Practical Art Projects Related to Children’s Picture Books about Ecology

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Abstract
This study presents art projects that reinforce scientific content presented in children’s picture books about ecology. Ten K-6 students from varying socioeconomic classes, and different cultural and language backgrounds from the United States and Spain participated. Next Generation Science Standards were identified and addressed in these art projects. Students’ understanding and engagement were evaluated through teacher observations, photographs, and a student attitude survey. Upper- and lower-elementary students evidenced increased understanding of environmental issues, and high level of enjoyment and engagement through these art projects integrated with science content. Researchers encourage educators to incorporate picture books and art in science lessons to increase student engagement and scientific learning while meeting various standards.

Key Words
NGSS, environmental education, ecology-themed children’s picture books, art projects, book content analysis, literature-based science lessons, art-infused science lessons

Introduction

This project aimed to positively impact the quality of literature-based, art-infused science instruction in the elementary classroom. Research shows that students learn science best when it is integrated with other curriculum areas such as literature and art (Ansberry & Morgan, 2010; Hardiman, Rinne, & Yarmolinskaia, 2014; Mantei & Kervin, 2014).

This paper presents a practical article documenting example art-science integrated projects related to ecology picture books. A companion research article published also in this issue of the Journal titled, “A content analysis of thirty children’s picture books about ecology,” by Martin, Hageman Montgomery, and Rule (2019) provides a strong research foundation from the literature for the use of picture books in teaching science. The content analysis in that report (Martin et al., 2019) rates thirty recent ecology picture books on twelve important characteristics. The reader may wish to access this paper for further information not contained in this practical article. The current practical article presents follow-up art projects that reinforce the content or message of the books and support a Next Generation Science Standards performance standard.
Practical Art Projects Related to Ecology Picture Books

Literature Review

Visual Arts and Student Science Learning

In addition to enhancing student learning of scientific concepts, children’s picture books can serve as a springboard to infuse art into science lessons. Not only do the illustrations included in books offer an opportunity for children to explore art, but also art-based activities can be used as a way of reinforcing, enhancing, and assessing student learning of science concepts while keeping in line with state standards.

In research designed to understand the role of visual arts in the teaching and learning of science to Grade 3 students, Dhanapal, Kanapathy, and Mastan (2014) found that the usage of visual arts increased student motivation to learn science as they enjoyed the freedom of choosing their preferred form of art to express their learning of science. Furthermore, visual arts and science both promote discovery learning (Alberts, 2010). Integrating science and visual arts allows students to explore and discover the world on their own, and engage in artistic science projects that enhance their imagination, higher-order thinking skills, creativity, and knowledge of both art and science.

Mantei and Kervin (2014) argued for a pedagogical approach that creates opportunities for children to make text-to-text connections by responding to picture books through meaningful discussions and visual art (p. 89). The authors contended that student-created artworks support student expression or funds of knowledge, “historically accumulated and culturally developed bodies of knowledge and skills essential for household or individual functioning and well-being,” that students bring to the classroom (Moll, Amanti, Neff, & González, 1992). According to Mantei and Kervin (2014), teachers should capitalize on this prior knowledge in order to take informed pedagogical approaches that build on existing knowledge and life values. In this regard, the interaction between word and image in picture books creates a supportive meaning-making environment that motivates readers to engage in meaningful discussions and helps them achieve new levels of understanding (Mantei & Kervin, 2014, p. 77).

Greater Long-term Learning of Science Content

Evidence of how arts-integrated curricula affect students’ long-term retention of content has been shown through a study conducted by Hardiman et al. (2014) in which control and experimental conditions were used. The authors contended that the knowledge and skills gained through in-school artistic activities may improve content learning and student outcomes more broadly, leading to success in other academic domains (Hardiman et al., 2014, p. 144). Moreover, the authors argued that arts-based curricula improve retention by prompting students to rehearse content through visual and performing arts activities. Results showed that students had learned roughly the same volume of science content regardless of how the units were taught. However, scores on distal posttests administered two months after each unit indicated that students retained what they learned significantly better when instruction was integrated with the arts, particularly students at the lowest levels of reading achievement (Hardiman et al., 2014, p. 147).

Arts-Integrated Science Projects

Arts-integrated science projects can take multiple forms. These multiple forms can take shape in a model built to demonstrate science and engineering practices in the NGSS, or it can be seen in a poster crafted to show crosscutting concepts. In their article titled “Pop-Up constructions motivate and reinforce science learning for upper elementary students,” Olsen, Zhbanova, Parpucu, Alkoury, and Rule (2013) outlined the efficacy of arts-integrated science lessons and the educational value of pop-up constructions. Art activities designed to summarize previous learning provide students with meaningful and engaging opportunities to organize, deepen, solidify, and demonstrate their understanding of concepts (Olsen et al., 2013, p. 120). This study stressed how pop-up constructions support inquiry-based learning, science and engineering practices emphasized by the National Research Council (National Research Council, 2011), and Next Generation Science Standards (Achieve, Inc., 2013). In addition to reinforcing cognitive abilities and supporting science standards, pop-up constructions also address English Language arts standards (Common Core State Standards...
Initiative, 2012) and support student creativity and curiosity (Olsen et al., 2013, p. 121). Furthermore, the authors pointed to the relevance of creativity as a crucial 21st-century skill which, according to Torrance and Safer (1990), can be integrated with the content of all school subjects. Classroom testing along with observations made by teachers during student work provided sound evidence that the lessons outlined in this study led to a raised awareness of environmental issues, resulting in students taking action. Similarly, students demonstrated creativity and enjoyment in their participation in pop-up activities and environmental lessons, which in turn enabled them to exercise fine motor skills and develop spatial skills and concepts of paper engineering (Olsen et al., 2013, p. 130).

Extensive literature supports the infusion of literature and art into science lessons through the use of books and art-based activities; however, such integration does not happen very often. To assist elementary school teachers and librarians in informing students of the world’s environmental problems, instilling in them an attitude of caring for the earth, and motivating them to be active agents of change, Rule and Atkinson (1994) presented an analysis of children’s picture books with ecology themes in their article “Choosing Picture Books about Ecology.” Our current practical article is a companion to a new content analysis that presents a new look on the study by Rule and Atkinson (1994), and engages in an examination of ecology-themed picture books both in English and Spanish, including pictorial information books, published from 1994 to present. Suggestions for art and construction projects that reinforce the content or message of highly-rated books and support NGSS science or engineering standards are provided in this current practical article. It is our hope that these two papers may assist elementary school teachers in the process of selecting appropriate children’s picture books with ecology themes that will help enhance student science learning. The main question this practical article addresses is: What art activities might be used in conjunction with highly-rated books to reinforce content and comprehension?

Hands-on activities can be used to motivate students and provide opportunities for them to reinforce and showcase their learning. The authors offer ideas for art integration into literature-based science learning that allow children to consolidate their understanding, and teachers to gain insight into students’ learning. Art projects that support scientific concepts addressed in selected books are described and linked to the NGSS. Students’ understanding is gauged through teacher observations of students while conducting the art activities.

The Design of the Lessons and Analysis

The authors generated activities and art projects that reinforce the content or message of the books and support a NGSS science or engineering standard. Teacher-made examples of art activities were produced, and observations of students’ performance in creating their artwork and comments about enjoyment of the activity were collected and documented. In addition, a student attitude survey and a follow-up interview were administered after the lesson and used to determine enjoyment of the activities.

Setting and Participants

Participants were ten K- Grade 6 students recruited in the Midwest and East Coast regions of the United States and Southern Spain. These students were of different socioeconomic classes and had different cultural and language backgrounds. Conducting the study with different populations of students allowed researchers to examine the science learning potential and pitfalls (both verbal and visual) of literature-based, art-infused science lessons.

Five students were from the Midwest region of the United States. There were four males and one female. One male and one female from this region were fluent in English and Spanish and were half Guatemalan. The three remaining males were White. All Midwest region children were from middle class families. Three students were from the East Coast region of the United States. This set of students was composed of two females and one male, all White, from an upper-middle class neighborhood. Two students had Spanish as the primary spoken language at home and one is bilingual. The last set of students was from Spain from middle class families. There were one male and one female, both White, and with Spanish as the primary spoken language.

The Internal Review Board Human Subjects Committee of the overseeing university approved this study.
Given the fact that the researchers did not have a permanent classroom at the time of the study, friends and relatives with children in the K-Grade 6 range were approached and invited to participate. The parents of five students were approached on the phone, whereas the remaining five families were invited via Skype. All students whose art projects are featured in this paper were fully informed about the study, and provided signed parent and student consent to participate prior to the study. Arrangements were made to conduct the art projects that were designed for the study and directly align to a Next Generation Science Standard for Ecology. A set of three students participated at the home of one of the researchers and two participated via Skype, whereas the children recruited via Skype participated remotely from their homes. The researcher met via Skype with the students and their parents, who served as helpers assisting the children in completing their art projects, taking notes of children’s comments regarding their projects, and taking photographs.

**Data Collection and Instrumentation**

Students’ understanding, creativity, and active engagement were evaluated through teacher observations and photographs taken while reading and working on the artwork projects. Additionally, a student attitude survey and a follow-up interview were administered after students had produced their artwork. See Table 1 for the student attitude survey.

