

A Content Analysis of Thirty Children's Picture Books about Ecology

Natalia Martín Martín, Jennifer L. Hageman,
Sarah E. Montgomery
and
Audrey C. Rule
University of Northern Iowa

Abstract

This study presents a content analysis of 30 ecology-themed children's picture books published in English and Spanish from 1994 to the present. Books were analyzed for the following aspects: 1) Nature appreciation, 2) Interrelatedness of Nature, 3) Realistic ecology problem, 4) Differing perspectives, 5) Hope for a solution, 6) Reflection and responsibility, 7) Steps for a solution, 8) Positive tone, 9) Representation of diversity, 10) Appropriate illustrations, 11) Story appeal, and 12) Developmental appropriateness. Scoring guidelines are provided in an appendix. Content analysis results revealed that most books raise awareness about the impact of human action on the environment, although some titles lack important traits such as offering differing perspectives of ecological problems. Researchers encourage educators to incorporate picture books and art in science lessons to increase student engagement and scientific learning while meeting various standards. A companion practical paper in the same issue of the *Journal* provides example art projects connected to the books.

Key Words

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

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Introduction

Literature-based science lessons in which children's picture books support students in building understandings of scientific concepts, combined with art activities that offer an opportunity for students to reinforce and demonstrate their learning, can provide a venue for an integrated approach to science instruction. To assist teachers in building a class collection of ecology-themed children's picture books that they can confidently incorporate in literature-based, art-infused science lessons, the researchers present a content analysis of children's picture books with an ecology theme. This theme is then linked to the Next Generation Science Standards (NGSS) to provide an up-to-date look at science integration today.

This paper presents a new look on a previous analysis of picture books about ecology conducted by Rule and Atkinson (1994). This project however, assesses ecology-themed picture books published both in English and Spanish from 1994 to the present. Follow-on art projects that reinforce the content or message of the books and support a NGSS performance standard are discussed in a companion paper in this same issue of the *Journal* in a paper titled, "Practical art projects related to children's picture books about ecology," by Hageman, Martín, Montgomery, and Rule (2019).

The relevance of this study can be recognized when trying to locate peer reviewed journal articles that link the NGSS with literature. The principles of the NGSS document support the enhancement of environmental education, namely education that aims to increase knowledge about environmental issues and provide the skills that support making informed decisions and active citizenship. While some teachers shy away from teaching science all together, it has been found, when it comes to environmental education, teacher knowledge is not an issue (Stevenson, Carrier, & Peterson, 2014). The issue is a lack of time to address all the information educators are required to teach students and also teach environmental education. Quality material that connects literature to the performance expectations in the NGSS could aid them in teaching environmental education. The lack of such material being available to teachers is what this study hopes to remedy. Teachers are provided with current resources that can aid them in their instruction of environmental education, as well as suggestions on how to connect those projects with the NGSS.

Literature Review

Environmental Education in the NGSS

The decline in the overall quality of science education in America reveals the need to identify possible strategies to increase student mastery of core science content. The 2015 Program for International Student Assessment, or PISA, study showed that American students were below the international average in math and about average in science, with Singapore as the top performer on the PISA tests (Kerr, 2016). Out of 70 participating nations across the globe, American students were outperformed by their counterparts in 36 countries in math, and 18 countries in science. Average scores in math have been on the decline since 2009, and scores in science have been flat during that same time period (Kerr, 2016). Based on the Framework for K-12 Science Education, the NGSS provide a new vision for American science education and an opportunity to improve science education and student achievement (NGSS Lead States, 2013a).

The NGSS differ from previous science standards in their emphasis on real world contexts for education. Past standards separated content from process, but the NGSS expect students to develop an integrated understanding of science as a body of knowledge and a set of practices for developing new knowledge (Penuel, Harris, & DeBarger, 2015). Additionally, the NGSS place great emphasis on young people learning to think critically and acting like scientists and engineers. Appendix A for the Framework of NGSS discusses the shift from Common Core Standards (Common Core Standards Initiative, 2012) in Science to student performance expectations, which are separated into three dimensions of learning: Science and Engineering Practices, Crosscutting Concepts, and Disciplinary Core Ideas. These are scaffolded from kindergarten as they grow more challenging to students each year. The focus is now on a deeper understanding of the content for every student and its application (NGSS Lead States, 2013b).

Environmental literacy refers to an individual's capacity to make informed decisions concerning the environment and take responsible action. Increasingly challenging environmental choices call for a type of education in schools that will help children understand ecology issues and how they apply to their daily lives (Coyle, 2005). Bodor (2016) refers to environmental education as a type of education that teaches children and adults about their environment and educates them on how to make informed decisions about ways of taking care of it. The NGSS offer a great opportunity for producing environmentally literate students that will both continue their commitment to caring for the environment into their adult lives and contribute to a prosperous and sustainable economy.

The NGSS support the enhancement of environmental education by having a major content focus on science related to the environment, such as energy, nature, climate, sustainability, the earth, and the impact of human activity on the earth. Next, there is an emphasis on the interconnected nature of sciences, and the development and practical application of skills in a real-world context (NGSS Lead States, 2013a). In addition, the NGSS include a greater integration of science and engineering that enables students to engage in engineering design practices to solve real-world problems (NGSS Lead States, 2013a). Science and

engineering are now more integrated in the NGSS from K-12, which is highly significant for environmental education as it helps foster a shift to green technology and a greener economy. Furthermore, the NGSS support Green School programs that help turn the school into a laboratory of learning by offering on-site opportunities for students to have practical and real world science and engineer education. Lastly, the NGSS promote the enhancement of environmental education through an emphasis on science learning in informal environments. The NGSS describe the potential that informal environments have to broaden participation in science and engineering for youth from non-dominant communities. Appendix D of the Framework of the NGSS defines a non-dominant community not as a group in numerical minority, but rather as individuals excluded from the social prestige and institutionalized privilege that dominant groups enjoy in the U. S. public domain (NGSS Lead States, 2013c). Such informal environments for science education include nature centers, arboretums, botanical gardens, zoos, aquariums, natural history museums, and other facilities. The partnership between schools and informal education associations can provide access to a wealth of resources and expertise that can spark student interest, and broaden and deepen their understanding of scientific concepts that are represented in the NGSS (Walsh & Straits, 2014, p. 55).

Picture Books and Student Science Learning

Research shows that implementing read-aloud sessions in the classroom to introduce science units makes science come alive for elementary students. Literature serves as a tool that sparks student interest in science topics and helps instill a sense of wonder in the science classroom (Ansberry & Morgan, 2010; Mayberry, 2014). Studies have also indicated that students who were taught using trade books were better able to understand difficult scientific concepts and developed more positive attitudes toward science (Moore & Moore, 1989). According to Moore (2009), 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. Therefore, literacy should be used as a means for

investigating and learning about the natural world and scientific phenomena.

Royce (2014) combined the NGSS, literature, and art in her lesson ideas, and provided examples of how literacy can be used to enhance students' scientific learning. She used two different trade books for the age groups—*Michael Recycle* (Bethel, 2008) for K-2, and *Where Does the Garbage Go?* (Showers, 1994) for grades 3-5—to cover NGSS performance expectations and the three dimensions of the *Framework for K-12 Science Education: Disciplinary Core Ideas* (Earth and Human Activity), Science and Engineering Practice, and Crosscutting Concepts. Royce (2014) used the books as starting points for science lessons and then provided activities for students in the classroom and beyond that connect to human involvement in the environment. With the younger students, Royce (2014) had "waste" in a bin for the students to sort according to the specifications of the book. She began after reading the book by having students use a data sheet to illustrate what is and is not recyclable. The students then sorted their bins and made any corrections to their data sheets. Then, students chose one item that is and is not to be recycled to write out a sentence explaining why. Examples were then given on how to share their green knowledge with others.

At the 3rd to 5th grade range, Royce (2014) began by handing students a data sheet and asking them to define the difference between garbage and trash, and to explain what a recyclable is. After reading the book, they have a definition of the difference of each: Garbage is food waste, trash is dry waste, and recyclable material is glass, plastic, metal, and paper. The students were then asked to classify items on their data sheets using items at home and at school that would fit. Students were asked where their local garbage goes and given time to research online. Once they discovered where their waste goes, they must illustrate or write the path of their garbage on their data sheets. Students visited the book again to examine a pie chart on waste. Once it was determined that they could make a difference when it comes to recyclables, students added two commitment statements of action to their data sheets. As Royce (2014) demonstrated in these examples, environmental education can be supported by picture books (books in which the picture is as important as

the text and in which texts and illustrations complement each other to provide more than either can do alone).

The double media of print and illustration employed by picture books substantially expand the possibilities for student comprehension and enjoyment (Bishop & Hickman, 1992). The universal appeal of picture books makes them a good source for use at all levels from kindergarten through high school, and in content areas such as physical education, social studies, language arts, art classes, music, mathematics, and science (Richardson & Miller, 1997, p. 6). Regular read aloud times of picture books help young children learn to read and value reading, and foster language development. Similarly, children's appreciation of art can be boosted as the visual clues enable beginning readers to enjoy pictures by themselves (Short, Lynch-Brown, & Tomlinson, 1993, as cited in Richardson & Miller, 1997, p. 3). Furthermore, a review of literature pertaining to the benefits of pictures and illustrations on a student's comprehension and retelling skills reveals 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 (Nicholas, 2007; Weeks, 2013).

While picture books have long been thought of as appropriate only at primary grade levels because of their short length, simple plots, and minimal number of characters, many studies strongly suggest that the use of picture books increases engagement and learning among older students (Graham, 2000; Neal & Moore, 1992; Reiker, 2001). This increased learning and level of engagement is largely due to the visual nature of the medium, and the sense of community and safe environment that it helps create for all students, including those who are reading below grade level (Beckman & Diamond, 1981, as cited in Reiker, 2011; Kane, 2007, as cited in Reiker, 2011, p. 7). In the past 25 years, picture books have been rapidly gaining popularity among older readers (Olness, 2007). In fact, many issues raised in more recent picture books require a maturity level of understanding and background that young children do not possess (Richardson & Miller, 1997, p. 6). Moreover, authors and illustrators now frequently choose the picture book vehicle for tackling complex topics, some that would be entirely inappropriate for young readers (Reiker, 2011, p. 4). For example, picture books that promote examination of important social and

cultural issues such as war, homelessness, death, guns, and drugs would not be appropriate for a young audience (Lott, 2001, p. 30).

The literature shows environmental education to be an effective way to teach children to appreciate nature and want to protect the environment. However, a lack of time and money are cited by teachers as major factors as to why they do not cover environmental literacy in the classrooms (Stevenson et al., 2014). Stevenson et al. (2014) found that inclusion of environmental children's books in the curriculum could aid teachers in their ability to meet two standards at once. This study suggested that for environmental literacy to be taught in schools, teachers would need to combine literacy with science and make sure that appropriate texts were being used to make it meaningful.

Lack of time and money is not the only challenge that teachers face to cover environmental literacy in the classroom. Environmental education is also shown to be a frightening subject for some children, and therefore needs to be taught with sensitivity and caution. An inappropriate approach to environmental education that places excessive emphasis on what's wrong and on dramatic scenarios may cause children to perceive environmental issues as unchangeable and/or beyond their control. Children may be left feeling hopeless and disempowered. Consequently, the focus should be instead on nurturing children's appreciation of nature and on providing them with the knowledge and the skills required to become actively engaged in environmental causes.

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). According to Pringle and Lamme (2005), in many ways picture books allow teachers to energize the science program, and demonstrate the logical connections that exist between classroom learning and the natural world outside the classroom. Picture books can provide readers with an array of science information in a welcome and familiar format (Pringle & Lamme, 2005, p. 13).

Mantzicopoulos and Patrick (2011) provide convincing evidence that the regular inclusion of science picture books in science lessons accompanied by rich discussion and opportunities for making observations, raising questions, retelling, and rereading, provide invaluable opportunities for young children to engage with the language of science.

Another example of literature supporting the use of picture books in science lessons is *Picture perfect science lessons* by Ansberry and Morgan (2010). The authors combine the intrinsic appeal of children's picture books with standard-based science content, and describe how a picture book can help guide students through an engaging hands-on inquiry lesson. Among the reasons that Ansberry and Morgan (2010) provide as to why children's picture books make an excellent resource in science class are that they provide context for the concepts being explored, tend to focus on fewer topics, and give more in-depth coverage of a concept. Additionally, the colorful pictures and graphics in picture books help explain abstract ideas and correct science misconceptions.

Indeed, Common Core literacy standards are deeply connected to the NGSS. Appendix M for the Framework of the NGSS discusses this connection and shows that the NGSS are committed to ensuring that literacy standards are an integral part of science. Reading, writing, and communication/speaking are just some of the literacy standards that connect to NGSS (NGSS Lead States, 2013d). These standards are scaffolded in conjunction with NGSS performance expectations.

Overview and Research Questions

The current paper presents a new look on a previous analysis of children's picture books with ecology themes conducted by Rule and Atkinson (1994). To provide an up-to-date look at science integration today, ecology-themed picture books published both in English and Spanish from 1994 to the present were assessed and linked to the NGSS. Additionally, follow-up art projects that reinforce the content or message of the books and support a NGSS performance standard are suggested.

This study addresses the following research questions:

1. How do different children's books on ecology rate against criteria for quality and efficacy?
2. What ecology books in Spanish are available and recommended?

The goal of this study is to assist elementary school teachers in the process of selecting appropriate ecology-themed children's picture books that can help enhance student science learning. Quality and efficacy were determined by rating each book against twelve defined criteria using a 1-5 grading scale, and calculating the average score for each book (see research question number 1). Additionally, given the growth of the Hispanic population in the United States, there is an urgent need for better-equipped schools that meet students' specific linguistic needs. Teaching literacy in all content areas becomes, therefore, of paramount importance. Changing the *how* of teaching through the integration of literacy instruction in science learning can assist non-native English speakers in building their comprehension of both English language and scientific concepts. Similarly, non-native English speakers' writing and overall skills in communication can be supported through the integration of literacy into science lessons. Therefore, books in Spanish were identified through an online search, and their quality and effectiveness measured through the same process employed to rate books in English (see research question number 2).

