Chalkboard or black paper (optional)
- Camera: magnifying lenses (optional)

Note: In cooler climates this activity may need to be conducted in spring or fall.

Preparation: Find a nearby tree (or trees) for doing this activity. Make sure there are no sharp objects, poisonous plants, or other hazards on or near the tree. Place and cut out the "Tree Poem" characters from the felt (if desired).

Warm Up
Begin by asking children if they have ever seen an animal home. Did they know that a tree can be a home to many different animals? Ask children whether they have ever cuddled under a tree, climbed in a tree, played with sticks or leaves from a tree, or swung on a tree swing in a tree. What animals do they think might live in a tree?

Ready, Set, Go!
1. Read aloud the "Tree Poem" poem on page 79. As you read, you may use the "Tree Poem" felt character and felt board to illustrate the poem. Or, have children act out the animals it describes such as the spider spinning and the moth fluttering. What animals live in this tree?

2. Ask children to sit with you to see what animals live there. What animals might their tree living in different places in the tree. [Point to the roots, at the trunk or under the bark, etc.] In the canopies—refer to "All Oak Tree" for clues. Point out that it will be best to be very still and quiet to not scare the animals. Practice waiting and looking quietly.

3. Lead children to the base or trunk you have chosen (see preparation). Give them time to explore the trees.

4. You might use the rhyme, "Look up, look down, look around to keep children focused on one area of the tree at a time. With "look up," then look high into the canopy of the tree. With "look down," they look at the base of the tree and at the ground around it. With "look around," they look at any trees around the tree of the tree and other leaves or branches they can see up close. What animals can you see at different levels?

5. After children observe any animals, help them look for signs of animals like chewed leaves, nests, or webs. Also look for signs of birds using the tree.

6. Keep a record of what children find, either by having notes on paper or by taking pictures.

Wrap Up
- What animals live in our tree? How do we know?
- Looking at our notes or pictures, what is the largest animal living in the tree? What is the smallest?

Tree Walk
Let's go on a nature walk to find different things that come from trees. What kinds of things might we find? You may each carry a small bag. If we see leaves and lots of something, you may put them in your bag. But, we should not take living parts from a tree because that can hurt the tree. [See page 7 for information about collecting nature and safety information.] We can use the things we collect for activities in our class. [See All Projects, Writing, Math, or Centers & Extensions activities.]
Wildlife Water Safari

Children discover water sources for local wildlife and create a field notebook.

Quick Facts

Animals that are not tame or domesticated are considered wildlife. Even in cities, you may find wildlife such as squirrels, raccoons, skunks, bird, fish, lizards, snakes, bugs, insects, spiders, worms, and mice.

Every animal needs food, water, shelter, and space to survive. The place where an animal finds these things is called its habitat. In cities and suburbs, habitats can be as small as a flower garden or the cracks of a sidewalk, or as large as a city park or urban waterfront.

The types of wildlife that children find on their safari will depend on the habitat they search. In the soil around buildings, students may discover small wildlife such as wall spiders, carpenter ants, or earthworms. Farther from the building, they may see a wider variety of insects and larger animals such as birds, mammals, and maybe even reptiles.

All wildlife must have water to survive. Many animals get their water from moisture in the food they eat. For small animals like insects and spiders, tiny drops of water or under leaves or in damp crevices can be enough to sustain them. Larger animals such as birds, mammals, and reptiles may need permanent water sources (such as ponds or fountains) or temporary ones (such as water that collects after a rain shower pooling in gutters, street puddles, or trash cans).

Sometimes children may not be able to find a water source for an animal they see, there are many possible reasons for this. The animal's habitat may be as little as a few inches larger than the area covered by their footprint. The animal's water source may be very small, like a drop, or hidden from view. The animal may be too small for the water they need, or the water source may be too far away.

Sometimes children may be curious about an animal they see. They may ask questions such as where an animal lives, what it eats, or how it gets its food. As children learn about wildlife, they are able to answer these questions for themselves.

Wild Wonderful Words

habitats, wildlife

Materials and Prep

- magnifying glasses (optional)
- cardboard tubes and binoculars (see page 48) and/or paper safari hats (see 92)
- copies of Wildlife Water Safari Field Notebook (page 94)
- pencils and ruler or compass to carry safari supplies
- crayons

Warm Up

Begin by asking children if wild animals live in your neighborhood. What wild animals have you seen? Do they think about wildlife they may have seen including squirrels, birds, insects, worms, and so on. Do you think wild animals need water like people do? When might they get water to drink?

Ready, Set, Go!

1. Tell children that they will all go on a safari to look for wild animals and places they might get water. Ask children what a safari is and what someone might take on a safari. Have them help you "pack" for the trip. You may want to include magnifiers, a flashlight, light-up clothing, and a water source. If you are going on a rainy day, bring along cardboard tube binoculars (see page 48) and paper safari hats (see page 48).

2. Give each child a cardboard tube and Wildlife Water Safari Field Notebook sheets (options for use with very young children, see page 94). Pack your soft gear and take children on a safari around the building, playground, or neighborhood.

3. On the safari, teach children to look for wildlife on trees that have been found. Older children may write the name of the animal beneath the drawing and mark it was spotted next to the eye symbol. If you have a camera, take a picture of the animal.

5. Help children look for water near each wildlife sighting. If or under leaves, in puddles, in street cracks, etc. Help them learn to find where the animal might get this water they need to live. Encourage children to draw in multiples. Make them and have them return to their field notes. Help them output and staple the pages into a complete field notebook.

Wrap Up

What wild animals live in our neighborhood? What do most of these animals eat or eat? What do these animals eat or eat? What do these animals eat or eat? What do these animals eat or eat? What do these animals eat or eat? What do these animals eat or eat? What do these animals eat or eat?
Wildlife is Everywhere!

Children make observations and understand that wildlife is all around us.

Quick Facts

Many people think of wildlife as the large animals of Africa, such as lions and elephants, or the large animals of the North American forests, such as grizzly bears and elk. However, wildlife includes any animal that has not been domesticated by people.

In contrast to domesticated animals such as farm animals and pets, which depend on people for their needs, wild animals provide for their own food, water, shelter, and other needs. Although plants can also be considered as wild or domesticated, only wild animals are called wildlife.

Wildlife includes bears, snakes, insects, spiders and other invertebrates (animals without a backbone), and vertebrates including fish, amphibians, reptiles, birds, and mammals. Wildlife also includes very small animals that can be seen only through a microscope.

Wildlife is everywhere—in trees, in soil, in water, and in the air. Even in the cleanest houses and buildings, signs of insects, spiders and other wildlife can be found near lights, on window sills, doormats, shelves, or window boxes or furniture.

Wildlife scientists study wildlife to learn how they live and interact with their environment. These scientists may focus on one wildlife species or a group of species during their studies. They record their observations with their senses and tools and often work in extreme or uncomfortable surroundings.

Wild Wonderful Words

- Wildlife
- Domesticated
- Wildlife Observation Scientist

Materials and Prep

- Selection of Animal Cards
- Whiteboards or charts
- Pencils and markers
- Camera

Preparation:

- Group activity
- 4 to 8 children, 1 adult
- Field trip to study wildlife

Wrap Up

5. Have each child draw a picture showing one of the animals or animals they saw and sign their drawings. Use this book to help them draw animal tracks.