**Table 1. Student Attitude Survey Questions**

<table>
<thead>
<tr>
<th>Attitude Survey Questions</th>
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<tr>
<td>1. Did you like the ecology book? Why or why not?</td>
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<tr>
<td>2. What was the best part or aspect of the book?</td>
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<tr>
<td>3. Did you enjoy the artwork today? Why or why not?</td>
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<tr>
<td>4. What could be changed about the art project to make it more fun or meaningful?</td>
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**Choice of Books for the Lessons**

A companion research paper, published also in this issue of the *Journal of STEM Arts, Crafts, and Constructions*, presents a detailed content analysis of the children’s ecology picture books (Martin et al., 2019). Please refer to that paper for book ratings. In addition to the book analysis, teacher observations, photographs, a student attitude survey, and a follow-up interview were used to gauge student understanding, enjoyment, creativity, and active engagement in art projects. This paper presents the students’ reading and art experiences.

Once the book content analysis part of the study was completed, five highly-rated books were selected by the researchers for use in arts-integrated lessons. It must be noted that there were multiple books with the same overall mean score and, therefore, they were ranked in the same place. The first book from the study’s list that was chosen was *One well: The story of water on Earth* (Strauss, 2007). Written by Rochelle Strauss and illustrated by Rosemary Woods, *One well: The story of water on Earth* (Strauss, 2007) had an Overall Mean Score (OMS) of 4.8 and tied for 1st place in the study’s overall ranking. This book has received many awards and acknowledgements, including: 2008 - Information Book Award, Children’s Literature Roundtables of Canada, Winner; 2008 - Green Prize for Sustainable Literature, Santa Monica Public Library, Winner; 2008 - Sigurd F Olson Nature Writing Award for Children’s Literature, Winner; 2008 - Notable Books for a Global Society, International Reading Association, Winner; 2008 - Silver Birch Award, Ontario Library Association, Short-listed; 2007 - Book of the Year, ForeWord...
Magazine, Short-listed; 2007 - International Book Award, The Society of School Librarians International, Winner; and 2007 - Notable Social Studies Trade Books for Young People, CBC, Winner. These awards helped to further acknowledge the book’s place on the study’s list and provided a reason to develop an art project using it.

The next book from the study’s list that was selected was *A place for turtles* (Stewart, 2013). Written by Melissa Stewart and illustrated by Higgins Bond, *A place for turtles* (Stewart, 2013) was given an OMS of 4.8 and tied for 1st place in the study’s overall ranking. This book has also received awards and acknowledgements, including: 2014 - Green Earth Book Award, Children’s Nonfiction, Winner; 2014 - Sigurd F. Olson Nature Writing Award, Children’s Category, Winner; 2014 - Outstanding Science Trade Books for Students K12, Winner; 2014 - Alabama Camellia Children’s Choice Award, Nominee; and 2014 - Delaware Diamonds, Nominee. One of these awards was from the National Science Teachers Association, which is one of the science websites the researchers used to validate their choice of books. This award and the overall enjoyment of the researchers while reading the book provided the reason for choosing it for an art project.

The third book from the study’s list that was chosen, *How to help the Earth by the Lorax* (Rabe, 2012), was written by Tish Rabe and illustrated by Christopher Moroney. This book was given an OMS of 4.5 and tied for 4th place in the study’s overall ranking. This title may not have won any awards, but was chosen for the notoriety of the main character, the Lorax, and the overall enjoyment and science connections noted by the researchers.

The fourth book from the study’s list that was selected was *Oil spill!* (Berger, 1994), written by Melvin Berger and illustrated by Paul Mirocha. *Oil spill!* (Berger, 1994) was given an OMS of 4.4 and tied for 7th place in the study’s overall ranking. Melvin Berger’s book has not received any awards, but was chosen for its scientific content and the distinction of being the oldest book on the study list, being written in 1994.

The fifth and final book from the study’s list that was chosen for art projects was the researchers’ Spanish selection: *Nuestro planeta en peligro/Our planet in danger* (Grant, 2008). This book was written and illustrated by Donald Grant and received an OMS of 4.0, tying for 13th place. *Nuestro planeta en peligro/Our planet in danger* (Grant, 2008) has no formal ratings or awards but was chosen by the researchers due to the publishing company itself, as it is known for publishing high-quality picture books of the most representative authors and illustrators around the world. Many schools in Spain are loyal to this publisher which has a long tradition of publishing and specializes in juvenile and children’s literature. Additionally, while *Nuestro planeta en peligro/Our planet in danger* (Grant, 2008) ranked in 13th place based on the overall mean score, it ranked 2nd among the books available in Spanish and English that were included in this project. Because identifying what children’s picture books with ecological theme are available in Spanish is one of the questions that drove this study, researchers decided that an example of a book in Spanish should be used in the art section of the project.

### The Reading and Art Integrated Lessons

Art projects to accompany the books and teacher-made examples of artwork were generated by the researchers. The art projects involved in this study are similar to typical day-to-day school activities and directly align to Next Generation Science Standards for Ecology (See Appendix for full lesson plans).

#### Researcher 1’s Lessons

Arrangements were made to conduct the art project sessions designed for the study. The children recruited via Skype participated remotely from their homes. Prior to the lessons, *A place for turtles* (Stewart, 2013) and *Nuestro planeta en peligro/Our planet in danger* (Grant, 2008) were made available to parents through Dropbox, whereas the parents of the kindergarteners were provided with a YouTube link for *How to help the Earth by the Lorax* (Rabe, 2012). Three meetings occurred via Skype, one with a fourth-grade student—who worked with *A place for turtles* (Stewart, 2013)—another one with a second-grade student—who read *Nuestro planeta en peligro/Our planet in danger* (Grant, 2008)—and the last one with three kindergarten students—who worked with *How to help the Earth by the Lorax* (Rabe, 2012). Parents were present during the lessons and served as helpers assisting the children in completing their art projects, taking
notes of children’s comments about enjoyment and understanding, and taking photographs.

In each lesson, the conductor read the book to the children while they observed the book illustrations. Discussions occurred during the reading of the books that provided insight into children’s understanding and enjoyment. Additionally, children were given plenty of time to look at the artwork and enjoy it. Once the books had been read and discussed, students engaged in art projects that reinforced the content or message of the stories. For A place for turtles (Stewart, 2013), the student created a 3D turtle shell. She was given the task to generate a 3D cardboard model of a turtle shell that resembled the 3D print models that have been used for turtles that had had their shells broken. Following the steps provided by the teacher, the student created her 3D turtle shell. Then, using markers, colored pencils, crayons, or acrylic paint, she decorated it like any of the turtles shown in the book. Through the book and art project, the student learned that the main function of the turtle shell is the protection of the turtle, and how making replacement shells helped those turtles that had been harmed survive. The student was able to understand that turtles have external structures that function to support survival, which directly connects with the NGSS 4-LS1-1. The turtle shell project also supported the NGSS 3-LS3-2, as the student decided to make the shell of a Western Pond Turtle and, therefore, it had to be flat since these turtles live in lakes. This decision to make a flat turtle shell for a Western Pond Turtle demonstrated the child’s understanding that turtles’ traits can be influenced by the environment.

The art project designed for Nuestro planeta en peligro/ Our planet in danger (Grant, 2008) involved making a Rainforest Diorama that was a representation of the ecosystem the child read about in the book. Using a variety of materials including a shoebox, construction paper, craft foam, felt, natural elements, crayons, and acrylic paint, the student created trees, plants, and animals that live in a rainforest ecosystem. Through the reading and art experience, the student learned aspects of the NGSS K-ESS2-2, K-ESS3-1, and 3-LS4-3. For example, the student became aware of how certain organisms can thrive in a rainforest habitat while others cannot survive well or cannot survive at all (3-LS4-3).

In addition, each student learned how the huge amount of rainfall, the lack of seasonal variations, and the high temperatures of the tropical rainforest support the growth of trees that stretch ever higher (K-ESS3-1). In turn, these tall trees create a canopy well above the ground and a shady damp environment below (K-ESS2-2) that offers a home for some organisms that have adapted to the climate below the canopy like certain plants that grow on the branches or trunks of the large trees (K-ESS3-1).

The last of the books with which researcher 1 worked was How to help the Earth by the Lorax (Rabe, 2012). Students created an Ocean Ecosystem using multiple materials. Egg cartons, craft foam, pipe cleaners, googly eyes, glue, and Play-Doh were used by the children to create sea animals. The students were given the freedom to decorate their sea creatures using acrylic paint as they wished, and to produce an ocean scene using multiple materials including egg cartons, sand, marbles, rocks, empty rolls of kitchen towels, and their sea animals. By creating a model of an ocean ecosystem where both land and sea animals were used, students expressed their understanding of the relationship between the needs of different plants and animals and the places they live, hence supporting aspects of the NGSS K-ESS2-2. Similarly, connections to the NGSS K-ESS3-3 were made during the reading and art creation as students communicated solutions to problems related to the impact of humans on the land, water, and other living things in the environment.

At the conclusion of the art projects, students were prompted to explain what their artwork represented and how it was connected to the book, which supported children making connections between the different parts of the lesson. Additionally, students’ description and explanation of their art work supported aspects of Common Core Literacy Standards related to reading and communicating (Common Core State Standards Initiative, 2012). Students’ comments about enjoyment of the activity and understanding of content were collected and documented throughout the lessons, and then analyzed.