Method

For this study, a content analysis of children's books conducted by the researchers was the primary form of data collection. The research team decided to analyze each book using an agreed upon approach that is explained in detail in the following section. After agreeing upon a quantitative scoring system for a total of 12 categories, the scores for each category for a given book were added and the book average score calculated. The reliability of the scores was ensured through the engagement of both team members in the analysis of each book and the clarification of the discrepancies encountered. Additionally, data were triangulated with published book reviews from NSTA Recommends, The Children's Literature, School Library Journal, Publishers Weekly, and Editorial Juventud, S. A. Similarly, other review

sources, including customer ratings from Goodreads and Amazon.com were utilized as well. The researchers monitored components related to student engagement, understanding of scientific concepts, and enjoyment through the observation of student performance in creating artwork.

Research Design

The first step of the content analysis portion of this study involved conducting a search to help identify books about ecology in English and Spanish to develop the annotated bibliography. Multiple books were found that discussed ecological topics such as natural ecosystems and life cycles, yet did not specifically address environmental awareness or ecological issues. Some of these titles were included in the final sample of 30 due to their age-appropriateness and value for conveying quality, accurate information about nature through text and illustrations. Likewise, the decision to include these titles was made based on their value for fostering nature appreciation and positive attitudes towards the natural world. See Appendix A for a list of the final sample of 30 children's picture books about ecology with a brief plot summary, arranged based on the primary focus of each book.

Next, a sample of six children's books not included in the final list was rated to identify rating criteria that required further clarification, determine where the most frequent disagreements evolved, and update rating instructions. See Table 1 for these books. Once a common understanding of the rating criteria was achieved, the process of analyzing each book began.

The analysis of selected books involved various phases that helped ensure its reliability, including: (1) Researchers individually taking text and picture walks through the book; (2) Researchers individually conducting a page-by-page analysis and scoring each book from 1-5 using an updated version of the rubric used in the published paper from Rule and Atkinson 1994 (See Table 2.); (3) Researchers conferring with each other; addressing discrepancies encountered; and updating rating criteria as needed; and (4) Triangulating the data with published book reviews from Barnes & Noble, NSTA Recommends, The Children's Literature, School Library Journal, and Publisher's Weekly,

and other review sources, including customer ratings from Goodreads and Amazon.com.

Table 1. *List of Ecology-themed Books Not Included in the Final Sample of 30*

Book Citation
Berkes, M. (2002). <i>Seashells by the seashore</i> . Nevada City, CA: Dawn Publications.
DiOrio, R. (2010). <i>What does it mean to be green?</i> Belvedere, CA: Little Pickle Press.
Franco, B. (2009). <i>Pond Circle</i> . New York, NY: Margaret K. McElderry Books.
Hopkins, H. J. (2013). <i>The tree lady: The true story of how one tree-loving woman changed a city forever</i> . New York, NY: Beach Lane Books.
Parr, T. (2010). <i>The Earth Book</i> . New York, NY: Little, Brown Books for Young Readers.
Schimmel, S. (1994). <i>Dear children of the Earth: A letter from home</i> . Minnetonka, MN: NorthWord Press

Methods of Data Collection and Instrumentation

Assisting elementary school teachers in the process of selecting appropriate and quality children's picture books with ecology theme that will support student science learning is the researchers' goal in writing this paper. According to Temple, Martinez, Yokota, and Naylor (1998), quality books are those that expand awareness in children and provide an enjoyable experience, without overtly teaching or moralizing. Quality books tell the truth, embody quality, have integrity, and show originality. The theme, genre, plot, characters, language, tone, and illustrations come together to provide a fulfilling experience. Situations are portrayed from a unique viewpoint, stretching the minds of children, and supplying them with new ways to think about the world.

Table 2. *Modified Version of the Rubric Categories Used Originally in the Published Paper from Rule and Atkinson (1994) and Now in the Current Study*

Category Used for Scoring Books
Title, Author, Illustrator, Date Published & Awards/Honors Status
Book Availability in Spanish and English
Listed Age Range per Book
Amazon Scores
Goodreads Scores
Nature Appreciation/Reasons for Score
Interrelatedness of Nature/Reasons for Score
Realistic Ecology Problem/Reasons for Score
Differing Perspectives/Reasons for Score
Hope for a Solution/Reasons for Score
Reflection and Responsibility/Reasons for Score
Steps for a Solution/Reasons for Score
Positive Tone/Reasons for Score
Representation of Diversity/Reasons for Score
Appropriate Illustrations/Reasons for Score
Story Appeal/Reasons for Score
Developmental Appropriateness/Reasons for Score
Average Book Score
Connections to the Next Generation Science Standards (NGSS)—a list of standards that can connect to the book (not rated)

Because a book content analysis involves assessing the content regarding the meanings, contexts, and intentions contained in messages (Prasad, 2008, p.1), a content analysis appeared to be a suitable method of data collection for this study. A page-by-page analysis was conducted and each book scored from 1-5 using an updated version of the rubric used in the published paper from 1994 (Rule & Atkinson, 1994). Indeed, a book content analysis allowed researchers to evaluate the quality of ecology-themed children's picture books, and how effectively authors and illustrators are conveying environmental concerns to children. The scaling categories and criteria for assessing picture books (including pictorial information books) are as shown in Table 3.

Data were collected through the updated version of the rubric used in the published paper from Rule and Atkinson (1994) shown in Table 2, and ratings assigned based on the following scale (see Appendix B for detailed description): (5) Outstanding—exceeds every part of the criteria with not one question in minds. (4) Very Good—meets criteria with slight omissions. (3) Good—covers the topic of the criteria but could do more. (2) Fair—may discuss one part or at least has some science related material. (1) Not Recommended—has no mention of the criteria at all.

Table 3. *Scaling Categories and Criteria for Assessing Children's Picture Books on Ecology*

Scaling Categories	Criteria
Nature Appreciation	Assesses the degree to which the book depicts beauty and harmony in nature. Answers the question, "What is the beauty of nature?"
Interrelatedness of Nature	Demonstrates the need for people's cooperation with nature. Shows how actions of one living thing affect others. Answers the questions, "Why is it like it is? What causes it? What are the effects? How is it changing?"
Realistic Ecology Problem	Presents an ecology problem in a realistic manner, without oversimplification or exaggeration. The effect of human choice on the situation is clear. Answers the questions, "What is it? How does it work?"
Differing Perspectives	Demonstrates different perspectives and interests on ecology problems. Answers the question, "What are the different points of view and values?"
Hope for a Solution	Assesses to what degree books convey a feeling of hope for a viable solution to the problem. Answers the question, "Is there hope for a solution?"
Reflection and Responsibility	Demonstrates the need for people's reflection about and awareness of their responsibility for caring for their planet. Answers the question, "What is my/our responsibility?"
Steps for a Solution	Rates books on whether there are actions that help to solve the ecology problem, whether there are actions that could be taken immediately by the reader, and whether at least some of the solutions could be realistically implemented by children. Answers the question, "What can be done to help solve the problem?"
Positive Tone	Emphasizes being effective in solving the problem rather than assigning blame or being "right." Positive and appropriate behaviors are emphasized, and the tone does not induce fear. Children are respectfully viewed as persons capable of thinking critically and logically. Answers the question, "What people's behaviors have a positive impact on the environmental issue?"
Representation of Diversity	Evaluates the degree to which stereotyping is avoided in treatment of either issues or characters. Answers the questions, "Does the book portray diverse populations? Is there diversity represented within cultural groups? Do the illustrations avoid reinforcing societal stereotypes? Are children portrayed as capable of creating change? Are different perspectives of the issue portrayed?"
Appropriate Illustrations	Assesses the degree to which illustrations enhance the text. Answers the questions, "Do illustrations complement and enhance the text? Are illustrations and photographs appealing? Do illustrations move the story forward?"
Story Appeal	Evaluates the characters and indicates whether the story has appropriate action, suspense, pace, and outcome. Answers the question, "Is the story structured and presented in a way that engages readers on both an intellectual and an emotional level?"
Developmental Appropriateness	Rates books on the appropriateness of concepts, vocabulary, and sentence structure. Answers the questions, "Is the information age appropriate to ensure children can understand it? Is the information accurate? Does the information eliminate threats to young readers?"
Connections to the Next Generation Science Standards (NGSS)	List of Next Generation Science Standards researchers feel can be accomplished with the book. This criterion is not rated.

Results and Discussion

Table 4 shows the scores that each book included in the study was given for each category as well the Overall Mean Score for each book. The scores in the table for each category are the mean of the two researchers' scores (the first and second authors). The Overall Mean Score of each title is the average of scores for that book. Of 30 books included in the analysis, 16 were given an average score of 4 or above, 12 scored between 3.5 and 3.9, and 2 were given 3.3 and 3.1

respectively. Seven books were identified and included in the study that are available both in English and Spanish, and one book was selected that is only available in Spanish. Only one book available in Spanish and English ranked within the top five with an overall mean score of 4.5, tying with two other books for fourth place in the study's rank. Three books, one of them available only in Spanish and the other two in English and Spanish, scored between 4.0 and 4.4. Lastly, of the four remaining books available in both languages, one scored 3.6 and three scored 3.5.

Table 4. Scores Given to the Study's Books for Each Category and Overall Mean Scores

Ranking, Title, Author, Illustrator, Date	Available in Spanish and English	Nature Appreciation	Interrelatedness of Nature	Realistic Ecology Problem	Differing Perspectives	Hope for a Solution	Reflection and Responsibility	Steps for a Solution	Positive Tone	Representation of Diversity	Appropriate Illustrations	Story Appeal	Developmental Appropriateness	Overall Mean Scores
1. <i>One well: The story of water on Earth</i> (Citizenkid), Rochelle Strauss, Rosemary Woods, 2007	No	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	4.0	4.0	4.0	4.8
1. <i>A place for turtles</i> , Melissa Stewart, Higgins Bond, 2013	No	5.0	5.0	5.0	5.0	5.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	4.8
3. <i>Olivia's birds: Saving the Gulf</i> , Olivia Boulter, Olivia Boulter, 2011	No	5.0	3.0	5.0	4.0	5.0	5.0	5.0	5.0	3.0	5.0	5.0	5.0	4.6
4. <i>The great big green book/El gran libro de la ecología</i> , Mary Hoffman, Ros Asquith, 2015	Yes	5.0	5.0	5.0	4.5	4.5	5.0	4.5	4.5	4.0	4.0	4.5	3.0	4.5
4. <i>How to help the Earth by the Lorax</i> , Tish Rabe, Christopher Moroney, 2012.	No	5.0	4.0	5.0	4.0	5.0	4.0	5.0	4.5	3.0	5.0	5.0	5.0	4.5
4. <i>Why are the ice caps melting? The dangers of global warming</i> , Anne Rockwell, Paul Meisel, 2006	No	5.0	5.0	3.0	5.0	5.0	5.0	5.0	4.0	5.0	5.0	4.0	3.0	4.5

Table 4 Continued. Scores Given to the Study's Books for Each Category and Overall Mean Scores

Ranking, Title, Author, Illustrator, Date	Available in Spanish and English	Nature Appreciation	Interrelatedness of Nature	Realistic Ecology Problem	Differing Perspectives	Hope for a Solution	Reflection and Responsibility	Steps for a Solution	Positive Tone	Representation of Diversity	Appropriate Illustrations	Story Appeal	Developmental Appropriateness	Overall Mean Scores
7. <i>No monkeys, no chocolate</i> , Melissa Stewart & Allen Young, Nicole Wang, 2013	No	4.5	5.0	4.5	4.0	5.0	3.0	5.0	4.0	3.0	5.0	5.0	4.5	4.4
7. <i>Oil spill!</i> , Melvin Berger, Paul Mirocha, 1994	No	3.0	5.0	5.0	3.0	5.0	5.0	5.0	4.0	4.0	5.0	4.0	5.0	4.4
7. <i>Wangari's trees of peace/Wangari y los árboles de la Paz</i> , Jeanette Winter, Jeanette Winter, 2008	Yes	5.0	5.0	4.0	4.0	5.0	5.0	5.0	5.0	2.0	4.0	4.5	4.0	4.4
10. <i>One plastic bag: Isatou Ceesay and the recycling women of the Gambia</i> , Miranda Paul, Elizabeth Zunon, 2015	No	2.0	5.0	4.0	5.0	5.0	5.0	3.5	5.0	3.0	4.0	5.0	5.0	4.3
11. <i>The promise</i> , Nicola Davies, Luran Carlin, 2013	No	3.0	3.5	4.0	5.0	5.0	3.5	4.5	4.0	5.0	4.0	5.0	4.0	4.2
12. <i>The tree</i> , Dana Lyons, David Danioth, 2002	No	5.0	5.0	4.0	4.0	4.0	4.0	1.0	4.0	4.0	5.0	4.5	4.5	4.1
13. <i>Earth remembers when</i> , Dawn Wynne, Gloria Piñeiro, 2012	No	5.0	5.0	3.0	3.0	3.0	5.0	5.0	3.0	3.0	5.0	5.0	3.0	4.0
13. <i>Life in the ocean: The story of oceanographer Sylvia Earle</i> , Claire A. Nivola, Claire A. Nivola, 2012	No	5.0	5.0	4.5	4.0	4.0	3.0	1.0	4.5	3.0	5.0	5.0	4.0	4.0
13. <i>Our planet in danger/Nuestro planeta en peligro</i> , Donald Grant, Donald Grant, 2008	Yes, only	5.0	5.0	4.0	4.0	3.0	4.0	5.0	3.0	3.0	5.0	3.5	3.0	4.0
13. <i>The sea, the storm, and the mangrove tangle/El mar, la tormenta y el manglar</i> , Lynne Cherry, Lynne Cherry, 2004	Yes	5.0	5.0	3.0	4.0	3.0	3.0	3.0	3.0	4.0	5.0	5.0	4.0	4.0