6. Which wildlife signs did children see? Explain to the children the importance of wildlife observation scientist and how they can help to protect wildlife.

Take Me Outside!

Wildlife in Our Neighborhood

Go on a walk in your neighborhood or at your school and look for wildlife. What do you see? What wildlife signs can you identify? Where have you found these animals? What do they look like? How do the animals move? What do they eat? How do they interact with each other? Which wildlife signs did you see? How many wildlife signs did you see in your neighborhood or school?
APPENDIX B. NSTA BOOKS AND ACTIVITIES
Our Very Own Tree

Parent/Teacher Handbook

Introduction
Two girls in an urban setting select an oak tree in a park to study. They learn to identify and compare trees and to notice seasonal changes in them. Their interest grows, and their study continues for a long period of time, which enables them to discover seasonal changes in the tree.

Inquiry Processes
The study of the oak tree in detail illustrates simply the importance of an in-depth study in science. Research on a topic must be developed in depth over a long period of time to produce knowledge and understanding. The girls' observations include events occurring to the tree, around the tree, and on the tree during different seasons. Eventually, they even create a scrapbook about the oak tree, telling what they learned during the four seasons.

Content
The use of books, teachers, and other resources is introduced in this story. The importance of observations is stressed. The girls attempt to determine if changes in the oak tree could be seen. Most changes occurred too slowly to be noted in short observations. But many changes are noted in this story, such as the loss of leaves in the fall, the storage of nuts by squirrels, the building of nests by birds, and the repair of a cracked limb by a tree surgeon.

The girls' activities also emphasize the idea of conservation and care of our natural resources. The girls do not damage the oak tree by picking an excessive number of leaves or digging up roots.

The activities the reader can do extend the research the girls do in the story. The trunk of the oak tree, like many other trees, is a woody stem. There is much that can be inferred from the external features of a woody stem. The features imply the order of its appendages—that is, parts of branches and twigs imply where leaves were attached.
Looking for Animals

By Lawrence F. Lowery

Wonder Why

NSTAKids
National Science Teachers Association
Introduction
Protective coloration of animals is the central concept explored in this book. Different animals blend in with colored backgrounds in a variety of ways. The reader can easily understand this concept from the illustrations in Looking for Animals. This book offers the reader an opportunity to see the animal in the open and then note the animal in a more camouflaged state.

Note: There are several factors that contribute to making an animal hard to see, such as its coloration, disruptive marks on its skin, its shape, and its behavior. Although this book has examples of all these factors, it emphasizes the factor of coloration.

Inquiry Processes
The science processes emphasized in this book are observation and comparison. Each highly visible animal is matched by another in a more natural habitat that makes the second more difficult to see. A keen sense of sight is the key to successful observation of animals in their natural environments. Through such observations, the reader will sense why some animals are able to survive while others are not. Field trips or family outings to a zoo or aquarium also provide opportunities to observe animals that cannot be seen elsewhere.

Content
The functions of animal coloration need to be stressed for children in any discussion of this book. The most obvious function is concealment. Animals often have a basic coloring that matches the background of the habitat in which they live. Another function of coloration (not presented in this book) is advertisement. Some animals have colors or features that attract the attention of animals of the same species or that serve to deceive or detract predators. Some scientists believe that another function of color may be physiological. The color of an animal's skin or coat may influence solar absorption in terms of body temperature control. Of course, some colors probably serve no function or are remnants of some lost function.

A predator is an animal that eats other animals. A prey is the animal that the predator eats. For example, the fox is a predator and the rabbit is its prey. The lion is a predator and the zebra is its prey. The natural camouflage of some animals protects them from being attacked by predators. They blend in with their environment so well that other animals might not see them. A camouflaged prey might not be eaten because the predator might not see it. A camouflaged predator might not be seen by a prey until it is too late to escape.
Science Activities

The Effect of Color in a Predator/Prey Hunt

An adult can easily set up this activity for youngsters to do. Select a vacant lot or lawn area to simulate a hunt for prey. Define the boundaries of the hunt area (e.g., a 30-foot strip that is 4 feet wide). Determine the general color of the area (e.g., green, brown, or yellow). Obtain 200 uncolored cocktail toothpicks. The toothpicks will be "worms" or "caterpillars" (the prey). The predators will be the "birds" (the predators) that eat the worms.

Color 100 toothpicks to match the general color of the hunt area. Soak the toothpicks overnight in a glass of food coloring or tempera paint. Do not use oil-based paints because the toothpicks will stick together. Remove the toothpicks to let them dry. When dry, break all the colored toothpicks and uncolored toothpicks in half. Place all 200 of the toothpicks in a bag and shake the bag to thoroughly mix the toothpicks. Without the "predators" watching, scatter the toothpicks evenly over the area chosen for the hunt.

Next, tell the predator(s) to play the part of birds that will feed on worms in the area. Start a timer and tell the "birds" to collect as many "worms" as they can by picking up each worm between a thumb and forefinger and placing it in an envelope before picking up another one. This action is analogous to a bird picking up a worm in its beak and placing it in its crop.

After five minutes, tell the predators to stop "hunting." Tally the results of the collection on a chart similar to the one below. Be sure to have the children wash their hands with soap and water after the hunt.

Remind the "birds" that the area started out with the same number of colored and uncolored "worms." Discuss the results. Were more colored or uncolored worms found? Was color an influence on the survival of the worms?

Speculate on what the next generation of worms would look like. The hunters will realize that the worms that remain will reproduce. Thus, subsequent populations will retain those characteristics beneficial to survival (in this activity, they would retain their color).

This hunt is similar to an experiment. In this case, the experiment was a test of a particular color in a selected environment. Because of its design, this activity can also lead to other experiments—try varying colors, use other environments, or use other methods (e.g., use tweezers to pick up the toothpicks). You might think of other factors to test. For example, another test might be to use black ink to draw a stripe around the middle of 50 of a set of 100 colored toothpicks to see if the stripe influences how many colored toothpicks are found. Do the tallies show whether the stripe has an effect in helping those "worms" survive?

<table>
<thead>
<tr>
<th>PREDATOR/PREY HUNT ACTIVITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area to Be Hunted</td>
</tr>
<tr>
<td>Green lawn</td>
</tr>
<tr>
<td>Number &quot;eaten&quot;:</td>
</tr>
</tbody>
</table>

Another activity can be found at www.nata.org/looking.
APPENDIX C. SAMPLES OF CHILDREN’S STEM DRAWINGS
bud
scars
leaf

bud
reg
leaves
APPENDIX D. KCG FIELD TRIP LESSON PLAN
KCG Field Trip Lesson Plans

Stonewall Field Trip
Wednesday May 9th, 2018 10am-12pm

Trip Information
Stonewall is bringing a total of 100 Kindergarteners. Meg Gravil, a PhD candidate will also be there doing some research.