Figure 1 through Figure 7 show the example art projects made by the teacher. The next section discusses the attitude survey results followed by a section describing teacher observations, student interviews results, and student artwork.
Figure 1. Teacher-made cardboard turtle shell

Figure 2. Teacher-made Rainforest Diorama

Figure 3. Teacher-made ocean ecosystem

Figure 4. Oil spill (food coloring) before adding soap

Figure 5. Oil spill right after adding soap

Figure 6. Oil spill 15 minutes after adding soap
Analysis of student attitude surveys. Two closed-ended items included in the student attitude survey that was administered after completion of the art projects required students to respond Yes or No. Two open-ended items prompted them to follow up their yes or no with a narrative response. Additionally, two open-ended questions required students to provide insights and ideas regarding their reading and art experience (See Table 1 for student attitude survey).

An analysis of the student surveys indicated that all students liked the ecology book that was presented. Three of five children stated that they liked the book because they were able to learn about the topic being discussed, one child noted that he liked the main character, and another student commented that she liked that the book “is good for nature.” When students explained the part or aspect of the book that they liked the best, two children showed evidence of making personal connections with the story. For example, one child stated that he liked when the garbage was burning in How to save the Earth by the Lorax (Rabe, 2012) because he likes smoke, although he knew it is not good for the environment. Another student said that she liked the girl brushing her teeth because she also brushes her teeth. A third student explained that what she liked the best about the book was that she did not know that people burn garbage and she liked learning that. A fourth student noted that the best part of the book was when the characters were happy in Nuestro planeta en peligro/Our planet in danger (Grant, 2008), and a fifth child stated that the best part of A place for turtles (Stewart, 2013) was when it explained how zookeepers raise turtle hatchlings until they are large enough to live independently in their natural habitat. The last two students’ answers show the empathic arousal that the books generated.

Additionally, students reported great enjoyment of the artwork. When they were asked to explain why they enjoyed the art activity, most of the children said because they love art. One student stated he enjoyed the art activity because he liked that “it turned out very nice.” Two children out of five also expressed that their enjoyment stemmed from working with their friends. Similarly, all of the students expressed great pride in their work when they completed the art projects, and they all agreed that including additional items would make the art activities more meaningful or fun.

Teachers’ observations and follow-up interviews. During the art projects, the teacher wrote down her reflections and observations on students’ attitudes and comments. Overall, all of the students were eager to participate and were observed to enjoy their work throughout the activity.

Many positive comments were given that indicated the students clearly enjoyed the art project, such as “This is so much fun. I like painting with my brush”, “That’s cool! I want to do a rainforest like yours!”, and “This is so exciting! I love crafts and I love your turtle!” Not only do these comments evidence students’ eagerness to participate in the art projects, but also how these type of projects supports children becoming appreciators of others’ work. In a follow-up interview conducted after students had completed their art projects and surveys, the most frequent reason given for their enthusiasm referred to the freedom to create in their own way and at their own pace. One student explicitly stated that she liked “paint, and colors, and cutting, and I have a lot of imagination and can do a lot of stuff.” Another student expressed her disappointment at not having enough opportunities to be creative at school. Yet another student voiced her intention to share her artwork with her friends at
school. Comments such as that participants liked working with friends and using art materials were heard repeatedly, which are examples of the motivation and enthusiasm that the sharing, interaction, and exploration involved in art generates. While some students expressed their frustration at having difficulties creating their animals, they were thrilled about their projects and frequently noted they loved creating their own natural environment.

Researcher observations of facial expressions and body language during the lessons showed the pleasure students gained from the freedom and creativity of the art projects. Figures 8 and 9 show children who were highly enthused and engrossed during their art projects. In Figure 10 a student was creatively engaged in generating trees that she wanted to place near the water and she would not "let anyone to cut them." Figure 11 shows a child working on the ocean bottom. A student not pictured wanted to make a shark to include in their ocean habitat, but the student working on the ocean bottom refused to make any shark because she wanted her fish "happy and a shark will scare them."

Figure 8. Student working on his Amazon Rainforest Diorama

Figure 9. Student measuring and cutting small flaps to make the edges of a turtle shell

Figure 10. Student creating trees to be placed near the water

Figure 11. Student painting the ocean bottom for ocean habitat
The teacher observed that no students needed redirecting, and all were on-task with creating their artwork. Likewise, the teacher noted that no particular student dominated the activity and children were disappointed when the lesson concluded. Moreover, some of the children expressed a strong desire to do another science/art lesson in the future. This cooperative spirit and request to repeat the experience are further examples of the happy flow of art activities, and the motivation and enthusiasm that the fulfilling work involved in art projects generate.

Students were extremely proud of their accomplishments and radiated that emotion while posing for pictures. In Figure 12, the children used Play-Doh to make different types of fish and found that making fish out of Play-Doh was easier and the fish looked nicer when compared to fish made out of egg carton. Figure 13 shows these students demonstrating their satisfaction and pride once their ocean habitat was completed. In Figure 14, the student is holding her example of a cardboard turtle shell. She used different tones of brown, green, and gold acrylic paint in an attempt to get as real a color as possible. The turtle shell was beautifully constructed and painted. The student had been working on it for over one hour, making it beautiful and trying different possibilities for color, so when it was complete, the enormous sense of accomplishment she felt was evident in her face. In Figure 15, the student was ecstatic and voiced that he would like to continue adding more animals and plants to his Amazon Rainforest.

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Figure 12. Students creating clay sea animals

Figure 13. Students taking pride in their completed artwork

Figure 14. Student showing her cardboard turtle shell

Figure 15. Student demonstrating a great sense of accomplishment after completing his rainforest diorama
In addition to the enjoyment and enthusiasm expressed during the creation of artwork, connections between the stories and accompanying crafts, and students’ real lives were made. Similarly, there was evidence that student learning about environmental issues occurred as a result of the book and art experience. Comments such as “I’m going to make a Western Pond Turtle...the shell needs to be flat because it lives in a lake” and “I’m going to tell my friends that they need to walk their dogs on a leash,” provide evidence that the story permitted the student to explore the endangered status of turtles, as well as learn about different types of turtles and their habitats at her developmental level. Other examples of students’ comments that show increased environmental awareness include “My mom gave my clothes to a child. That’s donating” and “I can put the rubber bands in the jar at school. Then, we always have rubber bands.” These remarks demonstrate students making connections between the story and their everyday lives, and understanding the importance that reusing and recycling have for the environment. Additionally, students’ answers to open-ended questions evidenced that they made connections between the reading and the art activities in which they participated. A student’s answer to the question “Why do you think we created an ocean environment?” was “Because the Lorax says we need to take care of fish.” This answer demonstrates that the child made the connection between what he learned from reading the book and the art project. Science learning had been made meaningful while allowing the student’s creativity to shine.

**Researcher 2’s Lessons**

The three art projects out of the five listed in the Appendix that Researcher 1 conducted with her students have been described previously—3D Turtle Shell, Rainforest Diorama, and Ocean Ecosystem. Researcher 2 conducted two separate sessions of the art projects with each group of students doing four out of the five arts-integrated projects, with an exception. The names used for the participating children are pseudonyms. The first group consisted of Hunter, Steve, and Angel. Angel and Steve live in a bilingual home, speaking English and Spanish. They were the exception and completed projects for *How to help the Earth by the Lorax* (Rabe, 2012)—Hanging Sea Life Display, *Oil spill!* (Berger, 1994)—Oil Spill Clean-Up Artwork, and *Nuestro planeta en peligro/Our planet in danger* (Grant, 2008)—Rainforest Diorama. The first art project they did was for *Nuestro planeta en peligro/Our planet in danger* (Grant, 2008) and was conducted in a similar way as Researcher 1 did. Students created rainforest dioramas as the second out of three stories in the book takes place in a rainforest.

The Hanging Sea Life Display based on *How to help the Earth by the Lorax* (Rabe, 2012) had three options for children to consider making and all involved recycling in some manner. Two of the projects were additions to accommodate the older children, Newspaper Fish and Paper Plate Sea Creatures. Hunter, Bob, and David also created this art project. They had egg carton sea creatures, newspaper fish, and paper plate fish as options to create. They chose egg carton sea creatures and paper plate fish to create. The Oil Spill Clean-Up Artwork based on *Oil spill!* (Berger, 1994) was the last project they created; Hunter, Bob, and David also completed this art project. This was more of a science experiment but it was also an expression of art. Milk was used as the “ocean,” food coloring was the “oil spill,” and the Dawn soap used reacted with the fat in the milk to push the “oil spill” away. This is comparable to how detergent helps break down the oil on animals when they are cleaned.