Table 4 Continued. Scores Given to the Study's Books for Each Category and Overall Mean Scores

Ranking, Title, Author, Illustrator, Date	Available in Spanish and English	Nature Appreciation	Interrelatedness of Nature	Realistic Ecology Problem	Differing Perspectives	Hope for a Solution	Reflection and Responsibility	Steps for a Solution	Positive Tone	Representation of Diversity	Appropriate Illustrations	Story Appeal	Developmental Appropriateness	Overall Mean Scores
17. <i>Because of an acorn</i> , Lola M. Schaefer & Adam Schaefer, Frann Preston-Gannon, 2016	No	4.0	5.0	4.0	2.0	4.0	3.0	5.0	4.0	3.0	4.0	5.0	4.0	3.9
17. <i>Compost stew</i> , Mary McKenna Siddals, Ashley Wolff, 2010	No	2.0	3.0	3.0	4.0	5.0	3.0	5.0	5.0	3.0	4.5	5.0	4.0	3.9
17. <i>The drop in my drink: The story of water on our planet</i> , Meredith Hooper, Chris Coady, 1998	No	5.0	3.0	4.0	4.0	4.0	3.0	1.0	4.0	4.0	5.0	5.0	4.5	3.9
20. <i>The eye of the whale: A rescue story</i> , Jennifer O'Connell, Jennifer O'Connell, 2013	No	4.5	3.5	3.5	4.0	4.0	3.0	1.0	4.0	3.5	5.0	5.0	4.5	3.8
20. <i>Salmon forest</i> , David Suzuki & Sarah Ellis, Sheena Lott, 2006	No	5.0	5.0	3.0	4.0	4.0	3.0	1.0	4.0	3.0	5.0	4.5	4.0	3.8
22. <i>Let's save the animals/Salvemos a los animales</i> , Frances Barry, Frances Barry, 2010	Yes	3.0	4.0	3.0	2.5	4.0	5.0	5.0	3.0	3.0	4.0	4.0	3.0	3.6
22. <i>Olly the oyster cleans the bay</i> , Elaine Ann Allen, Kelly Nash, 2008	No	5.0	4.0	3.0	3.5	4.0	3.0	1.0	4.0	3.0	4.0	5.0	4.0	3.6
22. <i>Uno's garden</i> , Graeme Base, Graeme Base, 2006	No	4.0	5.0	3.0	4.0	3.0	3.0	1.0	3.5	3.0	5.0	5.0	3.5	3.6
25. <i>Baby whale's journey</i> , Jonathan London, Jon Van Zile, 1999	No	4.0	4.0	3.0	3.0	4.0	3.0	1.0	4.0	3.0	4.0	5.0	4.0	3.5
25. <i>The old tree/ El viejo árbol</i> , Ruth Brown, Ruth Brown, 2007	Yes	4.0	4.0	3.0	3.5	4.0	3.0	1.0	4.0	3.0	5.0	4.0	4.0	3.5
25. <i>Peter's place/La playa de Pedro</i> , Sally Grindley, Michael Foreman, 2003	Yes	5.0	4.0	4.0	4.0	3.0	3.0	1.0	2.0	3.0	5.0	5.0	3.0	3.5
25. <i>Why should I save energy? ¿Por Qué Debo Ahorrar Energía?</i> , Jen Green, Mike Gordon, 2012	Yes	2.5	1.5	2.0	4.0	5.0	3.0	5.0	3.0	3.0	4.0	5.0	4.0	3.5
29. <i>The world that we want</i> , Kim Michelle Toft, Kim Michelle Toft, 2005	No	5.0	5.0	3.0	2.0	1.0	3.0	1.0	3.0	3.0	5.0	5.0	3.0	3.3
30. <i>A drop around the world</i> , Barbara Shaw McKinney, Michael S. Maydak, 1998	No	4.0	4.0	2.0	2.0	3.0	3.0	1.0	4.0	3.0	4.5	3.0	4	3.1

The 30 books examined for this study were divided into groups based on their main ecological focus. Some of the titles address multiple issues, but they all focus largely on one definable topic. It is important to note that the themes discussed in these books are highly relatable to children, allowing them to identify with important and, sometimes, complex environmental issues. For example, the issues of pollution and destruction of habitats are topics to which most children can relate. Litter on the ground and construction sites are commonplace and visible for most children on a daily basis. Therefore, most children should be able to make connections between what is depicted in a picture book about pollution or habitat destruction and their real lives. Another example of the relatability of the topics addressed in children's picture books with an ecological theme can be found in the topic of endangered animals. Most children find animals fascinating and love learning about them, watching their antics, and even developing special relationships with them. It only makes sense that the concept of endangered animals should be included in ecology-themed children's picture books.

Book analysis based on ecological focus.

The following main themes emerged from analyzing the study's books: Ecosystem/Life Cycles; Pollution; Destruction of Habitats; Environmental Activists/Biographies; Recycling/Going Green; and Endangered Animals. The books are briefly discussed in this section in relation to the way the authors and illustrators convey these environmental problems and solutions.

Ecosystems/life cycles. The four books out of the research set that discuss ecosystems and life cycles take a similar approach to the treatment of the topic. No environmental issue is addressed or ideas for action provided, but they all foster an appreciation of nature. Likewise, these books educate children on the interrelatedness between living things in an ecosystem and the key role each element plays in maintaining a balanced system.

The cumulative story and lush illustrations in *The world that we want* (Toft, 2005), and the simple text and colorful illustrations in *Because of an acorn* (Schaefer & Schaefer, 2016), get the message across in a simple and

child-friendly manner that humans have to take care of every part in an ecosystem to maintain its balance. These two books are not told, however, through a specific character to which children may be able to relate, so they may have difficulty connecting with the story. In *The world that we want* (Toft, 2005) the interconnectedness of the nine habitats portrayed is explored and the dangers that threaten each one of them described, yet the environmental message may be lost due to children's lack of personal connection to the habitats depicted. *Salmon forest* (Suzuky & Ellis, 2006), on the other hand, tells the story of a father who takes his daughter on a trip that introduces children to the salmon cycle.

Told from a familiar perspective, the book is informative, yet engaging. This book serves as a good introduction to the concept of ecosystem while still allowing children to relate to the story.

Unlike *Salmon forest* (Suzuky & Ellis, 2006), *Olly the oyster cleans the bay* (Allen, 2008) features animal characters, but the sea creatures succeed in showing in this tender story how important it is to keep oceans clean to ensure the continued survival of all its creatures. However, the book relies heavily on the story of the main character, a young oyster, rather than discussing the impact that human action has on the ocean. Consequently, children may not be able to make the connection and understand the role that humans play in maintaining the ocean clean.

Pollution. The way this environmental issue is addressed in the seven titles included in this group varies from book to book. *Oil spill!* (Berger, 1994) and *La playa de Pedro/Peter's place* (Grindley, 2003) show in a somber and serious manner the devastating impact that oil spills have on the environment. *Olivia's birds: Saving the gulf* (Bouler, 2011), on the other hand, tells the story of an 11-year-old girl who made a difference by selling her own bird drawings and donating the money raised to saving the wildlife affected by the Gulf oil spill (the Deepwater Horizon BP spill) in 2010. Olivia's story will probably be more enjoyable or, at least, feel less overwhelming for children when compared to *Oil spill!* (Berger, 1994) and *La Playa de Pedro/Peter's Place* (Grindley, 2013) due to the positive tone throughout the book and the accessibility of the book content. For example, birds are organized according to child-friendly classifications, like "Birds That Live in the Woods" and "Weird & Wacky Birds". These

child-friendly categories will likely help children understand the informational snippets included in the book. Conversely, the spill cleanup and containment methods described in *Oil spill!* (Berger, 1994), including skimmers, booms, absorbent materials, and poisonous chemicals, may be difficult for children to comprehend, thus making them feel more disconnected with the environmental issue.

Three of the books under this category send a powerful message about the importance of water and its conservation and protection—*The drop in my drink: The story of water on our planet* (Hooper, 1998), *A drop around the world* (McKinney, 1998), and *One well: The story of water on Earth* (Strauss, 2007). These books are set in locations around the world and/or historical settings that may be unfamiliar to kids. While they support children understanding the changeable nature of water and its importance to sustain life, the underrepresented setting and distant time frame will probably make it difficult for them, especially younger children, to identify with the ecological topic. Understanding abstract concepts like the global importance of water can be challenging for young children, whereas stories that take place in modern day America and in the immediate environment of the children will likely be more easily relatable for them.

Of the seven books included in this group, three of them—*The drop in my drink: The story of water on our planet* (Hooper, 1998), *A drop around the world* (McKinney, 1998), and *La playa de Pedro/Peter's place* (Grindley, 2003)—do not provide feasible ideas for action that children can take to help the natural environment. The remaining four do suggest specific solutions either in the Author's Note section of the book or during the book.

Destruction of habitats. The issue of habitat destruction is addressed in very different ways in the eight books grouped under this theme. *El viejo árbol/The old tree* (Brown, 2007) tells the story of an old tree which is about to be cut down, but the tree inhabitants manage to come together and save their home. *The sea, The storm, and the mangrove tangle* (Cherry, 2004), on the other hand, tells about the destruction of not just one tree, but an entire mangrove habitat. Children may, however, find it easier to understand the consequences that habitat destruction has for the environment from stories that take place in a smaller habitat, like a tree. Moreover, the idea of a whole habitat destruction

in general may also feel too big for children and beyond their capabilities to take action to help.

Uno's garden (Base, 2006) and *The promise* (Davies, 2013) portray how gloomy and gray a place feels when trees are cut down to make room for development. Set in an imaginary forest inhabited by imaginary creatures, the interesting animals featured in *Uno's garden* (Base, 2006) undergo the change from a lush and colorful place to a treeless, gloomy one as a result of the urbanization that takes place. Unlike *Uno's garden* (Base, 2006), *The promise* (Davies, 2013) starts out by showing a grey and gloomy city that may seem a bit poignant at first but, as the story develops, shows an increasingly colorful and hopeful world filled with trees.

The tree (Lyons, 2002) and *No monkeys, no chocolate* (Stewart & Young, 2013) raise children's awareness of the importance of rainforests by stressing how they provide a habitat for more species of plants and animals per square foot than any other habitat in the world. *The tree* (Lyons, 2002) is a simple but engaging story about all the things an 800-year-old Douglas fir has seen over its life. The wildlife the tree has sheltered, the river, the wind, the snow it has seen, all make for an interesting story that will hold children's attention throughout while allowing them to learn their responsibility to protect trees. On the other hand, *No monkeys, no chocolate* (Stewart & Young, 2013) is a non-fiction picture book that describes the life cycle of the cocoa tree. The text is very descriptive; however, the colorful illustrations support the descriptions, and the way the book keeps children wondering what the link between monkeys and chocolate is—due to the answer not being provided until the end—will maintain children engaged despite the lengthy text.

While some books, including *El viejo árbol/The old tree* (Brown, 2007) and *The tree* (Lyons, 2002), do not provide suggestions for actions that children can take to help environmental causes, *Earth remembers when* (Wynne, 2012) offers tips that are immediately actionable by children to make a positive impact on the environment. Some tips include using fabric bags instead of plastic baggies for snacks and sandwiches, using rechargeable batteries, unplugging anything that is not in use, and bringing their own utensils and cloth napkins to school.

Interestingly, most of the books included in this group portray the loss of natural habitat and development as a bad thing. The authors either explicitly express their negative view of habitat destruction or portray their negative views through the book illustrations. In *Nuestro planeta en peligro/Our Planet in Danger* (Grant, 2008), for instance, the environmental issues of pollution, deforestation, and overfishing are depicted in a clear, yet rather threatening manner for young children. Children are solely exposed to the consequences that the alteration of the environment has for the animals and plants that utilize that particular environment, which may leave them feeling like humans are causing irreparable damage to the environment. Having said that, it is important to note that, even though children are not exposed to differing perspectives on the environmental issue addressed in these books, the stories provide a good discussion point for why habitat destruction is also necessary to meet humans' needs.

Environmental activists/biographies. A commonality between the three books included in this group—*Life in the ocean: The story of oceanographer Sylvia Earle* (Nivola, 2012), *One plastic bag: Isatou Ceesay and the recycling women of the Gambia* (Paul, 2015), and *Wangari's trees of peace: A True Story from Africa* (Winter, 2008)—is that they all tell an inspirational story based on the life of strong, independent women who were passionate about something and who did not get deterred by the obstacles they found along the way. While addressing different environmental issues, these three stories carry within them an important message: It only takes one person to cause change; we only need to stand up for what we believe. *Life in the ocean: The story of oceanographer Sylvia Earle* (Nivola, 2012) illustrates the amazing diversity of the marine environment and the important role that oceans play in supporting our planet—from releasing oxygen, to shaping weather patterns, to providing a home to thousands of different types of creatures and life-forms. Education and environmental awareness are presented in this book as the first steps in making a difference since ignorance is said to be at the root of our actions. People cannot care if they do not know; therefore, they need to learn everything they can about the ocean. *Wangari's trees of peace: A True Story from Africa* (Winter, 2008), on the other hand, does not explicitly state the key role that education and

awareness play in people's ability to make informed decisions regarding the natural environment, but shows how Wangari Maathai used her education, intelligence, and creativity to make Kenya, and the world, a better place. *One plastic bag: Isatou Ceesay and the recycling women of the Gambia* (Paul, 2015) tackles the issue of the increasing amount of trash in Isatou Ceesay's village and depicts her efforts to improve her community. While set in an underrepresented location, Isatou's story will likely be relatable to most children as the sight of trash on the ground may be familiar to almost every child. Isatou's story shows how the smallest efforts can make a great impact. This will probably inspire children to make their small contribution knowing it will make this world a better place.