Schedule
8:30 - set up garden - staff
9:15 - station set up starts (Volunteers)
9:40 – meet at the front gate for a quick game plan talk
9:45 - Students Arrive and gather by logs
10:00 - Orientation
10:15 - Volunteers lead their first group to their station. Stations Start. Each Station will last approximately 11 minutes and there will be 2 minutes of transition time between each group. You will hear the megaphone when it is time to switch. (please do not switch early)
10:15-11:45 – stations
11:45 – end of stations. Volunteers lead groups to the field by the raised beds. Wrap up by Jackie. Volunteers clean stations by placing everything into a bin or bag. Please bring your bin or bag to the front gate.
12:00 lunch

Volunteers
Station 9:15-12
1. Wildlife Safari 1. Jan Schwartz
2. Planting Station 2. Mary Miller
3. Signs of Spring 3. Victoria Wallace
4. Worm Races 4. Lisa Pennington
5. Who Lives in a Tree 5. Suzanna Weisenfeld
7. Log Play (teacher led) 7. Teacher Led
8. Boat and Log Cabin (teacher led) 8. Teacher Led

Wildlife Water Safari

Standard: K-LS1-1. Use observations to describe patterns of what plants and animals (including humans) need to survive. [Clarification Statement: Examples of patterns could include that animals need to take in food but plants do not; the different kinds of food needed by different types of animals; the requirement of plants to have light; and, that all living things need water.]
K-ESS3-1. Use a model to represent the relationship between the needs of different plants and animals (including humans) and the places they live. [Clarification Statement:
Examples of relationships could include that deer eat buds and leaves, therefore, they usually live in forested areas; and, grasses need sunlight so they often grow in meadows. Plants, animals, and their surroundings make up a system.]

W.K.2 Use a combination of drawing, dictating and writing to compose informative/explanatory texts in which they name what they are writing about and supply some information about the topic.

Materials:
- Wildlife Safari Field Notebooks (page 94 of GUW)
- Magnifying glasses

Synopsis: Explore the Children’s Garden searching for wildlife or signs of wildlife. Investigate the habitat to figure out where those animals get their water.

Background information for educators:
Animals that are not tamed or domesticated are considered wildlife. Even in cities, you may find wildlife such as squirrels, raccoons, skunks, birds, fish, lizards, snakes, frogs, insects, spiders, worms, and more.

Every animal needs food, water, shelter, and space to survive. The place where an animal finds these things is called its habitat. In cities and suburbs, habitats can be as small as a street gutter or the cracks of a sidewalk, or as large as a city park or waterway. All wildlife must have water to survive. Many animals get their water from moisture in the food they eat. For small animals like insects and spider, tiny drops of water on or under leaves or in pavement cracks might be enough to sustain them. Larger animals such as birds, mammals, and reptiles may use permanent water sources (such as ponds or fountains) or temporary ones (such as water that collects after a rain shower in parking lots, sidewalks, gutters, or trash can lids).

Sometimes children may not be able to find a water source for an animal they see. There are many possible reasons for this. The animal’s habitat may be much larger than the area covered in your safari. The animal’s water source may be very small like a dew drop, or hidden from view. The animal may get most or all of the water it needs from the food it eats. Or, if the safari happened on a sunny day, the sun may have already “burned off” the dew or other water source. In these cases, water sources are there for animals, but just not visible to people.

Procedures:
Begin by asking students if wild animals live in the Children’s Garden. What wild animals have you seen here? Help them think about wildlife they may have seen including squirrels, birds, insects, earthworms, and so on. Do you think wild animals need water like people do? (Of course!) Where might they get water to drink? (From the stream, ponds, puddles, etc.)

1. Tell students that you will go on a safari to look for wild animals and places they might get water. What is a safari? (An expedition to observe animals in their natural habitat). Distribute magnifying glasses so they can get a closer look. Demonstrate how to use them.
2. Give each child the materials listed above.
3. Explore the KCG on a safari! On your safari, look for wildlife or clues that wildlife has been in the area (for example, droppings, nests, feather, tracks, holes in wood, etc.)

4. Help children look for water near each wildlife sighting (on or under leaves, in puddles, in sidewalk cracks, etc.) to try to find where the animal might get the water it needs to live. Encourage children to draw or write the animal’s water source next to the water symbol.

5. Show them the notebooks that you are going to send them home with. Encourage them to use them at school or at home. Be sure to emphasize that, “wildlife isn’t just at the Kentucky Children’s Garden, it is EVERYWHERE even where you live and go to school.”

Wrap up: If there is time, wrap up by reviewing what animals you saw on the hike and where they got their water. Give children the opportunity to describe their experiences and findings as fully as possible. What wild animals live in the Children’s Garden? Were most of the animals big or small? Where do most of the animals get the water they need? Were these places big or small?
Wildlife
Water Safari
Field Notebook
Planting Station

Standard: K-LS1-1. Use observations to describe patterns of what plants and animals (including humans) need to survive. [Clarification Statement: Examples of patterns could include that animals need to take in food but plants do not; the different kinds of food needed by different types of animals; the requirement of plants to have light; and, that all living things need water.]

Materials:
- Cups or pots (Clear plastic) - One per child.
- Soil (pre-moistened)
- Seeds
- Permanent markers (optional)
- Plant trays – one per class
- Care sheets – One per child

Synopsis: Learn what plants need to survive. Plant a seed of to take home and learn how to care for that specific plant.

Goals of Activity:
- Students will understand what plants need to survive.
- Student will learn how to care for their specific plant.
- Students will take a plant home.

Procedures:
1. Ask younger students if they have to eat every day? Drink every day? Have a place to stay? Breathe every day? Well so do plants! Tell them that plants need lots of sunshine, water, soil and food in order to grow up big and strong! Ask older students what plants need to grow?
2. We can eat different parts of a lot of plants! Point out a tomato (or other) plant. Tell the students what it is. Ask them what part of the plant we eat? [Fruit].
3. Point out a flowering plant. Tell students that other plants we just like because they are pretty!
4. Tell students that they are going to get to take a plant home so they can practice taking care of it. They each get to take home and grow some lettuce! Lettuce is a great spring or fall plant because it loves cold weather.
5. Tell them when they take it home they have to water it when the soil is dry and place it in a sunny window. If they have a yard or a larger flower pot, they can plant it in there and leave it outside. Ask them if they think they can take care of a plant?
6. Hand a plastic pot to each student.
7. Have them write their names on the a label and place it on the pot.
8. Pass around the soil bin and let them fill their pots.
9. Inform students that seeds usually need to be planted at about 2 times their height under the soil. Lettuce seeds are small! They actually need light to germinate, or start growing. So, don’t put them into the soil too far! In fact, they would be happy to grow right on the surface of the soil!
10. Give each student **5-6** lettuce seeds for their pots (please do not give out too many seeds or we will run out and students will have way too many plants in one pot).
11. Remind them that the soil is pre-moistened, so they don’t need to water until they get home (which will also be less messy for teachers and volunteers)
12. Show them the care sheets for their plants. Explain that they will each get one to take home when they get back to school so that they remember how to take care of their plant. (don’t give them out- they will go to the teacher at the end)
13. After they are done planting, have each student put their pots into their teacher’s tray.
14. Quiz them on what a plant needs to grow big and strong. Ask students what part of the lettuce they eat. Remind them it is the leaf.
15. If time, explore the garden beds with the kids.