The second group’s meeting took place over Skype and consisted of Bob and David as participants. Hunter also completed these art projects. This group did four out of the five art projects. The first art project they worked on was with the book *One well: The story of water on Earth* (Strauss, 2007) — Mixed Media Collage. This was a mixed media art project about water pollution that used paint, magazine clippings, bottle cap sea creatures students created, and other materials if desired. The second project created was the previously mentioned Hanging Sea Life Display based on the book *How to help the Earth by the Lorax* (Rabe, 2012), which was a project all the children completed. The third project they worked on was based on *A place for turtles* (Stewart, 2013)—3D Turtle Shell—and was conducted in a similar way as Researcher 1. Children created a three-dimensional turtle shell model like those created by three-dimensional printers for real turtles when they have damaged shells. The fourth art project they created was the previously mentioned Oil Spill Clean-Up Artwork project based on *Oil spill!* (Berger, 1994).
Examples were produced of all the art projects prior to the students creating them. They served as a version of what they could create. Children were given the freedom to create whatever they desired in the scope of the art project. No student was instructed that the coloring had to be realistic or that they could not create something they wanted to. The following Figures 16 through Figure 25 are teacher-made art project examples designed by Researcher 2.

**Figure 16.** Oil spill made by Researcher 2

**Figure 17.** Teacher-made oil spill after addition of detergent

**Figure 18.** Teacher-made oil spill five minutes after addition of detergent

**Figure 19.** Three-dimensional turtle shell partly-made

**Figure 20.** Painting the turtle shell
Figure 21. Teacher-made woven newspaper fish

Figure 22. Teacher-made shark made from paper plate

Figure 23. Teacher-made egg carton sea creatures
Analysis of student attitude survey. After the art projects were completed, the students were given a student attitude survey (see Table 1 for survey) that asked four questions. The questions were a mixture of closed- and open-ended questions. All five children were given two closed ended questions: Did you enjoy the ecology books today? and Did you enjoy the artwork today? All five children answered yes to both questions. Three children even went as far as listing their favorite books.

Two children, Steve and Hunter, listed that *Oil Spill!* (Berger, 1994) was their favorite book because they liked the artwork in it. Angel preferred the rainforest book—*Nuestro planeta en peligro/ Our planet in danger* (Grant, 2008)—because she enjoyed that craft the most. David enjoyed the books because they were about water creatures and he wants to be a marine biologist when he grows up. Bob enjoyed the books because he liked learning about, “the pollution we are putting in the environment and how to stop polluting.” All but two of them liked the artwork because they thought it was fun. Steve was a big fan of the *Oil spill!* (Berger, 1994) artwork project; he mentioned, though, that it was all fun. David said it was fun and challenging, and Bob said it was fun. Angel enjoyed going outside and getting things to put in her rainforest diorama. Hunter said it was all very cool to make and “awesome to see what my friends made.”

The two other questions given were open-ended and had a variety of responses. The first open-ended question was: What was the best part or aspect of the book you liked best? Steve and Hunter referred to the projects that accompanied the book *Oil spill!* (Berger, 1994) as their favorite part. The other three children referred to parts in the book, or the overall topic. Angel enjoyed the toucan character in *Nuestro planeta en peligro/ Our planet in danger* (Grant, 2008). Bob enjoyed the Lorax character in *How to help the Earth by the Lorax* (Rabe, 2012) and liked that it shared how to help trees. David liked that all the books were about water creatures and pollution. The last question the children answered was: What could be changed about these art projects to make them more fun or meaningful? Two of the children, Angel and Hunter, said they liked all the artwork and no changes needed to be made. Steve liked all the artwork but wanted to make more. Bob said that no changes needed to be made. However, David said that he would like the topics to be about something other than pollution.

Teacher’s observation; follow-up questions; and student enjoyment/engagement/creativity. The first session with Angel, Steve, and Hunter started with *Nuestro planeta en peligro/ Our planet in danger* (Grant, 2008). While Angel and her mother read the book in Spanish, the researcher went over the book in English with Steve. He had been exposed to Spanish in his home, but he felt more comfortable reading the story in English. After the book was finished, this group talked about the story and how their favorite character was the toucan. The researcher made the
choice to only read the story “Toco, La Selva Herida (Toco, 
the Wounded Jungle)” out of the three stories in Nuestro 
planeta en peligro/Our planet in danger (Grant, 2008). This 
decision was made because of the content of the book and 
the possibility of it being overwhelming to young readers. The 
section chosen was the least overwhelming of the three.

Steve and Angel liked the chance to go outside and 
gather objects to use in their dioramas. Angel found some 
moss, sticks, and half a walnut shell to use. Steve also found 
some moss and sticks to use in his diorama. Since Hunter 
was not doing this project he enjoyed being outside and 
helping Steve and Angel gather items. They also gathered 
some rocks, but never used them in their project. Even though 
a monkey was not shown in the book, Steve created one to 
use in his diorama. He also used a toucan as that was his 
favorite character from the story. See Figures 26 and 27. He 
was a big fan of the very large googly eyes and used them 
with every project that needed eyes. See Figure 28. When 
asked why he wanted to use them he said, “Because they are 
so silly and fun, I want to use them on everything.” He also 
used sticks but chose to lay them down to show they were cut 
down, just like they were in the book. He made a section that 
had oil because he said the machines left oil. While this was 
not in the book, it shows a connection with the knowledge of 
pollution that Steve had prior to working on the project.

Angel used her walnut shell to create a turtle. See 
Figures 29 and 30. When asked why she was using it she 
said, “I saw it and I just thought it would be cool.” The biggest 
connection to the story came when Angel decided to create a 
worker who had walked in some mud while cutting down trees. 
She commented that the trees were cut down, and the person 
she created would show why they were cut down. Both 
children were completely engaged throughout the project and 
showed enjoyment while completing their work.
Hunter started his mixed media project by creating three bottle cap creatures. He chose to make a turtle, a crab, and a glow in the dark fish that "lived deep in the ocean." This was an interesting combination to go with the great white shark, turtle, and shrimp he cut out of a magazine. He then cut out various food items to serve as the pollution in the water. Next, Hunter began his painting by starting with a winding road. When asked if he was just going to draw the beach he said, "No, I am drawing one of those windy roads, ya know, like the ones in California that are by the ocean," This demonstrated he had prior knowledge of what he was painting and showed that he knew most of his animals needed to be in the ocean and not just in a random water source. When Hunter was placing his magazine clipped animals, he demonstrated that the farthest part of the page was the deep part of the ocean. The connection then was lost with his "deep water fish" bottle cap, as he placed it close to the road which would not be deep enough for such a creature. He then placed his turtle next to the "pollution" to show that animals can be affected by the pollution in water. Although the ocean contains salt water, Hunter showed his understanding of the need for clean water by clipping the words: "Fight for fresh water!" and using them in his art project. He demonstrated engagement and enjoyment of the project from start to finish. Hunter really liked clipping the magazine pieces out and was very excited about the great white shark he used. See Figures 31 through 33.

While Angel and Steve were creating their dioramas, Hunter started reading One well: The story of water on Earth (Strauss, 2007). The book was rather long and the researcher could tell by page nine that he was feeling like the story was too much. Instead of reading the whole book a decision was made to stop the book and discuss what he had learned. He mentioned how the story talked about water, its many forms, and how it was an amount that never changed. A discussion then occurred about the fact that it does not change and what would happen if it were polluted. He made a connection with the ocean and the fact that there are varying forms of pollution in it.
Hageman, Martin, Montgomery, & Rule

Practical Art Projects Related to Ecology Picture Books

Figure 3. The completed water pollution project

Figure 32. The completed water pollution project

Figure 33. Male student showing his project

Next, Hunter, Steve, and Angel listened to *How to help the Earth by the Lorax* (Rabe, 2012). All the children said they recognized the character of the Lorax before this group began reading the book. Hunter mentioned that he had also seen the movie and enjoyed it very much. During the reading of the book, the children were asked if they conserved water and electricity. Hunter said, “Sometimes” while Angel said, “Yes, all the time we turn off the water when we brush and we turn off the lights when we leave a room,” yet her brother Steve said, Well sometimes I do it, but sometimes I don’t, I don’t know why.” This group talked after the book about how the book focused on recycling and reusing things. They also talked about where their garbage goes. Angel said garbage goes, “to the curb,” Steve said it goes, “in the garbage can,” and Hunter said it went, “to the city dump.” Hunter made the connection to the book about how members of his family recycle cans, while Steve and Angel did not make this connection, as it is not common to recycle them where they are from in a Midwestern state in the United States. Next, they were presented with three options to make that used items that could be recycled. None of them chose to do the newspaper fish, yet they were not sure why they did not want to. Steve chose first and wanted to make a paper plate shark to start, “cuz I can make it scary.” This shows that the stereotype of sharks as scary creatures is still something children believe.

Angel chose to make an egg carton oyster with a pearl made from a pipe cleaner to begin. Hunter chose to create a paper plate sea turtle first. Both Hunter and Steve chose to use large googly eyes on their creatures as they thought they were fun to use. After they painted their first project and were letting them dry, they all chose to do another. This demonstrates their enjoyment of the projects and the desire to continue. Hunter created an egg carton jellyfish, Angel created a purple paper plate fish and an egg carton underwater volcano, and Steve created an egg carton underwater volcano. When they were finished, they wanted their creations to have holes punched in them so they could be hung up. They chose to wear their egg carton creations as necklaces after this group was all finished with the art projects. All showed enjoyment and engagement while working on the projects. See Figure 34 through Figure 40.