The impact that deforestation and pollution have on the environment is depicted differently in the three books in this category. The artwork in both *One plastic bag: Isatou Ceesay and the recycling women of the Gambia* (Paul, 2015) and *Wangari's trees of peace: A true story from Africa* (Winter, 2008) depicts how the beauty of nature is undermined when the trees are gone or trash is everywhere, and restored when trees come back or trash is removed. *Life in the ocean: The story of oceanographer Sylvia Earle* (Nivola, 2012), however, depicts a healthy ocean brimming with life. No trash, oil spill, or industrial waste are portrayed in the book's colorful and compelling illustrations. But the environmental message is still there. The Author's note at the end sends a powerful message and clearly demonstrates how human disrespectful treatment of the ocean has a devastating impact on it.

Recycling/going green. Four books out of the research set focus on recycling. Although the process of recycling may be confusing for children, as the majority of them do not have the opportunity to see how paper plates or glass bottles are turned into reusable objects, the act of disposing of recyclables will likely be familiar to many of them. The value of recycling is discussed in *How to help the Earth by the Lorax* (Rabe, 2012) and *El gran libro de la ecología/The great big green book* (Hoffman, 2015). *Compost stew* (Siddals, 2010) does not, however, enlighten children about the purpose of composting, but rather it is only portrayed as a fun activity in which even younger children can participate.

¿Por qué debo ahorrar energía?/Why Should I Save Energy (Green, 2012) discusses why energy conservation is

important, but the consequences of a careless use of energy that are depicted in the book only refer to humans' needs, such as food shortage and power outages, without discussing its impact on the natural environment.

How to help the Earth by the Lorax (Rabe, 2012) conveys the need for the conservation of our natural resources in a child-friendly and non-threatening manner. However, *¿Por qué debo ahorrar energía? / Why should I save energy* (Green, 2012) and *El gran libro de la ecología/The great big green Book* (Hoffman, 2015) appear to give the message that either humans give back to the Earth or else they disappear, probably leaving children feeling overwhelmed. Additionally, the idea that the Earth may one day run out of resources may be difficult for younger children to understand. The planet's natural resources will not be exhausted overnight, but rather their depletion will become a problem in the future. But young children lack the ability to comprehend the abstract concept of future and, therefore, will probably have difficulty understanding the relevance of this environmental issue.

Endangered animals. Four books discuss the issue of endangered animals. *A place for turtles* (Stewart, 2013) addresses how human activities pose a threat to the continued existence of turtles. Lavish and superbly detailed illustrations portraying different types of turtles and humans engaged in activities to assist these beautiful animals, will enthrall and empower children to do their part in protecting these creatures. The book depicts a balanced representation of the destruction of turtle habitats by providing both a positive and a negative viewpoint of the problem. It shows, for instance, how the construction of a highway and the expansion of a school impact negatively the natural landscape, while still presenting this development as necessary and providing solutions to minimize its impact.

Baby whale's journey (London, 1999) tells the story of a baby sperm whale's life with her marine community. The book provides an insight into the life in the ocean and the book's Author's Note briefly refers to how commercial whaling has an impact on the sperm whale population. The threat that fishing lines pose to whales is, on the other hand, more realistically portrayed in *The eye of the whale: A rescue story* (O'Connell, 2013). An amazing true story of a whale rescue is told in a simple way that captures the beauty of the encounter of the divers with this magnificent creature, and

shows how certain fishing practices endanger whales. The marine environment may be unfamiliar for most children, making it difficult for them to identify with the story. However, the tale of a sperm whale mother protecting her baby from danger makes the story more relatable to young children who will be able to understand how animals form communities that help them survive.

Salvemos a los animales/Let's save the animals (Barry, 2010) introduces children to some endangered animals. This book teaches important facts about endangered animal species and how their habitat and survival are put at risk due to environmentally-unfriendly practices in which humans engage. Most children may have, however, little first-hand experience with some of the animals portrayed—rhinos, orangutans, tigers, and polar bears—which may make it difficult for them to find a connection. Additionally, the first pages show beautiful and colorful cut-out animals and then one page at the end of the book shows black silhouettes. A great way to show extinction, yet potentially upsetting for younger children.

Book analysis based on rating criteria for environmental education.

The books reviewed have been briefly discussed in relation to the way the authors convey environmental problems and solutions within each ecological focus. The following categories for quality and efficacy in supporting ecological education were used to rate the study's books and will be addressed here (See Table 3 for scaling categories and criteria for assessing children's picture books on ecology):

Nature appreciation. "You can't care if you don't know" (Sylvia Earle, as cited in Nivola, 2012). Ignorance is the root of the problem as a lack of knowledge and awareness prevents people from making appropriate, informed decisions regarding the environment. Therefore, the first step in teaching children to care about the environment is perhaps to educate them and nurture in them an appreciation of nature.

Out of the study's list of 30 books, 20 speak specifically about the natural environment and display it lavishly in the illustrations. In *La playa de Pedro/Peter's place* (Grindley, 2003), the beauty of the coastline is poetically described, while the lavish artwork portrays how the coastline

is better and more beautiful when it is clean than when it is covered with crude oil. In *A place for turtles* (Stewart, 2013), the choice of language brings the beauty of nature directly home. The stunning illustrations are painted with such attention to detail that the country settings feel almost real. Likewise, readers feel like they can hear the sounds of nature and touch the multiple turtles depicted throughout the book.

Other books have a subtler way of depicting nature appreciation. While fostering a love of nature, eight books included in this study are not quite as lavish in their presentation of the natural environment. For example, in *¿Por qué debo ahorrar energía? /Why should I save energy?* (Green, 2012) it is not until the end that the author shows how nature is better when humans care about it and are careful in their use of energy. Instead, the author's main focus is on giving reasons as to why people should save energy and what would happen if they use energy carelessly. Of the 30 books, two do not show nature appreciation whatsoever. While sending a powerful message about the importance of recycling, *One plastic bag: Isatou Ceesay and the recycling women of the Gambia* (Paul, 2015) discusses the issue of garbage in Gambia without explicitly depicting the beauty of nature or showing how nature is better without garbage. Similarly, *Compost stew* (Siddals, 2010) teaches children how to make compost, but again, it fails to explain and represent how the world is better and more beautiful when people make composting a routine.

Interrelatedness of nature. Everything in an ecosystem is connected and the actions of one living thing can affect the lives of many. If educators want children to begin to develop a passion for helping nature thrive, then they need to foster their awareness of how their own actions can help or harm the planet. Indeed, children's understanding of the causality in nature will affect their own decision making. Therefore, researchers examined to what extent books demonstrate that there is a connection between every living thing in an ecosystem and how the actions of one living thing, especially humans, can affect the lives of many.

Six books fail to show the interconnectedness of nature. While effective in teaching children ways they can save energy, *¿Por qué debo ahorrar energía? /Why should I save energy?* (Green, 2012) does not demonstrate how the actions of one living thing affect others. Children are given

the message that if they do not use energy carefully, there will be consequences for them and other people—no warm food, no buses, no computers. However, the impact that a careless use of energy may have on the natural environment and other living things is not described. The *eye of the whale: A rescue story* (O'Connell, 2013) and *Oil Spill!* (Berger, 1994) demonstrate how human actions negatively impact the marine wildlife, but the story fails to illustrate the connection that exists between different living things in the marine ecosystem or how, for instance, the food chain is impacted when there is an oil spill. *Olivia's brds: Saving the gulf* (Bouler, 2011) and *Salvemos a los animales/Let's save the animals* (Barry, 2010) send the message that humans need to protect animals and cooperate with nature. While both books refer to human activities that are putting wildlife at risk, the connection between the different species that exist in an ecosystem is, once again, not clearly portrayed. Similarly, *Compost stew* (Siddals, 2010) gives children a recipe to nourish the Earth, but the connection between composting and a healthier planet is not depicted.

Books like *No monkeys, no chocolate* (Stewart & Young, 2013) and *Salmon forest* (Suzuky & Ellis, 2006) explicitly show how an ecosystem works in harmony and how each part plays its own vital role. Other books, like *The drop in my drink: The story of water on our planet* (Hooper, 1998) and *One well: The story of water on Earth* (Strauss, 2007) show the interconnectedness of nature by emphasizing the importance of water to all living things on Earth.

Realistic ecology problem. How humans think about the environment, how they frame it in their minds begin to form in childhood. If the goal of environmental education is to support children becoming stewards of their environment, then environmental issues need to be represented realistically and as a social problem. Children need to be exposed, in a developmentally-appropriate manner, to the realities of human interactions with the environment and the resulting environmental social problems that occur. This study looked to see whether the books present an ecology problem in a realistic manner, without oversimplification or exaggeration, and whether the effect of human choice on the situation is clear. Additionally, researchers looked at the way the book does or does not support children feeling cheerfully empowered by what they learned through the reading.

Eighteen books out of the research set do encourage children to take action. While some of these books do not provide specific ideas for action, they still convey the message that humans, including children, can contribute to the health of the planet. Twenty-three books explicitly discuss the impact that human action has on the environment, and fifteen books show the environmental issue in a realistic way, although the problem is occasionally presented in a manner that may be frightening for young children.

Olly the oyster cleans the bay (Allen, 2008), for example, tells how sea creatures keep the ocean clean; however, children may have difficulty making connections between the need for humans to clean up the environment and the issues in the Chesapeake Bay. *A drop around the world* (McKinney, 1998) expands children's awareness of the water cycle and the importance of water for life, and provides interesting information about water in the book's Author's Notes. Nonetheless, it does not really address any water-related environmental issue except for pollution which is briefly discussed. *One well: The story of water on Earth* (Strauss, 2007), on the other hand, makes a strong case for water conservation by emphasizing the vital importance of freshwater on Earth. This book makes readers understand how much people rely on water for survival and think about water usage in a different way.

While some books convey the environmental issue realistically, they present the topic in a way that may be upsetting or overwhelming for younger children. *Nuestro planeta en peligro/Our planet in danger* (Grant, 2008) clearly demonstrates the impact that human actions have on the environment. The three stories that the book encompasses, however, may upset children as they read about a mother polar bear that is shot, rainforest animals that barely escape death as they find themselves in the middle of a group of loggers, and a fisherman's daughter who takes shelter from a typhoon in a coral reef. Like *Nuestro planeta en peligro/Our planet in danger* (Grant, 2008), *Earth remembers when* (Wynne, 2012) teaches about the devastating impact that human activities have on the Earth by illustrating what Mother Earth used to look like and what it looks like now as a result of the damage that humans have inflicted on nature. But again, the picture painted in the book may be scary to young children who may feel like the problem is so big and complex

that there is nothing they can do about it. *How to help the Earth by the Lorax* (Rabe, 2012), however, conveys the need for conserving our natural resources and for reducing, reusing, and recycling in a child-friendly manner without oversimplifying or exaggerating the issue. Additionally, the book suggests realistic ways in which children can reduce waste, thus supporting them feeling empowered by what they learned from reading the book. Another example of realistic, yet non-threatening portrayal of an environmental issue is to be found in *Olivia's birds: Saving the gulf* (Bouler, 2011). The catastrophic consequences that oil spills have on the environment and the need to save the ecosystem of the Gulf of Mexico are easy to understand for children. But at the same time, the author supports children feeling empowered by what they just learned as Olivia herself could make a difference.

Differing perspectives. Younger elementary school children have trouble seeing the world through others' points of view; therefore, a book told from a familiar perspective, like that of a human child, may be the easiest for them to relate to and understand the impact of the environmental concern. However, exposing children to alternative perspectives that show a balanced view of the environmental issue will help increase their ability to take such perspectives. Therefore, researchers identified how authors support students making sense of the natural world and determined whether or not differing perspectives are provided.

Sixteen of the 30 books included in the study tell the story through the lens of a human being, whereas fourteen presented the story from the point of view of multiple characters including an acorn, a drop of water, sea creatures, a cocoa tree, or the Earth. This is not a bad thing in itself as the stories presented are often relatable to children regardless of the nature of the main characters. For example, *Baby whale's Journey* (London, 1999) shows the efforts of a mother whale to protect her baby. The main characters may not be human, but children will be able to identify with the story as they have experienced their own mothers looking after them. *Uno's garden* (Base, 2006) is set in an imaginary forest with made-up creatures. Both the setting and characters may be unfamiliar to children, but the funny names and faces of the forest creatures, and the story plot will engage children in a story that conveys the seriousness of the environmental issue.

Interestingly, only five books present different perspectives of the environmental issue. *Why are the ice caps melting? The dangers of global warming* (Rockwell, 2006), for example, discusses the negatives and the reasons why we need things like electricity and gasoline for cars. This book portrays the seriousness of global warming and discusses human actions that increase carbon dioxide emissions, while still explaining how not everyone believes that humans cause global warming. Similarly, *A place for turtles* (Stewart, 2013) shows both sides of the ecological problem. Human activities that are harming turtles are described, including building highways and removing turtle natural habitats for development purposes. But instead of condemning these activities, the book gives the message that they are necessary and shows ways in which humans can minimize their impact on the environment, such as creating new wetlands when a habitat needs to be moved due to the expansion of a school. Conversely, some books do not go into the different sides of environmental issues, but rather focus on the harm that human actions inflict or have inflicted on the environment without presenting an alternative view of the problem. But by simply focusing on the damage that habitat destruction or air pollution inflict to nature—like in *Uno's garden* (Base, 2006) and *Earth remembers when* (Wynne, 2012) respectively—without showing children the arguments for housing developments or incinerators, children are not given the opportunity to engage their critical thinking skills and make decisions for themselves.