*At the end of the field trip, give the trays and care sheets to the teachers to take back to school with them.*

**Signs of Spring**

**Standard:** K-ESS2-1. Use and share observations of local weather conditions to describe patterns over time. [Clarification Statement: Examples of qualitative observations could include descriptions of the weather (such as sunny, cloudy, rainy, and warm); examples of quantitative observations could include numbers of sunny, windy, and rainy days in a month. Examples of patterns could include that it is usually cooler in the morning than in the afternoon and the number of sunny days versus cloudy days in different months.] RL.K.1 With prompting and support, ask and answer questions about key details in the text.

**Materials:**
- Spring book (*Spring* by Science Kids of *When Spring Comes* by Kevin Henkes)
- Scavenger hunts

**Synopsis:** Learn about and observe weather, plant and animal patterns connected to the time of year.

**Procedures:**
1. Discuss what happens during the season of spring. Ask the group how they know it is spring. [the days are growing longer, the weather is warming up, sometimes it is rainy and windy, there are lots of flowers including tulips, daffodils and tree flowers, birds are coming back, leaves are starting to grow, etc.]
2. Read a book. You can choose from *Spring* by Science Kids of *When Spring Comes* by Kevin Henkes
3. Pair students into groups of two.
4. Give each group a scavenger hunt and have them look around the garden to find each item plus one additional one of their choice.
Spring Scavenger Hunt

1. Rain cloud
2. Daffodil
3. Robin
4. A young Tulip Poplar leaf
5. A tree that is flowering

Worm Races

**Standard:** K-ESS2-2. Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs.

[Clarification Statement: Examples of plants and animals changing their environment could include a squirrel digs in the ground to hide its food and tree roots can break concrete.]

K.MD.A.1 – Describe and compare measurable attribute.
Materials:
● Worms
● Plates
● Coffee filters
● Baby wipes
● Spray bottles
● Worm rulers

Synopsis: Learn about and observe worms while playing a fun game.

Goals of Activity:
● Students understand worms are nature's recyclers.
● Students will treat wildlife with respect.

Set Up:
1. Place enough plastic plates on the tables so that there are enough for groups of two to share.
2. Place coffee filters on plates and spray them with until moist (not wet).
3. If needed, look for worms in the raised beds, the worm bin or in compost pile.

Procedures:
1. Ask if anyone recycles at home? Have students give examples of things that can be recycled (plastic, glass, paper, cardboard, metal).
2. Show students some compostable materials (food and yard waste). These items can't be recycled in the recycling bin but-- Nature has its own way of recycling old plant matter. Important invertebrates (animals without backbones, such as worms and insects) work to decompose (break down) dead plant material and turn them into new nutrients for plants. Have students feel their own backbone. Explain that these bones are vertebrae, and that makes us Vertebrates. Have students repeat both Invertebrates and Decompose aloud after you.
3. Worms are important because they eat dead plants and turn it into nutrients for new plants to grow.
4. Ask students how worms move? Do they have legs? No! They stretch and squeeze through the soil! Encourage the students stretch and squeeze like a worm. When they move through soil, they are changing it in several important ways. They are making little tunnels through the dirt, which can help plant roots grow and get oxygen.
5. Explain that today, you will befriend some of nature's recyclers! Remind students that worms are living creatures and we should show them kindness and respect. That means that we must be very gentle. You can touch, but please do not squeeze, pinch or poke them.
6. Hand out trays and worms. Ask the kids to see if they can determine which end is the head by watching how the worm moves and looking for the small pink/white "mouth."
7. Encourage children to touch the worm, how does it feel?
8. Have students measure the worms using their worm rulers.
8. Encourage students to name their worm so they can cheer it on when we race them. Ask students to share the name of their worm.
9. Tell students to place their worm on the center of the plate. The first worm to make it to the outer circle wins. Give them a spray to encourage them along.
10. Collect the worms when time is running out. Give the worms a spritz of water to refresh them. Pass out hand wipes to clean children's hands.

Who Lives in a Tree?

Standard: K-ESS3-1. Use a model to represent the relationship between the needs of different plants and animals (including humans) and the places they live. [Clarification Statement: Examples of relationships could include that deer eat buds and leaves, therefore, they usually live in forested areas; and, grasses need sunlight so they often grow in meadows. Plants, animals, and their surroundings make up a system.]
K-LS1-1. Use observations to describe patterns of what plants and animals (including humans) need to survive. [Clarification Statement: Examples of patterns could include that animals need to take in food but plants do not; the different kinds of food needed by different types of animals; the requirement of plants to have light; and, that all living things need water.]
RL.K.7 With prompting and support, describe the relationship between illustrations and the story in which they appear (e.g., what moment in a story an illustration depicts).
RL.K.10 Actively engage in group reading activities with purpose and understanding.

Background information for educators:
A tree is a “home” for many different animals. Some, such as beetles, ants, worms, and spiders, may spend their entire lives in and around a single tree. Others, such as squirrels, raccoons, opossums, or frogs may use one tree as a home base shelter, but venture afield for water, food, or mates. Still others, life birds, bees, or bats, may use a given tree only for a resting spot, temporary shelter, or to eat a meal.
Trees provide food and shelter in many ways. Various animals may eat a tree’s fruits, seeds, buds, flowers, leaves, bark, and even its roots. The tree’s leafy canopy may offer shelter from weather and from predators. Its branches and the hollows in its trunk may make good nesting sites. The soil and roots at its base may provide places for burrowing. Even a dead tree gives shelter and food to termites, beetles, and animals.
Like many animals, people also rely on trees for both food and shelter. Fruits such as apples, pears, peaches, and cherries come from trees, as do nuts such as walnuts, hazelnuts, and pine nuts. And, although most people don’t actually live in trees, many of us live in wooden houses made from trees.
Even with all the animal activity in and around a tree, it is quite possible to miss seeing any animals on a particular visit to the tree. Many times, the animals are quite small and may go unnoticed. Other times, the animals may be hiding or out looking for food somewhere else. If they are not visible, look for clues that animals live in or near the tree. Chewed leaves, empty nests, or abandoned spider webs, are all signs that animals live there.
Materials:
- “Tall Oak Tree” poem
- Oak tree drawing on poster board
- Laminated characters

Synopsis: Read a poem; learn about and observe animals that live in a tree.

Preparation: Find a nearby tree (or trees) for doing the activity.

Procedures:
Begin by asking children if they have ever seen an animal home. Did they know that a tree can be a home to many different animals? Ask children whether they have ever sat under a tree, climbed in a tree, played with sticks or leaves from a tree, or swung on a tire swing in a tree. What animals live in this tree?

1. Read aloud “Tall Oak Tree” poem. As you read, you may use the “Tree Poem” characters to illustrate the poem; or, invite children to hold the characters, listen for their, and come up and place them on the tree when it’s their turn. What animals live in this tree?