Figure 3. Hunter, Steve, and Angel listening to *How to help the Earth by the Lorax* (Rabe, 2012)

Figure 34. Angel, creating her oyster

Figure 35. Hunter, creating his jellyfish

Figure 36. Steve, creating his underwater volcano

Figure 37. Angel, creating her purple paper plate fish

Figure 38. Hunter, creating his paper plate sea turtle

Figure 39. Steve, creating his egg carton underwater volcano

Figure 40. Angel, creating her egg carton oyster
Figure 35. Completed oyster hanging from a string at the lower part of the image

Figure 36. Student making a paper plate shark

Figure 37. Student with completed jellyfish

Figure 38. Students engaged in project

Figure 39. Completed purple fish

Figure 40. Completed shark
Angel and Steve were then given a break while Hunter was going to begin with *A place for turtles* (Stewart, 2013). Instead of leaving, Angel stayed and listened to the story. Two points of interest in the book were the escape hatches for sea turtles and the high school that moved the marsh and got to study the turtles. Both children thought that the escape hatch was “cool” and Hunter liked that it saved the turtles and still allowed the fishermen to “do their jobs.” Both children liked that they moved the marsh and wished that they could study live turtles in school. Hunter also made a connection to the fence that was used by busy highways. He felt that they should be in more places, but not just for turtles.

Angel left after the story and the researcher continued with Hunter. Next, 3D printers were discussed and how they have been used to create shells for turtles that have been harmed. Hunter was familiar with those types of printers and was excited to make his own version of a shell. He understood that the main point of it was the turtle’s protection and that the art project was replicating it. Since they could be as creative as they wanted, he painted his turtle shell in cyclone colors as he is an Iowa State University fan. The researcher believed the addition of his favorite college football team showed his level of engagement and the fun he was having while creating the turtle shell. See Figure 41 through Figure 44.
The final book was *Oil spill!* (Berger, 1994), read to Angel, Steve, and Hunter. This was a long day for Angel and Steve; they started to indicate that they were tired during the reading of *Oil spill!* (Berger, 1994). The book seemed long to them and the researcher could see the waver in their excitement. None of them were familiar with the Exxon Valdez oil spill, so the researcher talked to them a little about the Deepwater Horizon BP oil spill, and Hunter demonstrated his understanding of the issue as he talked about how animals were affected.

The researcher continued the story. Steve was very interested when the group got to a machine that lifts sheets of oil off the top of the water. The book mentioned several other ways that have been used and the researcher discussed a recent study involving a super absorbent sponge. All children were noticeably concerned when the group reached the picture of a bird covered in oil. The researcher discussed how Dawn dish soap was used to clean the feathers of the birds and remove the oil. This was a great lead into the oil spill artwork activity.

During the oil spill simulation process, which only took minutes, the children expressed how much fun it was. They made observations about how each color reacted and noticed they could make a star with the red food coloring while the others only seemed to make a circle, although Angel was able to make a star with her blue food coloring. The researcher also talked with the children about how the milk was like the ocean, the food coloring was like an oil spill, and the Dawn was what was used to clean up animals. This was why the Dawn reacted with the fat in the 2% milk like the effect that Dawn has on the oil when cleaning animals. They enjoyed the activity so much that they completed it three times before the researcher ended the art project. See Figure 45.

Figure 45. Students experimenting with simulated oil spills
The second session of art projects was done over Skype with Bob, David, and the assistance of their mother. The researcher started with the book *One well: The story of water on Earth* (Strauss, 2007). As the book was long and time was limited during this session, the researcher chose to read only the first three pages of the book that highlight the importance of the one well and the water cycle. This group talked about how there was only one source of water, like the researcher did with Hunter. This group also talked about what would happen if the world had less water in one area, or how the water could become polluted.

They, then, began their mixed media art project by creating bottle cap creatures. They each chose to make three creatures. David made a turtle, a fish, and a crab while Bob made a seahorse, a crab, and a clownfish. They each made an ocean and a beach and cut out various food items from a magazine to be their “pollution.” David demonstrated his understanding of the need to have fresh water like Hunter did, with David writing fight water pollution in marker. Bob just wrote water pollution in paint on the top of his mixed media piece, so the connection is not clear with his work. Both David and Bob demonstrated their prior knowledge of crabs by placing them close to/on the beach. Both children had extensive knowledge of sea creatures and talked to each other about them as they were making them. See Figure 46 through 53.
Next, the researcher read the book *How to help the Earth by the Lorax* (Rabe, 2012). Before beginning the book, both boys mentioned how they were familiar with the Lorax and had watched both movies about the book. Like the discussion with Angel, Steve, and Hunter, the researcher talked with David and Bob about saving electricity, conserving water, and where their garbage goes. Both children said they only turn off the lights sometimes and, similarly, only turn off the water sometimes when brushing their teeth. Unlike the other session, they did not see an urgency in conserving energy or electricity while reading the book. When asked where their garbage goes they both replied, “to the dump” which was the same answer Hunter gave. After the book, this group discussed how conservation and recycling were the main points in the book.

After their discussion, they started the sea creature projects and, like the other group, neither boy chose to do the newspaper fish. David created an egg carton fish while Bob created an egg carton turtle and a paper plate shark. Like Steve, Bob picked the shark for its ability to be “scary,” but he also was very knowledgeable about sharks and wanted to make sure he had the correct number of fins, “they have pectoral fins you know.” This demonstrated his prior knowledge of sharks and his engagement in what he was working on. He created a tiger shark and knew it was not colored the way he did, but he wanted to make sure that
people that did not know could guess what he made. They both showed engagement and a desire to create during their work on this art project. See Figure 54 and Figure 55.

Figure 54. Bob’s tiger shark

Figure 55. Bob’s turtle and David’s pink fish

The third project they worked on used the book *A place for turtles* (Stewart, 2013). As with Hunter, David and Bob talked with the researcher about the escape hatch for sea turtles and the marsh being moved for school. They thought the marsh being moved and the high schoolers getting to work with the turtles was, “cool.” They were more interested in the sea turtle hatch, and they talked about sea turtles and how they sometimes eat plastic bags before the researcher mentioned it. This demonstrates their understanding of the impact pollution can have of sea creatures and their prior knowledge of how harmful plastic bags can be. This was a connection that the other session did not make. This group then talked about 3D printers, but unlike Hunter, they were unfamiliar with them. They could make a connection to the importance of making replacement shells for turtles and wondered if any had been done on sea turtles. They were very engaged in this activity and excited to make the turtle shell. See Figure 56 and Figure 57.

Figure 56. Bob’s turtle shell

Figure 57. David’s turtle shell

Time was running short, but both Bob and David wanted to do the oil spill artwork. There was no time to read the book, so the researcher led a small discussion about oil spills and that the book *Oil spill!* (Berger, 1994) was about the Exxon Valdez oil spill. Like the other session, they were not
familiar with that oil spill. They were also not familiar with the Deepwater Horizon BP oil spill. The researcher then discussed oil spill cleanup and mentioned there were several processes. The researcher then discussed the connections to the book with the artwork like previously done. Since this was not a planned activity for David and Bob, they had to improvise with materials. They were still able to have the reactions occur in the milk, they were just not as profound as the first session. Both children expressed great enjoyment in doing the project and wanted to do it again, but time was short and the project had to be ended. See Figure 58 and Figure 59.

Figure 58. David, oil spill after 5 minutes

Figure 59. Bob, oil spill after five minutes

Researcher 1 conducted art projects with two children from Southern Spain from middle class families, and three children from the East Coast region of the United States from upper-middle class families. The three Skype sessions conducted by Researcher 1 included work on three of the five art projects designed for this study—3D Turtle Shell, Rainforest Diorama, and Ocean Ecosystem. Researcher 2 conducted art projects with five children from the Midwestern United States, all from middle class families. The two sessions conducted by Researcher 2 included work on all five art projects created for this study—3D Turtle Shell, Rainforest Diorama, Mixed Media Collage, Oil Spill Cleanup Artwork, and Ocean Ecosystem. Both Researcher 1 and Researcher 2 saw children that were engaged through the activities from beginning to end. Additionally, all children showed connections between the text and real-life situations. Some children were even able to take the information gained and expand upon it, making a deeper connection to science. Most importantly, all children left with new ideas on how to help the world around them.

Connections to the Literature

Environmental education in the NGSS. While analyzing the study’s books, the researchers made every attempt to connect the environmental science content of the books with NGSS. Table 2 shows the NGSS for Ecology to which each of the 30 books of the research set is connected. This is comparable to the article by Royce (2014) in the NSTA journal titled “Science and Children.” While Royce used different books for different age levels, researchers differentiated instruction to allow them to use the same book at multiple levels. This was accomplished by using choice and challenge. Royce (2014) believed that literature can enhance students’ scientific learning. While each of the children who participated in this study had their own prior experiences with environmental learning, the use of high quality picture books helped to deepen that knowledge. This was shown most by the statement made by a student in the student attitude survey where he stated that the book How to help the Earth by the Lorax (Rabe, 2012) helped him with ideas on how to help trees. He already had the connection to the character, the Lorax, and the book reminded him that the Lorax wanted to save trees, allowing him to give examples like sharing magazines and using both sides of a paper.
However, some students had difficulty understanding the connection between human actions and their impact on the environment. When asked to explain how recycling or turning off the water while brushing their teeth helped the characters in the stories, one student was unable to find the connection. Another student was presented with the following conundrum: “We need trees to make some items that we use in our everyday lives, but cutting trees is bad for the environment. What could be the solution?” The child’s first answer was that “We don’t cut trees”; however, when asked how we would be able then to make those necessary items if we don’t cut trees, she was unable to think of a solution and looked confused. This may indicate that, although these children enjoyed the stories and the artwork, the books failed to convey the environmental issue clearly and/or provide a balanced portrayal of the environmental issue, leaving the students confused and insecure about what their role in helping preserve nature is.