Hope for a solution. When children are high in hope, they face problems and find solutions. They are able to withstand and endure difficulties as opposed to denying them. If teachers want children to look towards the future with confidence and believe in their own capability to enact change in environmental-related matters, a sense of hope needs to be fostered in them. To boost children's confidence in environmental matters, books should refrain from focusing on the negative impact that humanity has on the environment. Such focus on catastrophic environmental impacts may, in fact, lead children to view environmental issues as too depressing and too large for them to surmount. This study examined to what extent books convey a feeling of hope for a viable solution to the problem.

Twenty-three books out of the research set convey a positive hope for a viable solution to an environmental problem. Particularly optimistic are *A place for turtles* (Stewart, 2013), where with every problem presented there is a solution provided as well; *How to help the Earth by the Lorax* (Rabe, 2012), a cheerful and fun book which, while addressing the serious environmental issue of pollution, also suggests solutions that are immediately actionable by children; and *Olivia's birds: Saving the gulf* (Bouler, 2011), which shows how a girl used her talent as an artist to help raise money for relief efforts after the spill that occurred in 2010. All these books send an extremely optimistic feeling and leave readers with a desire to help. Books like *Wangari's trees of peace* (Winter, 2008), *One plastic bag: Isatou Ceesay and the recycling women of the Gambia* (Paul, 2015), *Oil spill!* (Berger, 1994), and *Olly the oyster Cleans the Bay* (Allen, 2008) demonstrate how caring for the environment is a group responsibility and how communities can work together to make a difference. Other books, including *Salmon forest* (Suzuky & Ellis, 2006) and *Baby whale's Journey* (London, 1999), do not address any environmental issue, but there is a positive tone throughout them. In fact, they both display the beauty of the natural environment and foster an appreciation and love of nature that contributes to a sense of balance with other living things on Earth.

Six books convey a mixed array of emotions. *La playa de Pedro/Peter's place* (Grindley, 2003), for example, conveys optimism and a message of tenacity of life when it tells about the oil spill cleanup crew's efforts and the resulting recovery of the coast. However, a message of little hope is also sent when the coastline is referred to at the end of the book as being scarred forever. Another example of mixed feelings can be found in *Earth remembers when* (Wynne, 2012) in which some alarming facts about the impact that careless human actions have on the planet are depicted. The picture conveyed is rather scary, but readers are not left feeling hopeless as the book communicates a positive feeling of hope through viable solutions to the problems caused by humans.

Only one book fails to convey hope for a viable solution to the ecology problem—*The world that we want* (Toft, 2005). This book focuses on nature's delicate balance and explains that the biggest threat that wildlife faces is the

destruction of natural habitats. Children are confronted with an environmental problem, the need for climate change and pollution to be reduced, but no viable solutions are mentioned, which may leave children feeling that it is not within their capability to help.

Reflection and responsibility. Environmental education is aimed to increase knowledge about environmental issues and provide the skills that support making informed decisions and active citizenship. In order to teach children how to make decisions for themselves, educators should ensure that the books employed for such purpose in fact promote children's reflection about environmental issues and support their becoming responsible for their actions. Researchers examined how the books encourage, whether explicitly or implicitly, children's reflection about ecological issues. In addition, it was determined how the books demonstrate the need for humans to take responsibility for their treatment of the environment, and to respect and protect the Earth.

All 30 books analyzed in this study promote environmental awareness to some degree. Books like *Because of an acorn* (Schaefer & Schaefer, 2016) and *No monkeys, no chocolate* (Stewart & Young, 2013), make reference to an environmental issue only at the end of the book. They focus on discussing the life cycle of an acorn and the cocoa tree respectively, and only address human impact on the environment after the story has been told. In other books like *Salmon forest* (Suzuky & Ellis, 2006), the responsibility of humans to protect our environment is not explicitly discussed; however, children's increased understanding of the important role that the salmon plays in its ecosystem will likely foster their sense of responsibility towards protecting the salmon and its habitat.

Thirteen books of the research set, for example, the need to protect and respect the turtles is felt throughout *A place for turtles* (Stewart, 2013), and reflection is encouraged on almost every other page as problems and solutions are presented. In *El gran libro de la ecología/The great big green book* (Hoffman, 2015) and *One well: The story of water on Earth* (Strauss, 2007), questions are asked throughout the book that encourage children's reflection. In addition to questions, *One well: The story of water on Earth* (Strauss, 2007) uses analogies and statistics that help children

understand the magnitude of the problem of water scarcity, as well as support their reflection about the importance of water and the way people use this precious resource.

Fourteen books foster children's reflection occasionally. Books like *Uno's garden* (Base, 2006) raise important questions about habitat destruction and extinction that may initiate conversations about the environment and finding balance with nature. However, children may not be able to realize the environmental issue until the end of the book when nearly all the imaginary creatures are extinct and humans are shown to have found a way to continue to grow while still protecting the Earth.

Three books of the research set fail to encourage reflection about the impact that humans' actions have on the environment. *Compost stew* (Siddals, 2010) encourages children to think about what can and what cannot go into a compost pile; however, reflection on the importance of composting for the environment is not promoted. Like *Compost stew* (Siddals, 2010), *The world that we want* (Toft, 2005) fails to encourage reflection about any environmental issue. Instead, it focuses on depicting the interconnectedness of various habitats, the wildlife, and the vegetation that thrive in each one. In *A drop around the world* (McKinney, 1998), reflection on the relevance of water in the natural world is encouraged, but children are not prompted to think about the ways they use water and how they can conserve it.

Surprisingly, the majority of the books analyzed do not go into different sides of environmental issues and rarely invite children to ask, "Is this just? Is this the truth?" Instead, they explain the issues in a rather black and white way. Therefore, adult input will be required in order to prompt children to engage their critical thinking skills and further explore the topics addressed.

Steps for a solution. To inspire children's environmental awareness and action, they need to be made aware of ways they can make their daily routine more environmentally-friendly. Books were rated on whether there are actions that help to solve the ecology problem, whether there are actions that could be taken immediately by the reader, and whether at least some of the solutions could be realistically implemented by children. Surprisingly, only seventeen books out of the selection of thirty provided actions that could be taken immediately by children, twelve books did

not provide any ideas for action whatsoever, and one book provided ideas that would require adult support.

The way the ideas for action are provided varies from book to book. Some of them conclude with a section that suggests ways that we can help, including *Nuestro planeta en peligro/Our planet in danger* (Grant, 2008); *No monkeys, no chocolate* (Stewart & Young, 2013); *One well: The story of water on Earth* (Strauss, 2007); and *Salvemos a los Animales/Let's save the animals* (Barry, 2010); whereas others provide specific and feasible ideas throughout the book, including *¿Por qué debo ahorrar energía? Why should I save energy* (Green, 2012), *Why are the ice caps melting? The dangers of global warming* (Rockwell, 2006), and *Earth remembers when* (Wynne, 2012). *Olivia's birds: Saving the gulf* (Bouler, 2011), *The promise* (Davies, 2013), *One plastic bag: Isatou Ceesay and the recycling women of the Gambia* (Paul, 2015), and *Wangari's trees of peace* (Winter, 2008) utilize the main character to show that it only takes one person to make a difference. Whether it is using one's talent to raise money, planting trees, or making purses out of plastic bags, these are inspiring stories that will enlighten and empower children to get involved themselves.

In *Salmon forest* (Suzuky & Ellis, 2006), *The World that We Want* (Toft, 2005), and *Baby Whale's Journey* (London, 1999) no environmental issue is addressed and, therefore, no solutions are given as no problem is explicitly provided. Unlike *Salmon forest* (Suzuky & Ellis, 2006) and *Baby whale's journey* (London, 1999), *La playa de Pedro/Peter's place* (Grindley, 2003) does expose children to an ecological problem, oil spills; however, it does not provide ideas for action. This lack of ideas for preventing oil spills or for alternatives to the use of fossil fuels may leave children confused as to what their role in protecting the coastline is. *Life in the ocean: The story of oceanographer Sylvia Earle* (Nivola, 2012), *The eye of the whale: A rescue story* (O'Connell, 2013), and *The drop in my drink: The story of water on Earth* (Hooper, 1998) encourage children to protect the ocean, whales, and multiple water sources respectively, but again no specific ideas to do so are suggested. Unlike these three books, in *The sea, the storm, and the mangrove tangle* (Cherry, 2004), two ideas for action are provided; however, their implementation by children will require adult support. Writing letters to Congress may be difficult for younger

children, although they can draw images and their parents can aid in writing the words underneath children's inventive spelling. The second idea the book provides, buying sustainably-caught shrimp, is something that children can discuss with their parents, but ultimately will be up to the parent to decide.

Positive tone. Children's growing awareness of the nature fragility and the environmental consequences of human activities should lead them to think that all is not lost. Environmental education should emphasize being effective in solving the problem rather than assigning blame or being "right". This study evaluated how positive and appropriate behaviors are emphasized, rather than dwelling on the negative impact that human actions have on the environment. In addition, it was determined whether children are encouraged to become actively involved in supporting environmental causes.

Books like *A place for turtles* (Stewart, 2013), *One well: The story of water on Earth* (Strauss, 2007), *Olivia's birds: Saving the gulf* (Bouler, 2011) and *Life in the ocean: The Story of oceanographer Sylvia Earle* (Nivola, 2012) express prior work that has been done to protect our planet. Only one book out of the 30 analyzed for this study ends in a negative tone. *La playa de Pedro/Peter's place* (Grindley, 2003) becomes involved in a community effort to help the environment; however, the book ends by stating that Peter's place will be forever scarred. Likewise, in *Salvemos a los animales/Let's save the animals* (Barry, 2010), children are given the message that if humans don't take better care of the planet and make some changes in the way they treat animals and their habitats, many animals will disappear forever. Beautiful and colorful cut-out animals are shown in the first pages, but then one page towards the end shows black silhouettes. This is, undoubtedly, a great way to show extinction; however, a little daunting for younger children. The book ends on a positive note by offering a list of things that man can do to prevent animal extinction.

All of the books included in the study have a positive feeling throughout with the exception of five—*Nuestro planeta en peligro/Our planet in danger* (Grant, 2008), *Earth remembers when* (Wynne, 2012), *Uno's garden* (Base, 2006), *La playa de Pedro/Peter's place* (Grindley, 2003), and *¿Por qué debo ahorrar energía? Why should I save energy?* (Green,

2012). *Nuestro planeta en peligro/Our planet in danger* (Grant, 2008) tells three different stories with happy endings but that show animals or humans in great danger. Although *Uno's garden* (Base, 2006) ends positively, both *Uno's garden* (Base, 2006) and *La playa de pedrol/Peter's place* (Grindley, 2003) tell a somber story of habitat destruction. *Earth remembers when* (Wynne, 2012) features fold-outs throughout the book that show the reader how clean the world used to be and how much it has changed due to man's careless actions, which gives a gloomy vibe to the book. Lastly, *¿Por qué debo ahorrar energía? /Why should I save energy?* (Green, 2012) provides ideas for how to save energy; however, it offers a rather scary scene of a lack of energy.

Seventeen books of the study list encourage children to become actively involved in environmental causes. Books like *How to help the Earth by the Lorax* (Rabe, 2012), *Why are the ice caps melting? The dangers of global warming* (Rockwell, 2006), *A place for turtles* (Stewart, 2013), and *One well: The story of water on Earth* (Strauss, 2007), offer a list of actions that are immediately actionable by children.

Six books focus on assigning blame and providing solutions to environmental issues alike. *¿Por qué debo ahorrar energía? /Why should I save energy* (Green, 2012), for example, tells how we can run out of energy due to humans' careless use of it. *Baby whale's journey* (London, 1999) seems to place some blame on the whaling industry for the declining number of whales. Similarly, *The world that we want* (Toft, 2005); *Life in the ocean: The story of oceanographer Sylvia Earle* (Nivola, 2012); *Nuestro planeta en peligro/Our planet in danger* (Grant, 2008); and *The sea, The storm, and the mangrove tangle* (Cherry, 2004) explicitly state how humans are damaging the environment filling it with garbage and depleting its resources.

Representation of diversity. Children need to see themselves reflected in the stories they read and make the necessary connections to the environmental problem that is presented to them. Educators need books that portray diversity, multiculturalism, and inclusiveness. They need books that embrace different cultures and lifestyles, and avoid stereotyping both in the treatment of issues and characters. The books were analyzed and the degree to which stereotyping is avoided in their treatment of either issues or characters determined. Likewise, it was identified whether

diverse populations, animal or human, are portrayed and/or diversity represented within cultural groups.

All 30 books in the study's list portray diverse populations—animal or human—successfully supporting children's tolerance and open-mindedness in their approach to cultures and lifestyles that differ from their own. *One plastic bag: Isatou Ceesay and the recycling women of the Gambia* (Paul, 2015) and *Wangari's trees of peace* (Winter, 2008), for example, offer insight into the African culture both through text and the colorful collages of African patterned clothes. While only briefly, *Salmon forest* (Suzuky & Ellis, 2006) tells about the encounter between the story's main characters and a Native American family, providing a glimpse of their culture's salmon fishing tradition. *Compost stew* (Siddals, 2010) and *Why are the ice caps melting? The dangers of global warming* (Rockwell, 2006) feature multicultural characters actively involved in activities to help protect the planet. A rare exception, in *El gran libro de la ecología/The great big green book* (Hoffman, 2015), a child in a wheelchair is depicted. The portrayal of the child helps raise awareness about disabled persons as a family concerned about the environment wonders whether elevators are really necessary. Diverse human populations based on race, ethnicity, and gender are portrayed in approximately half of the books included in this study. However, researchers noted that none of these books represent different family configurations, but rather, every illustration that depicts a family, shows a traditional nuclear family with two parents and children.