2. Ask children to visit a tree with you to see what animals live there. What animals might they see living in different places in the tree (around the roots, on the trunk or under the bark, and in the canopy – refer to “Tall Oak Tree” for clues)? Point out that it will be best to be very still and quiet to not scare the animals. Practice looking and walking quietly.

3. Lead children to the tree or trees you have chosen. Give them time to explore the tree(s).

4. You might use the rhyme, “Look up, look down, look all around” to help children focus on one area of the tree at a time. With “look up,” they look high into the canopy of the tree. With “look down,” they look at the base of the tree and at the ground around it. With “look around,” they look at eye level around the trunk of the tree and at any leaves or branches they can see up close. What animals can they see at different levels?

5. If children don’t see any animals, help them look for signs of animals like chewed leaves, nests, or webs. You may also use variations of the “Look up” rhyme so that children “Listen up” or “Touch up”

Wrap up:
What animals live in our tree? How do we know?
What is the largest animal living in our tree? What is the smallest?
How many animals did we find living in our tree? (Count together)
Who Lives in A Tree?

Directions: Read the “Tall Oak Tree” poem aloud. You may choose to use a felt tree and figures and a flannel board to illustrate each stanza as you read it, or you may opt to have children invent motions and act out the story. You may reduce the number of stanzas for very young children, or focus on one or a few at a time.

Tall Oak Tree

All is dark and quiet
In Tall Oak Tree at night
See a spider spin her web
In the pale moonlight

A moth flutters near
Drinking nectar in the dark.
He lands on Tree and disappears!
He looks just like the bark.

A bat swoops and zooms
Wow, what a stunt!
Flying bugs should be aware
Bat is on the hunt!

Tree frog breaks the silence
With his throaty call
High in Tree’s top branches
Sticky feet won’t let him fall

Moth flies up into the night
But gets caught in spider’s web
She wraps him up carefully
With her silken spider thread

The sky is getting lighter now
The tree frog stops his song
Nighttime creatures coming home
Daytime won’t be long

The morning sun is rising
And dove begins to sing
Coo...ooo...ooo...ooo
And stretches out her wings

She preens her feathers
Flaps her wings and leaves her cozy nest
She’ll search for seeds all day long
Coming back to Tree to rest

Squirrel wakes up and looks around
Breakfast on his mind
He climbs among Tree’s branches
Eating every nut he finds

Rat-a-tat-tat goes woodpecker
On a broken limb that died
She drills a hole to catch the bugs
From her they cannot hide

A snake is climbing up the tree
Looking for a nest
He likes to eat many things
But birds’ eggs are the best

Caterpillar crawls along
Munching every leaf in sight
When she hatches from her chrysalis
She’ll be ready to take flight!

Tall Oak Tree is a home
For animals big and small
The tree gives food to some
And provides shelter for them all

Birds and Caterpillars

Standard: K-ESS3-1. Use a model to represent the relationship between the needs of different plants and animals (including humans) and the places they live. [Clarification Statement: Examples of relationships could include that deer eat buds and leaves, therefore, they usually live in forested areas; and, grasses need sunlight so they often grow in meadows. Plants, animals, and their surroundings make up a system.]

K.CC.B.4 Count to tell the number of objects
K.CC.A.3 Know number names and the count sequence

Materials:
- Tri-color pasta or other multi-colored, biodegradable material (beans, popcorn, cereal)
- Dry erase boards
- Laminated construction paper in yellow, green, and orange

Synopsis: Students will demonstrate their knowledge of how camouflage is used for protection and survival while playing a fun game.

Background:
Many animals “blend in” with their surroundings. For example, snowshoe hares and some birds change from brown in summer to white in winter. A box turtle’s dappled shell and a fawn’s white spots mimic blotches of sunlight on a forest floor. And the two-toned appearance of many fish, dark on top and light on the bottom, helps them match differing levels of light in the water. When viewed from below, a fish’s light-colored belly blends in with the sky. When viewed from above, the darker top blends in with the water underneath. Any coloration, body shape, or behavior that helps an animal hide is called camouflage.

Blending in with the environment is a great way to avoid being eaten, but it’s not an adaptation limited to prey animals. Many predators are also camouflaged: the better to avoid being spotted by a potential meal. For example, a lion’s tawny coat matches the grasses of the African savanna and the leopard’s spots match the patchy sunlight of the African forest.

Preparation:
Scatter the colored materials in a grassy area.

Procedures:
1. Ask the group to name advantages that bullfrogs have because they’re green. Ask students whether they know what it is called when animals blend in with their surroundings (camouflage).
2. Take students to the area where you scattered the colored materials. Tell students that various types of tasty caterpillars are scattered here and that the students are hungry birds. Tell them what the caterpillars look like. Ask them to predict what color caterpillar might have the best camouflage for this environment. (Green!)
3. Have students circle up around the materials in the grass (alternatively, they can be seated on the stone wall and ‘fly’ from there). Tell them when you say “GO” that they should “fly” over to the field (demonstrate flapping wings) and pick up the first caterpillar they see. Then they should return to the circle (or stone). When every bird has caught a caterpillar, have each student place their caterpillars onto the piece of construction paper that matches.

4. As a group, count how many caterpillars you have from each color. Make a chart on your dry erase board.

5. Repeat this two more times.

**Wrap up:**
Review what colors of caterpillars were found during each hunt. (It is likely that the students will collect the colors that do not camouflage with the grass first, before collecting the green “caterpillars” which do camouflage with the grass.) Ask children why they think the orange caterpillars were caught first and the green caterpillars were caught last. *Is it because they blended in with their surroundings? (Yes!) Does anyone remember what this is called? (Camouflage!)*

**Materials**

Birds and Caterpillars
- Tri-color pasta or other multi-colored, biodegradable material (beans, popcorn, cereal)
- Dry erase boards
- Laminated construction paper in yellow, green, and orange

Who Lives in a Tree
- “Tall Oak Tree” poem
- Oak tree drawing on poster board
- Laminated characters

Worm Races
- Worms
- Plates
- Coffee filters
- Baby wipes
- Spray bottles
- Worm rulers

Signs of Spring
- Spring book (*Spring* by Science Kids of *When Spring Comes* by Kevin Henkes)
- Scavenger hunts

Wildlife Water Safari
- Wildlife Safari Field Notebooks (page 94 of GUW)
- Magnifying glasses
Planting Station
- Cups or pots (Clear plastic) - One per child.
- Soil (pre-moistened)
- Seeds
- Permanent markers (optional)
- Plant trays – one per class
- Care sheets – One per child

Kentucky Children’s Garden Map
APPENDIX E. ASSESSMENT ADMINISTRATION PROTOCOL
The Field Trip Project

Pre/Post Child Assessment Teacher Script

The Field Trip Project Testing Administration Script

Pre- Post-Assessment Testing Directions
Please follow these directions closely for the Pre- and Post-Assessment.
Children will need a pencil and crayons or colored pencils.
Pass out assessments when children have their materials ready.
Encourage children throughout the assessment to do the best they can. Give general praise, but not specific to any answers. Use praise such as: Great job! / Just draw/write what you think is best / it’s OK if you aren’t sure, just do what you think / I love how hard you are working! / etc.

Follow the script when all children are ready to begin.