Table 2. Book Connections to the Next Generation Science Standards (2013a, 2013b, 2013 c, & 2013d)

<table>
<thead>
<tr>
<th>Book</th>
<th>Connections to NGSS for Ecology</th>
</tr>
</thead>
<tbody>
<tr>
<td>One well: The story of water on Earth (Strauss, 2007)</td>
<td>3-LS4-3; 3-LS4-4; 4-ESS3-1; 5-ESS3-1</td>
</tr>
<tr>
<td>A place for turtles (Stewart, 2013)</td>
<td>K-LS1-1; K-ESS2-2; K-ESS3-1; K-ESS3-3; K-2-ETS1-1; 1-LS1-1; 1-LS3-1; 2-LS4-1; 3-LS1-1; 3-LS3-1; 3-LS3-2; 3-LS4-2; 3-LS4-3; 3-LS4-4; 4-LS1-1; 5-LS2-1; 5-ESS3-1</td>
</tr>
<tr>
<td>How to help the Earth by the Lorax (Rabe, 2012)</td>
<td>K-LS1-1; K-ESS2-2; K-ESS3-1; K-ESS3-3; 2-LS2-1; 2-LS4-1; 3-LS4-3; 3-LS4-4; 4-ESS3-1; 5-LS1-1; 5-ESS3-1</td>
</tr>
<tr>
<td>Oil spill! (Berger, 1994)</td>
<td>K-LS1-1; K-ESS3-3; 3-LS4-3; 3-LS4-4; 4-ESS3-1; 5-ESS3-1</td>
</tr>
<tr>
<td>Nuestro planeta en peligro/Our planet in danger (Grant, 2008)</td>
<td>K-LS1-1; K-ESS2-2; K-ESS3-1; K-ESS3-3; K-PS3-1; K-ESS2-1; K-ESS3-2; 1-LS1-2; 1-LS3-1; 2-LS4-1; 2-PS1-4; 2-ESS1-1; 2-ESS2-2; 3-LS4-3; 3-LS4-4; 3-ESS2-2; 3-ESS3-1; 4-ESS3-2</td>
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Conclusion

Summary of Findings

The findings in this lesson project demonstrate that picture books can serve as an engaging tool that can enhance environmental education and help instill a love of nature in children. Students evidenced growth in their understanding of the impact that human action has on the environment and ways that this impact can be reduced. The gains that students experienced were likely due to the ability that picture books have to take children vicariously to places (Moore, 2009), and to create meaningful and safe environments that support students’ increased awareness of world’s environmental issues without threatening them (Rule & Atkinson, 1994, p. 586). Art-based activities that were designed to summarize previous learning that occurred from the reading of picture books provided meaningful and engaging opportunities for children to reinforce and demonstrate their understanding of concepts. NGSS and Common Core Literacy Standards were supported during the literature-based, art-infused science lessons. The activities were not conducted in the school setting where typically larger groups of students are involved. However, the findings from this project evidenced that the infusion of environmental children’s books and artwork in science lessons allowed children to learn aspects of the NGSS and Literacy standards. This integrated approach to science learning may help remedy the problem of lack of time for...
covering environmental issues in the elementary classroom. Both lower- and upper-elementary students visibly enjoyed the artwork and exhibited a high level of interest and engagement during the lessons. The double media of print and illustrations, coupled with the sense of control and creativity involved in the art creation process, clearly increased students’ motivation to learn science. This study yielded the interesting finding that high-quality science picture books are particularly difficult to locate when multiple languages are required. The lack of high-quality children’s picture books with ecology themes that are available in Spanish poses an obstacle for the creation of language-sensitive classrooms that support multilingual learners. Equally interesting was that the student participants, with their diversity in cultural and social backgrounds, demonstrated similar enthusiasm to learn about environmental issues through picture books, and took similar pleasure and pride in their art creations. Therefore, an integrated approach to science instruction is recommended as it helps increase student scientific learning in an enjoyable, meaningful, and creative fashion, while meeting various standards at once.

**Picture Books and Student Science Learning**

The literature shows environmental education to be an effective way to teach children to appreciate nature and educate them on how to make informed decisions about ways of taking care of it (Bodor, 2016). Picture books and art can be combined to make a meaningful connection to environmental science. Similarly, reading a book aloud to students can provide a meaningful introduction to students and spark an interest in science (Ansberry & Morgan, 2010; Mayberry, 2014). Indeed, from this project, students increased their knowledge about ecological issues and ways they can help environmental causes.

All the children expressed an interest in one of the books and made a connection to the environmental science content. Some children made a connection to recycling/conserving while working with *How to Help the Earth by the Lorax* (Rabe, 2012). A connection was made with sea life and wanting to help the trees by one child. Finally, another child made a connection with the books with his expressed desire to become a marine biologist when he gets older. All the children had their connections to real-life and science expanded with the help of picture books. These meaningful connections from a six-year-old all the way to two eleven-year-olds show that picture books can help express important scientific information at varying ages (Richardson & Miller, 1997, p. 6).

Both younger and older children participated in this project and visibly demonstrated enjoyment and engagement by listening intently to the books being read aloud and paying attention to the requirements of the task during art projects. The study’s findings indicated that the double media of print and illustration employed by picture books substantially expanded the possibilities for student comprehension and enjoyment (Bishop & Hickman, 1992), and that picture books were appropriate not only for younger children, but also for older children (Graham, 2000; Neal & Moore, 1992; Reiker, 2011).

As Moore (2009) argued, one of the reasons why literature is beneficial to students’ science learning is that texts can take students vicariously to places, allowing them to gain scientific understanding in settings where direct firsthand experiences are not feasible. While reading one of the stories told in *Nuestro planeta en peligro*/*Our planet in danger* (Grant, 2008) that takes place in the Amazon Rainforest, a student stated that the best part of the book was that “it teaches you to look at the Earth.” When asked to further explain his response, the child stated that he liked looking at the illustrations portraying the Amazon Rainforest, and all the animals and plants that live in it, which evidences the pleasure he took from being able to “go” to those places through the stories.

Research has also shown that children’s literature has the potential to create a meaningful context that is familiar to children, and can make the teaching and learning process more relevant to students (Ostlund, 1998, as cited in Monhardt & Monhardt, 2006). Picture books, in particular, can provide a safe environment that help increase children’s awareness of world’s environmental issues without threatening or overwhelming them (Rule & Atkinson, 1994, p. 586). As previously mentioned, the book *Nuestro Planeta en Peligro/Our Planet in Danger* (Grant, 2008) encompasses three sections. Because this book contains some illustrations that researchers felt may be overwhelming to young students,
the second section in the book was the only one used as a six-year-old and a seven-year-old were present. Even though the section that appeared to be less threatening to young children was chosen to support the art project, one of the students expressed his fear that one of the main characters might get killed in the story. “When they were all happy” was this student’s response to the question about the best part of the book, which evidenced that the child felt overwhelmed by the events in the stories. This student’s remarks support research that calls for an appropriate approach to environmental education that places emphasis on nurturing children’s appreciation of nature and provides them with the knowledge and skills required to become actively engaged in environmental issues. Exposing children to dramatic scenarios may, as a matter of fact, lead children to perceive environmental issues as unchangeable and beyond their control. Conversely, the approach to the environmental issues discussed in *A place for turtles* (Stewart, 2013) and *How to help the Earth by the Lorax* (Rabe, 2012) showed that students’ understanding and empathy can be enhanced, while still allowing them to enjoy the learning experience without overwhelming or threatening them.

Additionally, researchers noted that some books appeared to be too long for children to be able to remain engaged throughout the reading. A six-year-old found the book *Oil spill!* (Berger, 1994) to be long. That may have more been the pace of the story, which seems slow at the start of the book. This was, in fact, one of the concerns about the book the researchers had during their analysis. The book *One well: The story of water on Earth* (Strauss, 2007) was also seen as too lengthy by one child. This is something the researchers also mentioned in the analysis of the book. Taking this into consideration, the book was stopped prematurely and the next session was presented with only three pages. Based on one researcher’s experience with the book, it would best be presented over multiple days, but is still an excellent resource.

In addition to an enhanced understanding of environmental issues, the study’s findings evidenced language learning gains that resulted from the students’ interaction with picture books. Nicholas (2007) and Weeks (2013) argue that picture books entice young children to read and interact with the text and serve as an effective tool to stimulate and promote children’s literacy skills and learning.

In this study, a student who spoke only Spanish at home and whose exposure to the English language was limited to three hours a week at school, demonstrated great interest in learning English terms related to turtles. Her curiosity about the sound and spelling of English words that described the book’s illustrations was evident. Likewise, her excitement when she was able to use those new words in sentences was palpable, supporting previous studies about the literacy and learning benefits derived from using picture books. However, the student required additional support from the teacher in order to understand the information from a book that was only available in English.