Ten of the books in the study portray diversity in animal populations, indirectly supporting children developing a positive perception of the diversity witnessed in the broader society. Exposing children to unfamiliar characters helps teach them that differences are to be cherished and appreciated rather than judged and feared. In books like *El viejo árbol/The old tree* (Brown, 2007), animal characters are anthropomorphized. This book tells about the discordance among the inhabitants of an old tree and how, despite their disagreements, the neighbors were able to work together for a common cause—save their old tree, their home. Regardless of the non-human nature of the characters featured, the story sends a powerful message: By coming together, challenging environmental issues that may be beyond our power to solve individually, can be remedied. Likewise, in *The sea, the storm,*

and the mangrove tangle (Cherry, 2004) and *Salvemos a los animales/Let's save the animals* (Barry, 2010), a diverse animal population is employed to provide factual information about animals. This information supports children's awareness of the dangers these animals face and the need for humans to protect them. If children can successfully see the environmental problem, understand the importance of embracing diversity, and make the necessary connections, it should not matter if the story is told through human or animal characters.

Only two books were found to potentially reinforce stereotyping in the treatment of characters. *One plastic bag: Isatou and the recycling women of the Gambia* (Paul, 2015) shows only women taking care of the house, which reinforces the expectation that a woman should be responsible for the housework and children. In *Wangari's trees of peace* (Winter, 2008), comments made by men in the story—such as that women can't plant trees—may also reinforce the stereotype that planting trees is a man's profession. Wangari, however, provides an excellent female role model that will inspire young girls to pursue their dreams and fight these stereotypes head on.

As previously stated, only five books out of 30 consider more than one perspective of the ecological problem. But explaining the issues from one viewpoint and leaving out opposing perspectives can reinforce stereotypes in the treatment of these problems. Children's ability to make informed decisions about the environment is better served when they are exposed to positives and negatives of environmental issues and invited to ask questions. By exposing children to both sides, they are made aware that certain human activities are necessary even though they harm the environment. Nonetheless, there are ways in which these activities can be performed that minimize the environmental impact.

Appropriate illustrations. In picture books, written language and illustrations need to go well together in order to help children understand the message better. Ideally, beautiful and enchanting drawn images should captivate children and make the story come to life. Indeed, with the help of pictures, it becomes easier for children to understand environmental issues presented in ecology-themed picture books while enjoying the story. Therefore, researchers examined the

degree to which illustrations in the books selected for this study enhance the text and move the story forward.

Researchers noted great variety in the approach that illustrators take to depict the environmental topic. Some books like *Because of an acorn* (Schaefer & Schaefer, 2016) and *Nuestro planeta en peligro/Our planet in danger* (Grant, 2008) use minimal text with most of the story being told through the artwork; whereas other books, including *One well: The story of water on Earth* (Strauss, 2007) and *A drop around the world* (McKinney, 1998), rely heavily on text to convey the environmental message. Then, there are books in which the story is carried as much by the pictures as by the text. Books like *A place for turtles* (Stewart, 2013); *The tree* (Lyons, 2002); *The sea, the storm, and the mangrove tangle* (Cherry, 2004); and *Life in the ocean: The story of oceanographer Sylvia Earle* (Nivola, 2012) are exquisitely illustrated with captivating artwork and a wealth of detail that will enthrall children. Kids will feel like they can actually hear the wind, touch the creatures depicted, or feel on their skin the coldness of the water in the vast ocean.

Some of the books use humorous illustrations that engage children and successfully send the environmental message. For example, *Olly the oyster cleans the bay* (Allen, 2008) uses vibrant and rich artwork that depicts the amusing and comical expressions of Olly and creatively portrays various characters and the colorful underwater. In *Why are the ice caps melting: The dangers of global warming* (Rockwell, 2006), fun cartoon-like and educational illustrations complement the information provided through the text. Humor is also used as a means to keep children engaged in *No monkeys, no chocolate* (Stewart & Young, 2013), in which two little bookworms add humor and extra insight to the story.

In *Oil spill!* (Berger, 1994) factual information is made understandable through the use of artwork that helps comprehend information provided through text that children may have difficulty picturing. Collage and pull-out illustrations employed in *Salvemos a los animales/Let's save the animals* (Barry, 2010) create depth, give a sense of texture, and add excitement and enjoyment to the story. Similarly, *Olivia's birds: Saving the gulf* (Bouler, 2011) uses colorful, captivating sketches that, considering they have been drawn by an 11-year-old girl, are amazingly accurate portrayals of the different types of birds included in her book.

Through the use of watercolors, *The promise* (Davies, 2013) moves readers from a world of grays to a world of color and life, showing how the world is transformed from a sad, gloomy place to a green and vibrant one. Colorful illustrations are also used in *Wangari's trees of Peace* (Winter, 2008) and *One plastic bag: Isatou Ceesay and the recycling women of the Gambia* (Paul, 2015). The setup of the artwork in the former like a comic book full of bright, folk art graphics, and the collages from African patterned clothes depicted in the latter, support the story and provide a look into a different culture. Books like *Nuestro planeta en peligro/Our planet in danger* (Grant, 2008), set in underrepresented locations that are depicted through vibrant, descriptive illustrations, enable children to explore the world with their imagination, discovering similarities and differences with the world they had imagined. Another example of bright and eye catching artwork can be found in *The world that we want* (Toft, 2005). Stunning hand-painted silk illustrations are featured that beautifully complement and enhance the information provided through text.

Only one book was found to be visually confusing for children. *El gran libro de la ecología/The great big green book* (Hoffman, 2015) uses imaginative and vivid cartoon-like imagery that evokes the beauty of the planet. The child-like appearance of the illustrations will appeal to children; however, some pages are so busy with portrayals of various environmental issues, that it may be difficult for children to be able to focus on a specific problem.

Story appeal. Children learn best when they can relate to the events in the story and connect with the characters. When reading stories, children should be able to identify a character who resonates with them and reflect how they may feel and/or act in similar situations. Likewise, to keep children's attention throughout a book, the story plot needs to advance in logical steps without making the story predictable. Suspense, which causes readers to be curious about what comes next, keeps children turning pages and anticipating the ending. Books were examined to determine whether the characters and setting are relatable to children and whether the story has appropriate action, suspense, pace, and outcome.

Some of the books, including *¿Por qué debo ahorrar energía? /Why should I save energy?* (Green, 2012) and

Salmon forest (Suzuky & Ellis, 2006), feature familiar characters and depict situations that children will have experienced themselves, making the stories relatable to them. A family who has a power outage and a father and a daughter that go on a fishing trip allow children to add their own family and camping experiences to the story. Highly relatable are also the stories delivered in *Olivia's birds: Saving the gulf* (Bouler, 2011), *The promise* (Davies, 2013), and *Compost stew* (Siddals, 2010), all of which are told from the perspective of young children. *Olivia's birds: Saving the gulf* (Bouler, 2011) is particularly engaging as the story of an 11-year-old who was able to raise money to support a cause is very inspiring. At the end of the book, children will probably be looking out of their windows trying to spot birds and thinking about the things they can do to help protect them.

Rhyme and rhythmic text that build upon each other are used in several books and make the reading experience fun, engaging, and memorable. *The world that we want* (Toft, 2005), *Earth remembers when* (Wynne, 2012), and *How to help the Earth by the Lorax* (Rabe, 2012), are excellent examples of the use of rhythm and rhymes to engage children. In addition to rhymes, *Earth remembers when* (Wynne, 2012) uses fold-out pages with gorgeous illustrations that provide a sense of suspense for what lurks beneath. The Lorax, on the other hand, is a familiar and adorable character which, through rhyming sounds, helps get the environmental message across.

Books like *Olly the oyster cleans the bay* (Allen, 2008) and *El viejo árbol/The old tree* (Brown, 2007) feature marine creatures and forest wildlife respectively. The characters may seem un-relatable to children; however, they are made relatable as they are anthropomorphized and tell engaging stories that children will find familiar. Like in *Olly the oyster cleans the bay* (Allen, 2008), the marine ecosystem provides the setting for *The eye of the whale: A rescue story* (O'Connell, 2013), *Baby whale's journey* (London, 1999), and *La playa de Pedro/Peter's place* (Grindley, 2003). While some children may not be familiar with the marine environment, they will be drawn into the real story of a whale rescue, the learning journey of a baby whale's life, and the world of a young boy who is devastated when an oil spill occurs and his beautiful beach is destroyed.

Sometimes, the title of a book alone is enough to draw readers in. *No monkeys, no chocolate* (Stewart & Young, 2013), for instance, makes readers wonder what the link between monkeys and chocolate might be. Furthermore, it is not until the end of the book that this connection is disclosed, maintaining suspense and building anticipation. Similarly, suspense is effectively maintained throughout *Uno's garden* (Base, 2006) as well. With intriguing and engaging imaginary creatures, and a vibrant made-up setting, children are led through this somber, yet hopeful story about the need for humans to find a balance with nature.

The majority of the books analyzed succeed in making the story relatable and maintaining children engaged all throughout. However, some books, including *One well: The story of water on Earth* (Strauss, 2007) and *Oil spill!* (Berger, 1994), provide factual information in a manner that may cause children to disengage. The former tied with *A place for turtles* (Stewart, 2013) for 1st place in the study's overall ranking. However, page after page is filled with information on Earth's water supplies that may slow down the pace as some children may need some time to comprehend all the facts. Similarly, *Oil spill!* (Berger, 1994) describes strategies and equipment used to contain and clean up spills. Undoubtedly, interesting and educational information, but the risk exists that children may disengage due to the unfamiliarity of the topic.

Wangari's trees of peace (Winter, 2008) and *One plastic bag: Isatou Ceesay and the recycling women of the Gambia* (Paul, 2015) are set in Africa, which will be an unfamiliar location for most of the children. Nonetheless, characters and story are highly engaging as children will be able to find commonalities with the events portrayed. Garbage on the ground and trees that are being cut down may be frequent occurrences in many children's lives. Like these two books, *Nuestro planeta en peligro/Our planet in danger* (Grant, 2008) is also set in underrepresented locations, but the characters—animals and children—depicted in the book are very engaging. Children may find, however, that the stories are a bit confusing as the events feel disjointed at times.

Developmental appropriateness. Picture books about ecological themes help introduce children to scientific concepts in a developmentally-appropriate manner, allowing them to associate the feel-good joy of reading with science. But hypothetical situations and abstract concepts are hard for

young children to understand. Therefore, for a story to effectively contribute to the development of scientific concepts in young children, it needs to be presented in an appropriate level of abstraction and through appropriate sentence structure and vocabulary. The appropriateness of concepts, vocabulary, and sentence structure employed in the study's books was determined. If a basic knowledge of ecology is required to understand the topic of the book, researchers identified if this knowledge is provided for the reader. Additionally, it was determined whether the ecology problem is presented in a manner that is neither threatening nor overwhelming to children.

Sidebars, glossaries, and Author's Notes provide effective means to further challenge children to dig deeper into environmental issues. The combination of simple, clear narrative, and detailed illustrations in *A place for turtles* (Stewart, 2013) makes the book accessible for young children. Sidebars, on the other hand, serve to challenge older children and high-level readers to learn more about turtles. Like in *A place for turtles* (Stewart, 2013), *The tree* (Lyons, 2002) allows readers to have access to more specific information about the Pacific rainforest—this time through the book's Author's Note—while still maintaining the story simple and entertaining. Likewise, *A plastic bag: Isatou Ceesay and the recycling women of the Gambia* (Paul, 2015) tells a simple but effective story that includes some words in Wolof, the local dialect, but any word in Wolof used in the text is described in the glossary of the book, making it possible for children to follow along.

The technical concepts that are presented in books like *Oil spill!* (Berger, 1994) may seem difficult to understand for young children; yet, the double media of text and illustrations helps support children understanding these unfamiliar terms. Some of the books, however, provide an excellent introduction to ecological topics, but are too difficult or too lengthy for children to comprehend and stay engaged without adult input. *One well: The story of water on Earth* (Strauss, 2007), for example, is explained in a child-friendly manner, but it is too lengthy and dense for younger children to follow and stay engaged throughout the book. *The drop in my drink: The story of water on our planet* (Hooper, 1998), introduces children to the water cycle, but it may be difficult for children below the age of ten to read it without adult

support. Conversely, titles like *Because of an acorn* (Schaefer & Schaefer, 2016) and *Salvemos a los animales/Let's save the animals* (Barry, 2010), while appropriate for preschoolers, may be too simple for children above the age of six.

For the most part, the books analyzed require very little understanding of abstract concepts, even though environmental issues are full of abstract concepts. In addition, when new vocabulary is introduced, most of the books provide a description of these concepts. In *Oilly the oyster cleans the bay* (Allen, 2008), for instance, most new vocabulary, like detritus and algae, is introduced in an authentic way intertwined with the plotline. Similarly, *Salmon forest* (Suzuky & Ellis, 2006) enlightens children about the salmon life cycle. While many children may not have first-hand experience of salmon streams, the glossary at the end of the book supports children's understanding of scientific concepts used in the story such as fungi, spores, and spawning.

Interestingly, researchers noted that nine books out of the research set present the environmental issue in a somehow frightening or overwhelming manner for children. *Earth remembers when* (Wynne, 2012) describes a rather scary picture of the state in which our planet is. Children may find images like that of an animal carcass or a seal trapped in a net upsetting and overwhelming. In *Nuestro planeta en peligro/Our planet in danger* (Grant, 2008) and *Baby whale's journey* (London, 1999), children see how a polar bear's mother is shot and how a whale's mother is fighting to protect her baby respectively, both images that young, sensitive children may find alarming and upsetting. Similarly, although the book has a happy ending full of hope, the events in the middle of the story in *Uno's garden* (Base, 2006) may feel a bit poignant for children; whereas the disappearing silhouettes in the last page of *Salvemos a los animales/Let's save the animals* (Barry, 2010) will likely leave children concerned and saddened.