SAY First of all, I need everyone to write your name on the top of the your paper. There is a space for you to do this.

We are going to answer some questions about animals and science. Some of the words may be new to you, but that’s OK. Just answer the questions as best you can. I will read each question aloud to you and give you time to answer the question. Be sure to let me know if I move too quickly or you haven’t finished your answer.

#1. Let’s look at number 1. It says, “Circle all of the things that are living or were alive at one time.” Do that now (or comfortable prompt to get children to begin).

“Give me thumbs up when you’re ready to move on.”
- OR -
Move on when children appear ready.
(Use whatever you and your children are accustomed to for moving through the rest of the assessment questions)

#2 Now let’s look at number 2. Circle all of the animals that are not real. Do that now.

#3 Number 3 is a little different. Number 3 says, “What things must animals have to survive? List or draw as many as you can.” Go ahead and do that in the space at the bottom of the page.
#4 Number 4 says, “Can a fish live on land? Write why or why not, then give some reasons.” Use the lines below the question to write your answers as best you can.

#5 All right. Let’s look at number 5. It says, “Draw a line to connect the animal to the food it eats.” So draw a line from the picture of each animal to the picture of the food that you think it eats.

#6 For this question you get to draw a picture. Number 6 says, “Draw an animal in its natural habitat. Draw other animals and plants that live there.” You can use your crayons/colored pencils to make this drawing. Try to make everything as it would really look in nature.

(if children ask what ‘habitat’ means, just continue to encourage them to try their best, but do not provide them the answer; give children several minutes to work on this, no more than 5 min;) when children are ready or time is up, proceed to the questions under the drawing space.

a. Under your drawings, there are some questions. The first question asks for the name of the animal. On the first line, write the name of the animal you just drew.

b. The second question asks, “Where do you think this animal gets its water?” On the line under this question, write where you think the animal you drew gets its water.

c. The third question asks, “What do you think this animal eats?” Write something you think your animal eats on the bottom line.

#7 All right! The last question is another one where we match things. Number 7 says, “Draw a line to connect each animal to its habitat.” You need to draw a line from each animal to the picture that looks most like its habitat. (again, do not define habitat for children)

Great job! We are finished!
1. Circle all of the things that are living or were alive at one time:
   - [ ] Dog
   - [ ] Pig
   - [ ] Rocks
   - [ ] Dinosaur

2. Circle all of the animals that are not real:
   - [ ] Unicorn
   - [ ] Dragon
   - [ ] Cow

3. What things must animals have to survive? List or draw as many as you can.
4. Can a fish live on land? Write yes or no, then give some reasons.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

5. Draw a line to connect the animal to the food it eats.

- Squirrel
- Fish
- Frog
- Bee

- Acorn
- Flower
- Beefly
6. Draw an animal in its natural habitat. Draw other animals and plants that live there.

What is the name of this animal?

______________________________________________________________

Where do you think this animal gets its water?

______________________________________________________________

What do you think this animal eats?

______________________________________________________________
7. Draw a line to connect each animal to its habitat.
APPENDIX G. CHILD INTERVIEW PROTOCOL
The Field Trip Project
Child Interview Script

Supplies needed:
- Digital audio recorder, extra batteries
- Children’s assessments
- Pencil, paper

Protocol:
- Ask teacher to identify a spot in the classroom to work with 3-4 children
- Ask teacher to assemble group of 3-4 children

Part 1. What are we doing?
Thanks for coming to chat with me! We are going to talk about animals and habitats, and I want you guys to tell me about some of your answers on the test you just took. But first, we are going to pick out new names for ourselves. You can choose the name of an animal, or superhero, or anything you want! When I call on you, I will use your new name. Do you have any ideas what you’d like to be called?

- Write children’s pseudo names on their assessment

Part II. Questions
OK, great! I love all your pretend names! Let’s talk about animals.

1. What do you think of when I say ‘wild animal’? Can you name some wild animals? (Additional prompts/clarifiers as needed)

2. What do wild animals need to survive? Let’s look at your answers for question three on the test you just took. ________, let’s start with you. What do wild animals need to survive? (Additional prompts/clarifiers as needed)

3. Can a fish live on land? Look at the answers you put on your paper. What do you all think? ________, do you think a fish can live on land? (Why or why not; additional prompts/clarifiers as needed)

4. OK, now we get to look at everyone’s drawing of his or her animal in its habitat. Can you find that page in your test? Great! Let’s go around the table, because I want to hear everyone talk about your animal and its habitat. ________, tell us about your animal. (ask about other features in drawing; where the animal gets water; what it might eat; additional prompts/clarifiers as needed)