To support this student with vocabulary, the teacher translated the book and created a PowerPoint so that she was able to view the book illustrations while reading the text first in Spanish and then in English. Additionally, the teacher prepared flashcards with keywords related to the topic that the student kept nearby throughout the activity. The student was occasionally asked to repeat vocabulary and encouraged to express herself in English. To assist her and reinforce her positive attitude, the teacher modelled possible responses and comments and provided frequent, positive oral reinforcements. At the end of the activity, the student stated that she liked learning English during her science lesson and expressed her desire to continue to learn the language. These comments further evidenced the motivation that picture books generate and the language knowledge students gain from their interaction with picture books.

**Visual Arts and Student Science Learning**

Researchers noted that picture books not only served as springboard for environmental education, but also served as a springboard for art. The books chosen for this analysis often have lavish, colorful art that help tell the story, while fostering an appreciation of art in children. Dhanapal, and others (2014) found that visual arts increased student motivation to learn science as they enjoy the freedom of choosing their preferred form of art to express their learning of science. Students’ creativity and sense of control over their artwork were supported by this study. During the art projects generated by the researchers, students were given the opportunity of choice to express their creativity and science
knowledge gained. This was shown, for example, through the addition of a construction worker to the rainforest of one child, the use of the toucan in the rainforest by her brother, the choice given for the artwork created for How to help the Earth by the Lorax (Rabe, 2012), and the choice of media (acrylic paints, crayons, markers, construction paper, etc.) made available for use in each project. Further evidence of the motivation that the art projects generated was the students’ desire to repeat the experience and to discuss their project ideas with friends at school. Comments like “We never do projects like this... sometimes we talk in class about the book. But the book doesn’t have so many pictures and art is more fun” and “Because I like paint, and colors, and cutting, and I have a lot of imagination and can do a lot of stuff...” support ideas about students’ increased motivation to learn science as a result of the integration of art in the lessons. Clearly, the art projects designed in this study led to a raised awareness of environmental issues, and an increased enjoyment and creativity in students’ participation (Olsen et al., 2013, p. 130).

Similarly, during the artwork creation, connections between the art project and the book occurred as shown by the frequent references children made to what they had learned from the books. This connection is evidenced in comments like “The animals on the sand don’t make pollution because they don’t throw trash, they don’t burn trash,” “We are not going to let anyone to cut them (trees),” or “My turtle’s shell is flat because it lives in the water,” where the students are relating their project to the information previously learned during read-aloud times.

Implications for Practice

Raising student awareness of world’s environmental issues in a realistic, yet non-threatening manner is not an easy task. The teacher must support student understanding of the threats that our planet face and the impact that human action has on nature’s delicate balance, while ensuring that children see their own role in environmental causes and feel empowered to make a difference. In addition, increasing curriculum demands appear to leave no room for environmental education in the elementary classroom. However, this study has demonstrated how environmental education can be effectively integrated in the busy school day through literature-based, art-infused science lessons, in which children learn multiple standards at once. Furthermore, this study evidenced that the integration of science with literature and art allowed students’ creativity and control over their work, and had them engaged and demonstrating positive attitudes toward science. Therefore, the authors recommend that elementary school teachers incorporate art and literature in the form of children’s picture books in their science instruction. This integration helps instill a sense of wonder in the science classroom (Ansberry & Morgan, 2010; Mayberry, 2014), allows student exploration and discovery of the world on their own (Alberts, 2010), and supports students’ creativity and enjoyment while addressing multiple standards (Olsen et al., 2013).

Additionally, since the book analysis revealed that certain titles lack some important traits—presenting issues in a sensitive manner, encouraging children’s reflection about environmental issues, offering differing perspectives of the ecological problem, or providing doable ideas for action that children can take to make their daily routine more environmentally-friendly—educators are encouraged to ensure that the books selected for use in the classroom present environmental issues in a cautious and developmentally-appropriate manner. Similarly, it would be advisable to use multiple picture books and other resources in order to compensate for weaknesses found in individual titles. In fact, most of the books that are lacking in some of these traits provide excellent conversation points that teachers can use to spark student discussions and motivate them to further explore issues. Some of the tools teachers may use to encourage reflection include: Journaling, problem solving scenarios, and an analysis of the problem/sustainability depicted in the picture book. Moreover, multiple perspectives are an important aspect that should be addressed during science lessons; therefore, educators are encouraged to use some of the following tools to help cover all sides to a story: T-charts, Venn diagrams, mind-maps, and debates on “controversial” issues.

Importance of Book Availability in Multiple Languages

Ideally, high-quality children’s science picture books should be available at schools in multiple languages.
However, it must be noted that, when researchers started the project, it was anticipated that locating high quality science picture books would be the easy part of the study, whereas the hard part would be choosing only 30 to analyze. Contrary to this expectation, high quality science picture books were not easy to locate. Even harder was to find them in multiple languages for English language learners. But when a student’s first spoken language at home is not English, teachers cannot simply present the child with the same material that is presented to native English-speaking students. Certainly, science learning can be particularly frustrating for English language learners due to its complex vocabulary, which is often difficult even for native English speakers to learn. High-quality multilingual children’s picture books about science become, therefore, a key factor for students’ success in learning science. Science picture books provide an excellent means to make lessons more efficient and effective as they provide students with non-linguistic cues that make language and content more accessible to them. Regardless of linguistic background, all children are able to interpret pictures with minimal linguistic skills. Moreover, even native English speakers will benefit from using picture books in science lessons as the visual support that the artwork provides will enable them to better understand the environmental issues addressed. Since much of the success that non-native English-speaking students experience in learning science will depend on the quality of the resources to which they have access, educators and administrators are encouraged to strive to locate and facilitate those resources. If educators and administrators want to offer equal opportunities for all students by creating a language-sensitive classroom, their unshakable determination to demand that better-quality science books be available at schools in multiple languages becomes paramount.

Studies with a larger population and conducted in the school setting would make the results of this study more generalizable.

Conductors of future study might consider using a control and an experimental group to measure differences in student science learning, level of engagement, and motivation. Pretest, posttest, and distal posttest assessments could be used to measure student understanding and retention of knowledge, whereas student engagement and attitude toward science could be measured through student journals, student attitude surveys, and teacher observations. Additionally, implementing the intervention for a relatively long period of time, ideally at least one semester, might capture stronger positive effects of literature-based, art-infused science lessons in student learning and engagement in comparison to a more traditional approach to science learning.

Artwork created by students could also be incorporated in student presentations delivered both within and outside the school setting. In addition, student-made brochures, podcasts, posters, and other informational materials could be used to share students’ findings. This would enable them to share their learning and take social action by raising awareness and educating others on environmental issues and ways to help environmental causes. Similarly, community service learning projects could be held as a celebration and continuation of student learning. Community service learning projects may include school garden projects, tree-planting projects, composting projects, stream restoration projects, alternative sources of energy investigations, volunteering, solving a local environmental issue, and many other projects. Such approaches, paired with picture books and the arts could support students working to take action to promote environmental awareness and sustainability.

Limitations and Suggestions for Future Research

The 10 students who participated in this study were recruited in the Midwest and East Coast regions of the United States and Southern Spain. While the diverse cultural and social background of the students allows, to some extent, to generalize the study findings, the authors acknowledge the limitations of a study with such a small group of students.
Practical Art Projects Related to Ecology Picture Books

References


Practical Art Projects Related to Ecology Picture Books


Appendix

Art Projects and Connections to the NGSS

Book: *One Well: The Story of Water on Earth; Art Project: Mixed Media Collage*

**NGSS and Three Dimensions**

- **K-ESS3-1:** Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live. **DCI:** ESS3.A: Natural Resources **CCC:** Systems and System Models **SEP:** Developing and Using Models
- **K-ESS3-3:** Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment. **DCI:** ESS3.C: Human Impacts on Earth Systems; ETS1.B: Developing Possible Solutions **CCC:** Cause and Effect **SEP:** Obtaining, Evaluating, and Communicating Information
- **3-LS4-3:** Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all. **DCI:** LS4.C: Adaptation **CCC:** Cause and Effect **SEP:** Engaging in Argument from Evidence
- **3-LS4-4:** Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change. **DCI:** LS2.C: Ecosystem Dynamics, Functioning, and Resilience; LS4.D: Biodiversity and Humans **CCC:** Systems and System Models; Interdependence of Science, Engineering and Technology **SEP:** Engaging in Argument from Evidence
- **4-LS1-1:** Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. **DCI:** LS1.A: Structure and Function **CCC:** Systems and System Models **SEP:** Engaging in Argument from Evidence
- **5-LS1-1:** Support an argument that plants get the materials they need for growth chiefly from air and water. **DCI:** LS1.C: Organization for Matter and Energy Flow in Organisms **CCC:** Energy and Matter **SEP:** Engaging in Argument from Evidence

**Materials**

- Magazines
- Construction Paper (multiple colors)
- Craft Foam/Felt (multiple colors)—optional
- Plain Paper (8.5 X 11 inches or larger)
- Bottle Caps (colored already to specific colors)
- Googly Eyes
- Markers/Colored Pencils/Crayons/or Acrylic Paint with Paint Brush and Sponge
- Glue Sticks or Glue
- Natural Elements (twigs, tree bark, etc.)—optional
- Scissors

**Steps**

1. Using the bottle cap, a googly eye, construction paper, and the glue/glue stick, create a fish. Glue the googly eye on, create a fin out of the construction paper, and then decorate further if you wish to. Let it dry—This is just an idea. Be creative and find new ways to make your own creatures!
2. Using the plain paper create a poster that displays a polluted body of water and a clean body of water. How you decide to divide it or make it blend together is up to you.
3. Cut out images and words from the magazines to help represent what you want people to know or think about.
4. Using markers/colored pencils/crayons/or acrylic paint with a paint brush or sponge, create the background to your poster. Examples are the sky and the ocean.
5. Using construction paper and images cut out of the magazines, create another layer over your background. You could add animals or words that remind you of pollution or clean water.