Conclusion

Summary of Findings

The book analysis based on ecological focus generated the following six book themes: ecosystems/ life cycles, pollution, destruction of habitats, environmental activists/ biographies, recycling/ going green, and endangered animals. The 30 analyzed books varied from 4.8 to 3.1 out of 5.0 points in overall mean score, indicating that many books, to a large extent, satisfied the criteria for effective children's ecology picture books. Many of the low-scoring books did not include steps for a solution, an important part of empowering readers.

Two-thirds of the books depicted nature lavishly in illustrations, engendering nature appreciation. The interrelatedness of nature was portrayed in most books, but six failed to address this important concept. Eighteen books presented realistic ecology problems, without over-simplifying or exaggerating the issues and encouraging children to take action. Many books presented the story through the eyes of a child, while others took perspectives of animals, plants, or raindrops; however, only five books presented multiple perspectives on the environmental issues. Twenty-three of the thirty books conveyed positive hope for a happy solution to the problem, an important aspect lest children feel overwhelmed in unsolvable problems and give up or tune out.

All of the books promoted environmental awareness to some extent and fourteen fostered some children's reflection and responsibility toward the problem. Twenty-five of the books had positive tones throughout. All thirty books portrayed diverse human or animal populations, supporting children's positive perceptions of diversity with only two books possibly reinforcing stereotypes. A great variety in illustration style was found in the books, including humorous illustrations, with only one book being identified as being visually confusing to children. The books used different devices to make their stories appealing. Many books used sidebars, glossaries, or author's notes to allow children to learn more about the topic. Most concepts were not abstract and were easily understood by readers, but nine books presented frightening or overwhelming scenes.

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.

Implications for Practice

Raising student awareness of the 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.

Because 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 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.

Some examples of online resources that can be used to encourage student reflection and present a range of differing viewpoints, ethical positions, and interpretations include:

- [Children of the Earth United](#): This is a non-profit organization that provides children with information, activities, a list of eco-careers, and newsletters; allows children to add their environmental contributions to the website; and more.
- [Eco Boys and Girls](#): The Eco Boys and Girls are illustrated characters developed by Maria Snyder which advocate for pro-environmental practices. The Eco Boys and Girls teach children in grades PreK-2 the value of respecting their environment by practicing recycling and conservation, as well as respecting other people and creatures who inhabit the earth by showing love and care for them.
- [Edutopia-Environmental Education](#): This website provides resources for teaching about the environment, sustainability, and conservation; offers examples of environmental action projects; and shows ways to take learning outside.
- [EekoWorld, PBS Kids](#): This website has informational videos about environmental topics, games to entertain, events, and a section for teachers and parents to help expand learning.
- [EIA Energy Kids](#): This website provides information about energy, renewable resources, saving energy, games and activities, science fair ideas, field trip ideas, lesson plans, and more.
- [Facing the Future](#): This website offers standards-based resources, teacher workshops, and service learning opportunities used by teachers, schools, and districts in all 50 states and over 120 countries.
- [NASA's Climate Kids](#): This website provides an informational resource that includes trivia and games to educate while entertaining students.

- [National Geographic Kids](#): This website is the child-focused brand of National Geographic Partners. National Geographic Kids inspires young adventurers to explore the world through award-winning magazines, books, apps, games, toys, videos, events, and a website.
- ["Science and Children"](#), NSTA: This journal provides information, lessons, and NGSS information for elementary teachers.
- [Science for Kids](#): This website provides information on various science topics including Earth Science, projects, worksheets, experiments, and more.
- [Teachervision, "Green" Activities & Classroom Resources](#): This website provides links to various ecological resources/lessons to enhance student learning, including making the school a greener place.
- [YES! Magazine](#): This independent, ad-free online magazine covers sustainability, peace and social justice, happiness, climate change, and more.

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 because of 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. Because 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.

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Appendix A

List of Final Sample of 30 Children's Picture Books about Ecology with a Brief Plot Summary and Arranged Based on the Primary Focus of Each Book

Ecosystems/Life Cycles:

- Allen, E. A. (2008). *Olly the oyster cleans the bay*. Centreville, MD: Tidewater Publishers. — Tired of travelling all his life, a young oyster named Olly wants to settle down and do something important. He wants to help clean the Chesapeake Bay like other sea creatures do and wonders what he can do. Great message about the importance of all creatures in an ecosystem. Anthropomorphized with colorful and imaginative portrayals of characters.
- Schaefer, L. M., & Schaefer, A. (2016). *Because of an acorn*. San Francisco, CA: Chronicle Books. —An acorn leads us through its life cycle and shows how every tree, every plant, every flower, every fruit, every animal is important to maintain the balance of nature. Minimal text combined with detailed and appealing illustrations demonstrate that one element leads naturally to another.
- Suzuky, D., & Ellis, S. (2006). *Salmon forest*. Vancouver, Canada: Greystone Books. —Kate discovers how the forest ecosystem and the salmon need each other on a fishing trip with her father in the Pacific Northwest. Vibrant watercolor illustrations and child-friendly language offer insight into the interconnection of all living things.
- Toft, K. M. (2005). *The world that we want*. Watertown, MA: Charlesbridge Publishing. —The delicate balance of nature is brought to the forefront as the interconnectedness between nine habitats, the wildlife, and vegetation native to each are explored. Back matter presents additional information on habitats, species, and pollutants that threaten them. Luminous, detailed illustrations.

Pollution

- Berger, M. (1994). *Oil spill!* New York, NY: HarperCollins Publishers. —With a focus on the Exxon Valdez oil tanker spill in 1989, this nonfiction book explains the causes and effects of oil spills. Similes and colorful imagery help understand the impact of oil spills on the environment and make for great discussion points.
- Bouler, O. (2011). *Olivia's birds: Saving the Gulf*. New York, NY: Sterling. —Olivia, an 11-year-old girl, makes a difference in the world by selling her own bird drawings and donating the money raised to saving the wildlife affected by the Gulf oil spill in 2010. Youngsters will be inspired by this story about using one's talents to make a difference.
- Grindley, S. (2003). *La playa de Pedro (Peter's place)*. Barcelona, ES: Editorial Juventud, S. A.—Young Pedro loves his coast and the wildlife that lives there, but is appalled at the devastating impact that the shipwreck of a tanker has on his special place. Important message within a sad story.
- Hooper, M. (1998). *The drop in my drink: The story of water on our planet*. New York, NY: Viking Juvenile Books. —A boy wonders where water comes from. This non-fiction book expresses and illustrates the eternal and changeable nature of water. Powerful message of the importance of water. Lengthy with vibrant illustrations.
- Mckinney, B. S. (1998). *A drop around the world*. Nevada City, CA: DAWN Publications. —A raindrop travels to interesting places and people: inside a cow, on mountain peaks, underground, as steam or snow. Back matter includes four pages of science about water.Lengthy, poetic text, and colorful artwork.
- Rockwell, A. (2006). *Why are the ice caps melting? The dangers of global warming*. New York, NY: HarperCollins Publishers. —The temperature is perfect on Earth to sustain life, but human activities are contributing to global warming. The good news is that we can all do our part in reducing excessive greenhouse gasses. Fun cartoon-like illustrations. Empowering.

Strauss, R. (2007). *One well: The story of water on Earth (Citizenkid)*. Toronto, Canada: Kids Can Press. —All water on Earth is connected and essential to sustain life. Powerful message about the importance of water conservation and protection. Lengthy, with delicate paintings and statistical snippets.

Destruction of Habitats

Base, G. (2006). *Uno's garden*. New York, NY: Harry N. Abrams. —Uno goes to live in the forest because he greatly enjoys the plants and animals that he found there. Overtime, as more and more people follow him, the forest ends up turning into a huge city where there are neither plants nor animals. Lush artwork with comical imaginary creatures and fictional setting. Somber with happy ending.

Brown, R. (2007). *El viejo árbol (The old tree)*. Barcelona, ES: Editorial Juventud, S. A.— There is some discordance among the inhabitants of the old tree, but faced with a common threat, they come together to save their home. Great message of collaboration and community spirit. Anthropomorphized with elaborate watercolor illustrations and a surprise last pop-up page.

Cherry, L. (2004). *The sea, the storm and the mangrove tangle*. New York, NY: Farrar, Straus Giroux (BYR). —A seed sprouts and grows to be a mangrove tree over 100 years. Children will marvel at the lush, realistic illustrations of the mangrove habitat and its wildlife, while becoming aware of the continued destruction of mangrove habitats largely due to commercial interests.

Davies, N. (2013). *The promise*. Somerville, MA: Candlewick Press. —A promise made by a young girl while trying to snatch an old woman's bag takes us on a journey from an ashy and gloomy city to a green and bright landscape. A somewhat improbable story, yet full of hope.

Grant, D. (2008). *Nuestro planeta en peligro (Our planet in danger)*. Barcelona, ES: Editorial Juventud, S. A.—The stories of Nanook, a little bear cub in the North Pole; Toco, a toucan in the Amazon rainforest; and Sathu, a fisherman's daughter in the Pacific Ocean, show us that our planet is in danger and we all have a responsibility to take care of it. While lacking subtlety in presenting the environmental message, the vibrant illustrations of the underrepresented animals and their environments will enthrall children and encourage a discussion of reasons for the destruction of natural habitats.

Lyons, D. (2002). *The tree*. Bellevue, WA: Illumination Arts Publishing Company, Inc.—An ancient Douglas fir in the Pacific rainforest has seen many things in its long life of 800 years. It has had joyful days, fearful days, and sad days. Great message about the consequences of the removal of a species from its environment. Emotional and thought-provoking. Richly-detailed illustrations.

Stewart, M., & Young, A. (2013). *No monkeys, no chocolate*. Watertown, MA: Charlesbridge.—Cocoa trees are dependent on many forest creatures for their continued survival. Two little bookworms in the bottom right-hand corner of the pages add humor and information to a simply written text. Realistic watercolor illustrations.

Wynne, D. (2012). *Earth remembers when*. Manhattan Beach, CA: Dawning Press. —The Earth's current state of health is compared to what it used to be before. Human actions have devastating effects on the environment, but there are solutions for everyone. Children are included in ways to make a positive impact as well. Rhyming verse. Vibrant, rich illustrations. Pull-out pages.

Environmental Activists/Biographies:

Nivola, C. A. (2012). *Life in the ocean: The story of oceanographer Sylvia Earle*. New York, NY: Farrar, Straus Giroux (BYR). —Sylvia Earle takes us on a journey of exploration and discovery into the deep ocean water. Earle's growing passion for the ocean will inspire youngsters to pursue their dreams. Extensive Author's Notes section describes Earle's activism in speaking out for the protection of oceans. Whimsical watercolors.

Paul, M. (2015). *One plastic bag: Isatou Ceesay and the recycling women of the Gambia*. Minneapolis, MN: Millbrook Press. —Isatou Ceesay tackles the problem of the increasing amount of trash in her village and shows how the smallest efforts can make a great impact. Colorful, engaging collages from African patterned clothes. Inspirational.

Winter, J. (2008). *Wangari's trees of peace: A true story from Africa*. Orlando, FL: Harcourt Children's Books. —Wangari returns home from studying abroad only to find how whole forests were being cut down. Her determination, perseverance, and teamwork made it possible to replant the hillsides of her country. Folk art graphics portraying colorful traditional clothing. Cultured feel.

Recycling/Going Green:

Green, J. (2012). *¿Por qué debo ahorrar energía? (Why should I save energy?)* Madrid, ES: Anaya. —Natural resources are limited but there are many things we can do to save energy. Slightly oversimplified approach to energy conservation. Amusing colored illustrations.

Hoffman, M. (2015). *El gran libro de la ecología (The great big green book)*. Barcelona, ES: Editorial Juventud, S. A.—Our planet is just a small part in the Universe, but is unique. We can all help make our planet beautiful again. Visually confusing. Both kind-friendly and far-fetched suggestions for action.

Rabe, T. (2012). *How to help the Earth by the Lorax*. New York, NY: Random House Books for Young Readers. —After talking us through the path that trash goes and how the environment is being polluted in the process, the Lorax tells us we can all help by reducing, reusing, and recycling, and urges us to do so right now! Multiple simple and actionable suggestions for action. Rhyming sounds. Fun and bright illustrations.

Siddals, M. M. (2010). *Compost stew: An A to Z recipe for the Earth*. New York, NY: Crown Publishing Group. —There are many things that can go into a compost pile. Kids help collect all kinds of ingredients for their compost stew. Alphabet book. Lively rhyming and colorful collage illustrations.

Endangered Animals:

Barry, F. (2010). *Salvemos a los animales(Let's save the animals)*. Barcelona, ES: Editorial Juventud, S.A.—Environmentally-unfriendly human actions endanger animals, but we can all take an active part in protecting our wildlife. Somber. Simplistic die-cut designed illustrations.

London, J. (1999). *Baby whale's journey*. San Francisco, CA: Chronicle Books. —A baby sperm whale enjoys learning and discovering the marine habitat while it's mother whale protects it from danger. Poetic prose and mystical artwork. Emotional.

O'Connell, J. (2013). *The eye of the whale: A rescue story*. Gardiner, ME: Tilbury House Publishers. —Off the coast of San Francisco, a group of divers coordinate efforts and risk their lives to free a tangled whale. Simple story with painted illustrations. Heartwarming.

Stewart, M. (2013). *A place for turtles*. Atlanta, GA: Peachtree Publishers. —Turtles are an important part of animal food chains but face multiple dangers that threaten their continued survival. Ideas for overcoming those problems are provided. The Author's Notes section includes maps that show where each turtle's natural habitat is related to the United States. Simple and informative text. Realistic and superbly detailed acrylic illustrations. Part of a series.

Appendix B: Grading Criteria: Categories and Indicators

Grading Criteria

- 5: Outstanding**—exceeds every part of the criteria with not one question in researchers' minds
- 4: Very Good**—meets criteria with slight omissions
- 3: Good (average)**—covers the topic of the criteria but could do more
- 2: Fair**—may discuss one part or at least has some science related material
- 1: Not Recommended**—has no mention of the criteria at all

Categories and Indicators

1. Nature Appreciation: Assesses the degree to which the book depicts beauty and harmony in nature. Answers the question, "What is the beauty of nature?"