5. Let’s talk about camouflage. What is camouflage? Tell me about an animal that is well camouflaged. (Additional prompts/clarifiers as needed)
<table>
<thead>
<tr>
<th>Level of Knowledge</th>
<th>Overall Evaluation</th>
<th>Rubric</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low level knowledge</td>
<td>Numeric score and Level of understanding</td>
<td>Scoring Criteria</td>
<td>no response, unclear response, or no explanation given for answer choice. Hard to analyze understanding</td>
</tr>
<tr>
<td>0 - No Understanding</td>
<td>1 - Incorrect/ Scientific Misconceptions</td>
<td>very basic/vague content knowledge and still incorrect</td>
<td>does represent some sort of meaning</td>
</tr>
<tr>
<td>2 - Partial Scientific with misconceptions /Nonscientific Fragment</td>
<td>3 - Partially Scientific Notion</td>
<td>basic/vague content knowledge with some misconceptions, but correct (scientific fragments/ facts)</td>
<td>does represent some level of knowledge</td>
</tr>
<tr>
<td>4 - Scientific minor justification</td>
<td>5 - Scientific with justification</td>
<td>vague but correct response showing incomplete knowledge with no connections.</td>
<td></td>
</tr>
<tr>
<td>4 - Scientific minor justification</td>
<td>5 - Scientific with justification</td>
<td>correct response but provides minor explanation/ justification with no misconceptions</td>
<td></td>
</tr>
<tr>
<td>In depth knowledge</td>
<td></td>
<td>response contains all parts of a scientific answer</td>
<td></td>
</tr>
<tr>
<td>Criterion</td>
<td>Task 1: Circle all the animals that are living or were alive at one time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>---------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level</td>
<td>Criterion</td>
<td>Notes</td>
<td></td>
</tr>
<tr>
<td>3 - Scientifically accurate</td>
<td>• all the correct items are circled (dog, pig, and dinosaur)</td>
<td>Dividing this into correctness will be important later if focusing on answers (themes)</td>
<td></td>
</tr>
<tr>
<td>2 - Partially scientific</td>
<td>• At least one of the correct items are circled (dog, pig, or dinosaur)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 - Incorrect/Scientific Misconceptions</td>
<td>• incorrect items circled (rock) • no correct items circled • all items circled</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 - No score</td>
<td>• no objects circled, or corrections so messy that it is not possible to decipher which items have a circle around them</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Task 2: Circle all the animals that are not real</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>Criterion</td>
</tr>
<tr>
<td>3 - Scientifically accurate</td>
<td>• all the correct items are circled</td>
</tr>
<tr>
<td>2 - Partially scientific</td>
<td>• at least one of the correct items is circled (unicorn or dragon)</td>
</tr>
<tr>
<td>1 - Incorrect/Scientific Misconceptions</td>
<td>• incorrect items circled, but no correct items circled • all items circled</td>
</tr>
<tr>
<td>0 - No score</td>
<td>• no items circled, or corrections so messy that it is not possible to decipher which items have a circle around them</td>
</tr>
<tr>
<td>Criterion</td>
<td>Task 3: What must animals have to survive?</td>
</tr>
<tr>
<td>-----------</td>
<td>----------------------------------------</td>
</tr>
</tbody>
</table>
| **5 - Scientific with justification** | • Animals need food from other animals and plants  
• Water from the environment  
• Shelter- to protect them from the natural predators and weather.  
• Air or space- need to breathe air/need space in which to live | Need as a minimum food and water as answers to meet NGSS requirements |
| **4 - Scientific minor justification** | • food, may say from other animals and/or plants, or name specific food for specific animal  
• water, may say from the environment  
• must include 3 of 4 needs  
Must include some justification with answer ("from the environment") | Need as a minimum food and water as answers to meet NGSS requirements |
| **3 - Partially Scientific Notion** | • Answer includes food or water or another need (i.e., space, shelter, air) may be given  
• answer includes both food and water  
• answer may include specific shelter (i.e., barn, nest, hole, grass, clover, fish) or food;  
• Answer does not include incorrect information (i.e. owners, friends, etc)  
• Answer is general with no justification ("from the environment") | |
| **2 - Partial Scientific with misconceptions /Nonscientific Fragment** | • Answer includes food or water or another need (i.e., space, shelter, air) may be given  
• may include specific food or shelter (i.e., barn, nest, hole)  
• answer MAY include both food and water  
• Answer includes some incorrect information (i.e. owners, friends, etc.) | incorrect: teleological, type of misconception: i.e. preconceived notion |
| **1 - Incorrect/ Scientific Misconceptions** | • answer may include other needs that are incorrect  
• answer is incorrect, but information is given in an understandable manner  
• answer is basic, vague, or incomplete | |
| **0 - No Understanding** | • No response  
• unclear response  
• cannot decipher writing or drawing | |
<table>
<thead>
<tr>
<th>Criterion</th>
<th>Task 4: Can a fish live on land? Write yes or no, then give some reasons</th>
<th>Notes</th>
</tr>
</thead>
</table>
| **5 - Scientific with justification** | • answer includes **both** water and no appendages  
• child identifies 2 or more characteristics regarding fish that make them appropriate for water | Need as a minimum fish need water and have no appendages to hold them up on land to meet NGSS requirements |
| **4 - Scientific minor justification** | • answer includes **both** water and no appendages  
• child identifies 1 or more characteristics regarding fish that make them appropriate for water | Need as a minimum fish need water and have no appendages to hold them up on land to meet NGSS requirements |
| **3 - Partially Scientific Notion** | • answer includes water or no appendages  
• child MAY identify one characteristics regarding fish that make them appropriate for water  
• no incorrect information  
• answer MAY be general w/no justification. ("can't live on land" "can't breathe") | |
| **2 - Partial Scientific with misconceptions /Nonscientific Fragment** | • answer includes water or no appendages  
• some portion of fragment is correct  
• answer may include incorrect information  
• Answer is very vague/basic (i.e. can't survive" "it will die") | |
| **1 - Incorrect/ Scientific Misconceptions** | • answer does not include water or no appendages  
• answer is incorrect, but information is given in an understandable manner  
• student only writes "no" | |
| **0 - No Understanding** | • No response  
• unclear response  
• cannot decipher writing or drawing  
• unable to evaluate/analyze | |
<table>
<thead>
<tr>
<th>Criterion</th>
<th>Task 5. Draw a line to connect the animal to the food it eats</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level</strong></td>
<td><strong>Criterion</strong></td>
<td><strong>Notes</strong></td>
</tr>
<tr>
<td><strong>3 - Scientifically accurate</strong></td>
<td>• all the items are correctly connected</td>
<td></td>
</tr>
<tr>
<td><strong>2 - Partially scientific</strong></td>
<td>• at least one of the items is correctly connected to its food</td>
<td>Dividing this into correctness will be important later if focusing on answers (themes)</td>
</tr>
<tr>
<td></td>
<td>• answer incorrect, but may be possible (e.g., fish connected to fly)</td>
<td></td>
</tr>
<tr>
<td><strong>1 - Incorrect/Scientific Misconceptions</strong></td>
<td>• incorrect items connected, but no correct items connected</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• answer may be possible, but not probable (e.g., frog connected to fish)</td>
<td></td>
</tr>
<tr>
<td><strong>0 - No score</strong></td>
<td>• no items connected, or connections so messy that it is not possible to decipher which items are connected</td>
<td></td>
</tr>
<tr>
<td>Criterion</td>
<td>Task 6: Draw an animal in its natural habitat. Draw other animals and plants that live there.</td>
<td>Notes</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Level</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>5 - Scientific with justification</strong></td>
<td>• drawing must include a real animal living today</td>
<td>Need as a minimum food and water as answers to meet NGSS requirements</td>
</tr>
<tr>
<td></td>
<td>• must be drawn accurately (e.g., 4 legs if dog)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• animal must be in authentic, natural environment in which it lives</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• sun in drawn in sky</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• some food source must be drawn (plant or animal, depending on animal drawn)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• must have at least 2 or more other real animals that would live in the environment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• must have at least 2 or more plants that would live in the environment</td>
<td></td>
</tr>
<tr>
<td><strong>4 - Scientific minor justification</strong></td>
<td>• drawing must include a real animal living today</td>
<td>Need as a minimum food and water as answers to meet NGSS requirements</td>
</tr>
<tr>
<td></td>
<td>• must be drawn accurately (e.g., 4 legs if dog)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• must include 1 or more other real animals that would live in the environment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• must include 1 or more other plants that would live in the environment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• some food source must be drawn (plant or animal, depending on animal drawn)</td>
<td></td>
</tr>
<tr>
<td><strong>3 - Partially Scientific Notion</strong></td>
<td>• drawing must include a real animal living today</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• some part of the drawing must be accurate;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Some food source must be drawn (plant or animal, depending on animal drawn)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• parts may be missing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• does not include inaccurate information, only missing information</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• must be drawn somewhat accurately (e.g., 2 legs instead of 4 if dog)</td>
<td></td>
</tr>
<tr>
<td><strong>2 - Partial Scientific with misconceptions/Nonscientific Fragment</strong></td>
<td>• drawing must include a real animal living today</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• some part of drawing must be accurate and least 1 part of question is depicted in drawing (i.e. plant, animal, or shelter)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• parts are missing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• some part of drawing MAY be inaccurate (e.g., unnatural characteristics or colors)</td>
<td></td>
</tr>
<tr>
<td><strong>1 - Incorrect/Scientific Misconceptions</strong></td>
<td>• drawing is inaccurate</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• parts are missing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• information given is incorrect (e.g., horses eat fish)</td>
<td></td>
</tr>
<tr>
<td><strong>0 - No Understanding</strong></td>
<td>• No response</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• unclear response</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• cannot decipher writing or drawing</td>
<td></td>
</tr>
</tbody>
</table>
### Task 7. Draw a line to connect each animal to its habitat.