6. Glue the creatures you created in your body of water, either side you choose.

7. Take a picture.

8. Clean up.

This mixed media collage represents the beauty of nature through the clean body of water and the harshness of pollution and how it affects the planet’s one water supply.

**Book: A Place for Turtles; Art Project: 3D Turtle Shell**

**NGSS and Three Dimensions**

- **3-LS3-2**: Use evidence to support the explanation that traits can be influenced by the environment. **DCl**: LS3.A: Inheritance of Traits; LS3.B: Variation of Traits **CCC**: Cause and Effect **SEP**: Constructing Explanations and Designing Solutions

- **4-LS1-1**: Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. **DCl**: LS1.A: Structure and Function **CCC**: Systems and System Models **SEP**: Engaging in Argument from Evidence

**Materials**

- Cardboard (around 8.5 X 11 inches)—2 pieces
- Frisbee or CD
- Smaller Circular Object than the one listed above
- Ruler or Straightedge
- Pencil/Pen
- Clear Tape
- Markers/Colored Pencils/Crayons/or Acrylic Paint with Paint brush
- Scissors

**Steps**

1. Using the frisbee or CD (larger circular item) and a writing utensil, trace around the circular object onto the cardboard (on the side that may have writing).

2. Use the smaller circular object to trace a circle in the center of your larger circle.

3. Draw a line down the center of the circle using your writing utensil, making sure not to draw in your center circle. Repeat this step in the other direction.

4. Now draw a line between your two lines cutting them in half. Remember to not write in the inner circle. Repeat this step in the other direction. You should now have eight almost equal sections.

5. Flip over your shell and decorate it using markers/colored pencils/crayons/or acrylic paint. When it is dry go to the next step.

6. Now flip your shell back over to the side you made lines on. Cut each line but do not cut past the inner circle.

7. Once all your sides are cut, fold in a section a little and tape it to the section next to it. Repeat until the cardboard resembles a 3D shell.

8. Take a picture of your fabulous creation.

9. Cut a bottom for your shell by tracing the shell you made. Remember to cut a hole for the neck and tail of the turtle—optional.

10. Clean up.

This is a 3D model that resembles the 3D printed models that have been made for turtles that have had their shells broken.
Book: How to Help the Earth by the Lorax; Art Project: Hanging (Optional) Sea Life Display/Ocean Ecosystem

NGSS and Three Dimensions

· K-ESS2-2: Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs. DCI: ESS2.E: Biogeology; ESS3.C: Human Impacts on Earth Systems CCC: Systems and System Models SEP: Engaging in Argument from Evident
· K-ESS3-1: Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live. DCI: ESS3.A: Natural Resources CCC: Systems and System Models SEP: Developing and Using Models
· K-ESS3-3: Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment. DCI: ESS3.C: Human Impacts on Earth Systems; ETS1.B: Developing Possible Solutions CCC: Cause and Effect SEP: Obtaining, Evaluating, and Communicating Information
· 3-LS4-3: Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all. DCI: LS4.C: Adaptation CCC: Cause and Effect SEP: Engaging in Argument from Evidence
· 3-LS4-4: Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change. DCI: LS2.C: Ecosystem Dynamics, Functioning, and Resilience; LS4.D: Biodiversity and Humans CCC: Systems and System Models; Interdependence of Science, Engineering and Technology SEP: Engaging in Argument from Evidence

Materials

· Egg Cartons
· Acrylic Paint (multiple colors) and Paint Brush
· Googly Eyes
· Craft Foam (multiple colors)—optional
· Glue or Glue Stick
· Scissors
· Pipe Cleaners
· Rocks, Marbles—optional
· String
· Hole Punch
· Plastic Bag for Jellyfish or Octopus Tentacles—optional

Older Student Material Alternatives

· Paper Plates
· Cupcake Liner—optional
· Newspaper
· Markers/Colored Pencils/Crayons

Steps

1. Cut apart the egg carton so the parts that hold the eggs are separated.
2. Paint the egg carton pieces the color of the sea creature you wish to make. Wait until they are dried and then glue them together if needed.
3. Cut craft foam or construction paper in the shape of your fish fins and tail if needed. Glue them onto your sea creature.
4. Add pipe cleaners with glue for legs and arms if needed.
5. Glue googly eyes onto sea creatures.
6. Punch two holes in the carton and put the string through the holes. Tie a knot—optional.
8. Create an ocean bottom and add your creatures together to create an ocean scene—optional.
9. Clean up.

This is the ocean ecosystem.

**Steps for Older Students—Option 1: Paper Plate Sea Creatures**

1. Use a full paper plate and color it to resemble a sea creature using markers/colored pencils/crayons or paint.
2. Add other materials for details (cupcake liners for scales; construction paper or foam for fins, teeth, or eyes; pipe cleaners for claws; or google eyes).
3. Punch a hole in the top and feed the fishing line through the hole to create a hanging creation.
4. Take a picture of your creation.
5. Clean up.

**Steps for Older Students—Option 2: Newspaper Fish with Colored Paper Scales**

1. Cut out a fish shape from a newspaper. The fish should be folded in half (fold the face close to the tail of the fish) so you can cut slits .5 inch apart.
2. Use construction paper or colored plain paper and cut the paper in .5 in strips.
3. Weave the colored paper back and forth through the slits one by one.
4. Once you have weaved all your strips cut the top and bottom to resemble fins.
5. Add details like eyes to your fish.
6. Punch a hole in the top of your fish and feed fishing line through it to create a hanging creation.
7. Take a picture of your creation.
8. Clean up.

**Book: Oil Spill! Art Project: Oil Spill Cleanup Artwork**

**NGSS and Three Dimensions**

- K-ESS3-3: Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment. **DCI:** ESS3.C: Human Impacts on Earth Systems; ETS1.B: Developing Possible Solutions **CCC:** Cause and Effect **SEP:** Obtaining, Evaluating, and Communicating Information
- 3-LS4-4: Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change. **DCI:** LS2.C: Ecosystem Dynamics, Functioning, and Resilience; LS4.D: Biodiversity and Humans **CCC:** Systems and System Models; Interdependence of Science, Engineering and Technology **SEP:** Engaging in Argument from Evidence
- 5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment. **DCI:** ESS3.C: Human Impacts on Earth Systems **CCC:** Systems and System Models; Science Addresses Questions About the Natural and Material World **SEP:** Obtaining, Evaluating, and Communicating Information

**Materials**

- 2oz. 2% Milk
- Liquid Food Coloring (multiple colors)
- Dawn Dish Soap
- Qtip
- Bowl that can hold more than 2 oz.

**Steps**
1. Place the 2oz. of 2% milk in the bowl.
2. Slowly add drops of the food coloring to the milk, making sure to leave space between the drops.
3. Take a picture.
4. Place a small amount of Dawn dish soap on the Qtip.
5. Place the Qtip in one of the food coloring drops and watch the color run away.
6. Finish the rest of your drops with the Qtip.
7. Take a picture of your artwork.
8. Clean up.

The milk is like the vast ocean and the food coloring is like the oil that can be spilled in it. The Dawn dish soap is what they use to clean up the oil on animals. Just like the oil, the Dawn reacts with the food coloring and the fat in the milk.

**Book: Nuestro Planeta en Peligro/Our Planet in Danger; Art Project: Rainforest Diorama**

**NGSS and Three Dimensions**

- **K-ESS2-2**: Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs. **DCI**: ESS2.E: Biogeology; ESS3.C: Human Impacts on Earth Systems **CCC**: Systems and System Models **SEP**: Engaging in Argument from Evident
- **K-ESS3-1**: Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live. **DCI**: ESS3.A: Natural Resources **CCC**: Systems and System Models **SEP**: Developing and Using Models
- **3-LS4-3**: Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all. **DCI**: LS4.C: Adaptation **CCC**: Cause and Effect **SEP**: Engaging in Argument from Evidence

**Materials**

- Shoebox
- Construction Paper (multiple colors)
- Craft Foam/Silk Paper/Felt (multiple colors)—optional
- Natural Elements (twigs, tree bark, dried flowers and leaves, etc.)—optional
- Plain Paper
- Scissors
- Glue Sticks or Glue
- Markers/Colored Pencils/Crayons/or Acrylic Paint with Paint Brush and Sponge
- Amazon Rainforest Animals—optional

**Steps**

1. Get your shoebox and cover the outside of the box with construction paper of your choice.
2. Create the sky and ground for your ecosystem and glue them in.
3. Create trees and fold the bottom so you can glue your trees to stand up in your diorama.
4. Create the animals that will live in your rainforest and glue them in the diorama.
5. Add as many details as you wish (leaves, rocks, flowers, etc.).
6. Take a picture of your creation.
7. Clean up.

This rainforest diorama is a representation of the ecosystem children read about in the book.