<table>
<thead>
<tr>
<th>Level</th>
<th>Criterion</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 - Scientifically accurate</td>
<td>• all the items are correctly connected</td>
<td></td>
</tr>
<tr>
<td>2 - Partially scientific</td>
<td>• at least one of the items is correctly connected to its habitat</td>
<td>Dividing this into correctness will be important later if focusing on answers (themes)</td>
</tr>
<tr>
<td></td>
<td>• answer incorrect, but may be possible (e.g., deer in pasture)</td>
<td></td>
</tr>
<tr>
<td>1 - Incorrect/Scientific Misconceptions</td>
<td>• incorrect connections made, but no correct connections</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• answer may be possible, but not probable (e.g., bee connected to pond)</td>
<td></td>
</tr>
<tr>
<td>0 - No score</td>
<td>• no items connected, or corrections so messy that it is not possible to decipher which items are connected</td>
<td></td>
</tr>
</tbody>
</table>
The Field Trip Project

Teacher Interview Protocol

Supplies needed:
- Digital audio recorder, extra batteries
- Paper, pencil

Part I. Thank you!
First, thanks so much for participating in the study. I cannot tell you how much I appreciate everything you have done to make this study happen. I learned so much and I can't wait to write it all up.

Part II. Why the interview?
I wanted us to meet and debrief about the experience of using the Growing Up WILD curriculum, NSTA books, and assessment in your classes. As I mentioned previously, the objective of the study was to enhance classroom learning with the use of a field trip and nature-based activities in the classroom. The children's pre-post tests will give me some information, but I really want to hear your perspective as teachers.

Part III. Questions
I have some questions written down that I want to make sure and ask you, but I really just want you to share your thoughts about this experience. I am going to turn on the audio recorder now so that I capture everything we talk about. Here are the questions, but please feel free to make any comments or ask any questions at anytime.

1. What did you think of the Growing Up WILD curriculum? Was it difficult to implement with your children? Did you find the selected activities beneficial to your children? Do you think the children enjoyed GUW activities?

2. Did participation in this study help you meet science learning standards in your classroom? Did GUW activities help you meet science standards? Did KCG field trip activities help you meet science standards?

3. Are there other curricular activities you've used in the past to prepare children for learning on a field trip? If so, what kind of materials/curricula?

4. Will you use the GUW curriculum in your classroom after this study? If yes, will you use it just in combination with field trips or for other purposes?

5. GUW is an environmental education curriculum. Are you familiar with any other environmental education curricula? How familiar are you with environmental education in general? What are your thoughts about environmental education? Would you feel supported to use such curricula in your classroom on a regular basis?
# Classroom Observation Protocol

## Classroom Information

<table>
<thead>
<tr>
<th>Observer</th>
<th>Date</th>
<th>Obs time begin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
<td>Time</td>
<td>Obs time end</td>
</tr>
<tr>
<td>Teacher</td>
<td>Grade</td>
<td>Total obs time</td>
</tr>
<tr>
<td>Observer type</td>
<td>Children Present</td>
<td>Children Absent</td>
</tr>
</tbody>
</table>

| Lesson Activity Title | Book Title | Other Activity (describe) |

1. **Alignment to warm-up activities in lesson plan**  
   - [ ]  
   - A: All taught  
   - M: Most taught  
   - S: Some taught  
   - N: Not taught

   **1. Comments:**

2. **Alignment to main activities in lesson plan**  
   - [ ]  
   - A: All taught  
   - M: Most taught  
   - S: Some taught  
   - N: Not taught

   **2. Comments:**
3. What was the level of student engagement in the lesson?

Notes:

1. Disruptive disengagement. Students were frequently off task, as evidenced by gross inattention or serious disruptions by many. This was the central characteristic during much of the class.

2. Passive disengagement. Students appeared lethargic and were only occasionally on task carrying out assigned activities. For substantial portions of time, many students were either clearly off task or nominally on task but not trying very hard.

3. Sporadic or episodic engagement. Most students, some of the time, were engaged in class activities, but this engagement was inconsistent, mildly enthusiastic, or dependent on frequent prodding from the teacher.

4. Widespread engagement. Most students, most of the time, were on task pursuing the substance of the lesson. Most students seemed to take the work seriously and were trying hard.

Approximate percentage of time spent on

<table>
<thead>
<tr>
<th>Activity</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>12. Teacher-led/whole-group instruction</td>
<td></td>
</tr>
<tr>
<td>13. Individual work time</td>
<td></td>
</tr>
<tr>
<td>14. Group work time</td>
<td></td>
</tr>
<tr>
<td>15. Other (not research related)</td>
<td></td>
</tr>
</tbody>
</table>
REFERENCES


Association for Psychological Science. (2008). What does it mean to be alive? 

*ScienceDaily*, 29. Retrieved from 

[https://www.sciencedaily.com/releases/2008/04/080428104529.htm](https://www.sciencedaily.com/releases/2008/04/080428104529.htm)


President’s Council of Advisors on Science and Technology (PCAST). (2010). *Prepare and inspire: K-12 science, technology, engineering, and math (STEM) education for America’s future K-12*. Retrieved from https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/pcast-stemed-report.pdf


Duram. Retrieved from


https://unesdoc.unesco.org/notice?id=p%3A%3Ausmarcdef_0000017772&queryId=6ee17378-ee93-4665-a3d5-3f1174837ddc&posInSet=1


https://unesdoc.unesco.org/ark:/48223/pf0000032763


https://arboretum.ca.uky.edu/content/field-trip


VITA

EDUCATION
M.S. Spalding University Social Work 2000
B.S. Western Kentucky University Social Work 1999

PROFESSIONAL EXPERIENCE
2015-present University of Kentucky: Graduate Assistant
2013-2015 University of Kentucky: Evaluation Center Assistant Director
2005-2015 University of Kentucky: Research Coordinator

SCHOLASTIC PROFESSIONAL HONORS
2019 Nietzel Distinguished Faculty Program recipient
2018 Graduate Admission and Selection Committee: $2000
Department of Early Childhood, Special Education, & Rehabilitation Counseling
University of Kentucky College of Education
2018 Graduate Admission & Selection Committee: $1,699
Department of Early Childhood, Special Education, & Rehabilitation Counseling
University of Kentucky College of Education
2018 Graduate Student Congress Research Award: $300
University of Kentucky Graduate School
2018 The Arvle and Ellen Turner Thacker Research Fund: $1,000
University of Kentucky College of Education
2018 The A. Edward and Anita Blackhurst Student Research Fund: $1,000
University of Kentucky College of Education

PROFESSIONAL PUBLICATIONS
Gravil, M., & Reynolds, K. (2016). Creating crosswalks to bridge formal and informal
learning experiences. Phi Delta Kappan Common Core Writing Project,
KappanCommonCore.org
quality for children with and without disabilities. Early Education &
Development, 21(1), 21-37.

MARY M. GRAVIL