- 5: The book speaks specifically about the natural environment and displays it lavishly in the illustrations. For example, a book about pollution explicitly shows how nature is better without it, and prompts readers to have sympathy and concern for the natural environment.
- 4: The book shows natural appreciation although not quite as lavishly. For example, a book talks about rolling hills and shady trees that make a location a beautiful place. However, it does not display it richly in the illustrations and/or the text is more limited in the use of terms that foster an appreciation of nature.
- 3: The book shows nature appreciation fairly well.
- 2: The book slightly shows some nature appreciation, but mostly talks about a certain environmental concern without explicitly discussing the beauty of nature.
- 1: The book makes no mention of the beauty of nature whatsoever. For example, it talks about a specific habitat reserve. This reserve, however, is not said to be beautiful, but rather just a useful place to send creatures. Another example would be a book on recycling that does not discuss nature or the outside environment.

2. Interrelatedness of Nature: Demonstrates the need for people's cooperation with nature. Shows how actions of one living thing affect others. Answers the questions, "Why is it like it is? What causes it? What are the effects? How is it changing?"

- 5: The book demonstrates clearly that there is a connection between every living thing in an ecosystem and how the actions of one living thing can affect the lives of many. The book supports children developing an understanding of the impact people can have on the environment and the need for people's cooperation with nature. For example, a book where an animal or plant is taken away or threatened to be taken away from the natural environment that discusses the consequences of such removal.
- 4: The book demonstrates that there is a connection between every living thing in an ecosystem and/or discusses how people's actions affect the environment. The book addresses the need for people's cooperation with nature but could go farther.

- 3: The book demonstrates that there is a connection between living things in an ecosystem and the need for people's cooperation with nature, but the environmental message is somewhat lost in the story plotline.
- 2: The book does not help students understand much about the connections between different living things. The need for people's cooperation with nature is poorly conveyed.
- 1: The book does not demonstrate how the actions of one living thing affect others, nor does it support children understanding the need for people's cooperation with nature.

3. Realistic Ecology Problem: Presents an ecology problem in a realistic manner, without oversimplification or exaggeration. The effect of human choice on the situation is clear. Answers the questions, "What is it? How does it work?"

- 5: The environmental problem is easy to understand and apply to the real world, without oversimplifying or exaggerating it. The book may be a funny, lighthearted book that, nonetheless, expresses the seriousness of the environmental issue. The book supports children feeling cheerfully empowered by what they have just learned. It shows children becoming actively involved in supporting environmental causes.
- 4: The book depicts an environmental issue in a clear and non-frightening manner, although the problem may be slightly oversimplified or exaggerated. The book shows the effect that human actions have on the environment. Children are encouraged to become actively involved in environmental causes.
- 3: The environmental issue is oversimplified or exaggerated but children are able to make some connections between human action and the environment.
- 2: The environmental issue is dealt with lightly. Children are unlikely to make the connection between human action and the environment.
- 1: The book dismisses the seriousness of the environmental issue and/or causes children to leave their reading experience thinking negative outcomes, for example, that the world is going to come to an end, or that their drinking water will kill them, or that they are bad children for using too much paper.

4. Differing Perspectives: Demonstrates different perspectives and interests on ecology problems. Answers the question, "What are the different points of view and values?"

- 5: The story is told from a familiar perspective and exposes children to an alternative point of view, so that a balanced view of the environmental issue is depicted. Children can see their own role in protecting the environment as opposed to feeling it is out of their hands. For example, a book about habitat destruction also looks at the positive side of development; or a book about pollution presents both a positive and negative effect of using incinerators—positive: the incinerator burns trash and produces energy; negative: the incinerator creates air pollution.
- 4: The story is told from a familiar perspective but fails to expose children to an alternative point of view. For example, a book about environmental destruction, whether it is about building houses or overfishing, is presented as bad without showing the benefits to human beings.
- 3: The story is told from an unfamiliar perspective that may make it difficult for children to engage and feel they have a role in protecting the environment. Children are exposed to differing points of view.
- 2: The story is told from an unfamiliar perspective. No alternative viewpoints are offered. Science-related material is covered.
- 1: The story does not pertain to science-related material and fails to provide any perspective on environmental concerns.

5. Hope for a Solution: Assesses to what degree books convey a feeling of hope for a viable solution to the problem. Answers the question, "Is there hope for a solution?"

- 5: The book conveys a profoundly optimistic feeling of hope for a viable solution to the environmental problem. For example, a book shows how a whole neighborhood successfully addresses an environmental problem by coming together and inviting all neighbors to help solve the problem as part of a wider community effort.
- 4: The book largely conveys a positive feeling for viable solutions to the environmental problem. The solution may be abstract but still feasible. For instance, a book shows turtles struggling to survive due to human actions and recognizes the challenges that protecting them may need to be faced. However, the book emphasizes the actions that humans can take to help them rather than dwelling on the challenges.
- 3: The book conveys a mixed feeling of pessimism and positivism about the ecology problem. Solutions may not be viable. Difficulties to implement them are emphasized.
- 2: The book conveys a feeling of very little hope for a viable solution to the ecology problem.
- 1: No hope for a viable solution to the ecology problem is conveyed. Children are confronted with an environmental problem without discussing solutions to fix it, likely causing them to believe the problem is simply too large to surmount.

6. Reflection and Responsibility Demonstrates the need for people's reflection about and awareness of their responsibility for caring for their planet. Answers the question, "What is my/our responsibility?"

- 5: The book clearly demonstrates the necessity and responsibility of humans to respect and protect the natural world. Reflection about the environmental problem and/or the impact that our actions have on the planet is encouraged throughout the book. For example, a book about deforestation goes beyond facts (how forests are being cut down for industrial benefit causing wildlife and biodiversity extinction) and constantly prompts students to reflect on what causes it, how it could be prevented, what they (children) could do to help, etc.
- 4: The book nurtures environmental awareness in children by demonstrating the need for people's responsibility for caring for their planet. Children are occasionally encouraged to reflect on the ecology problem and/or the impact of their own actions on the natural world.
- 3: The book promotes environmental awareness in children fairly well. Children's reflection on the ecology problem may not be encouraged.
- 2: The book vaguely promotes environmental awareness and does not encourage children's reflection on the environmental issue.
- 1: The book addresses an ecology theme but it does not nurture environmental awareness in children, nor does it demonstrate the need for people's reflection about their responsibility for caring for their planet.

7. Steps for a Solution: Rates a book on whether it provides actions that help solve the ecology problem, whether it provides actions that could be taken immediately by the reader, and whether at least some of the solutions could be realistically implemented by children. Answers the question, "What can be done to help solve the problem?"

- 5: The book provides specific ideas for practical actions that can be taken immediately by the reader to help solve the ecology problem. The book encourages children to become actively involved in supporting environmental causes. For example, a book tells about the members of a family who come together to prevent an old tree from being cut down, or provides lists of environmentally friendly activities for children to do in their daily lives.

- 4: The book provides specific ideas for actions that can be taken to help solve the environmental issue, although some of the solutions cannot be realistically implemented by children.
- 3: The book provides specific ideas for actions that can be taken to help solve the ecology problem; however, most of the actions cannot be realistically taken by children.
- 2: The book provides specific ideas for actions that can help solve the environmental issue, but none of them can be realistically taken by children.
- 1: The book does not provide specific ideas for actions that can be taken to help solve the ecology problem.

8. Positive Tone: Emphasizes being effective in solving the problem rather than assigning blame or being “right.” Positive and appropriate behaviors are emphasized, and the tone does not induce fear. Children are respectfully viewed as persons capable of thinking critically and logically. Answers the question, “What people’s behaviors have a positive impact on the environmental issue?”

- 5: The book emphasizes a positive feeling and the good things humans have already done to help the Earth. The book encourages children to become actively involved in supporting environmental causes and ends on a positive note. For example, a book provides lists of environmentally-friendly activities for children to do in their daily lives; or, while it starts with images of polluted landscapes or destroyed habitats, the book ends positively with renewed natural landscapes.
- 4: The book mainly conveys a positive feeling. It may not focus on solving an environmental problem and/or may sometimes refer to “being right and being wrong.” Children are viewed as persons who can think critically. The book ends positively.
- 3: The book conveys both positive feelings and a sense of assigning blame. It may not discuss solutions to an environmental problem. Children are viewed as persons capable of thinking critically. It ends on a positive note.
- 2: The book discusses the individuals responsible for causing the problem. The book may not discuss environmental solutions. Children are not viewed as persons capable of thinking critically. The book may induce fear and ends on a negative note.
- 1: The book focuses on assigning blame, induces fear, and ends on a negative note. Children are not viewed as persons capable of thinking critically and logically.

9. Representation of Diversity: Evaluates the degree to which stereotyping is avoided in treatment of either issues or characters. Answers the questions, “Does the book portray diverse populations? Is there diversity represented within cultural groups? Do the illustrations avoid reinforcing societal stereotypes? Are children portrayed as capable of creating change?”

- 5: The book does not reinforce stereotypes in treatment of either issues or characters. Diverse populations are portrayed and/or diversity represented within cultural groups. Both sides of the environmental issue are considered so that a balanced representation of the ecology problem is conveyed. For example, a book that features characters from different cultural backgrounds and with different physical appearances. A book that looks at both the positives (reduces carbon emissions, controls temperature rise, etc.) and the negatives (installation cost, technical reliability, etc.) of green technology.
- 4: The book does not reinforce stereotypes in treatment of characters. Diverse populations and diversity within cultural groups are portrayed. While considering both sides of the environmental issue, the book provides significantly more insight into one of the perspectives.
- 3: The book portrays diversity among characters but fails to consider differing perspectives of the environmental issue and/or has some stereotyping in the treatment of characters.

- 2: The book considers both sides of the ecology problem but fails to portray diverse populations and/or reinforces stereotyping in the treatment of characters.
- 1: The book reinforces stereotyping in treatment of both issues and characters.

10. Appropriate Illustrations: Assesses the degree to which illustrations enhance the text. Answers the questions, "Do illustrations complement and enhance the text? Are illustrations and photographs appealing? Do illustrations move the story forward?"

- 5: The book features illustrations that enhance the text, move the story forward, and bring the book to life. The artwork is appealing, draws students in, and enables children to make connections to characters and the ecology topic. The book includes vivid, colorful, and captivating illustrations that foster an appreciation of art.
- 4: The book's artwork is appealing, featuring vivid and colorful illustrations that draw children into the story. Most illustrations enhance text and move the story forward; however, some images simply duplicate the text itself without expanding the story.
- 3: Most illustrations are appealing, enhance text, and move the story forward.
- 2: Illustrations are appealing but fail to enhance the text and/or move the story forward.
- 1: Illustrations are not appealing, fail to enhance the text, and do not move the story forward.

11. Story Appeal: Evaluates the characters and indicates whether the story has appropriate action, suspense, pace, and outcome. Answers the question, "Is the story structured and presented in a way that engages readers on both an intellectual and an emotional level?"

- 5: The characters are someone readers feel something in common with or care about. The setting is interesting and/or familiar to readers. The story has a clear plot, and is appealing and appropriate for the recommended reading age. The story's appropriate action, suspense, and pace (length of paragraphs, fragments, scenes; use of descriptions and transitions; etc.) are maintained throughout the book, keeping readers entertained and engaged, and pulling them through the events. The events of the story clearly lead to the outcome, which leaves children thinking about what they learned from reading the book.
- 4: The story has a pace that is too slow or too fast for the audience to maintain engagement. The mention of the environmental issue may be vague, but the rest of the elements described above are included.
- 3: The story has an incorrect pace and the characters are hard to relate to, but the plot is strong. There is no mention of the environmental issue.
- 2: The story features an incorrect pace, the characters are hard to relate to, the plot is unclear, and there is no mention of the environmental issue, but the scientific content and setting are strong.
- 1: The story, plot, and characters are not age appropriate. There is no mention of the environmental issue. The setting is uninteresting and/or unfamiliar to readers. The story's action, suspense, and pace fail to keep readers engaged. The story ending does not make the preceding events meaningful.

12. Developmental Appropriateness: Rates books on the appropriateness of concepts, vocabulary, and sentence structure. Answers the questions, "Is the information age appropriate to ensure children can understand it? Is the information accurate? Does the information eliminate threats to young readers?"

- 5: The book requires children to understand concepts and information presented at an appropriate level of abstraction for the suggested reading age. Vocabulary and sentences are easy to understand. If a basic knowledge of ecology is required

to understand the topic, the book provides this knowledge for the reader. The ecology problem is presented in a manner that is not threatening or overwhelming to children. For example, a book that deals with issues that younger children have some experience with so that they can feel emotionally invested. A book about endangered species that takes place in modern day America and teaches children that the squirrels and raccoons they see every day are in danger of being killed by some environmental threat.

- 4: Most information and concepts are presented at an appropriate level of abstraction. Sentences and vocabulary are mostly easy to understand for the suggested reading level. Some basic knowledge of ecology required to understand the topic may be missing. Children are informed of the ecology problem without feeling overwhelmed. The book setting/time may make it a bit difficult for children to relate to the environmental problem. For example, a book about habitat destruction that takes place in the past or in underrepresented locations that children are not familiar with.
- 3: Approximately half of the information presented is understandable to children in terms of level of abstraction and sentence structure. A substantial amount of basic knowledge of ecology required to understand is missing. Some aspects of the ecology problem are presented in a manner that may be threatening or overwhelming to children.
- 2: Most information and concepts are too abstract for the suggested reading level. For example, a book intended for younger readers is set in a place that is depicted in an abstract or nonspecific way. Sentences are mostly too difficult for children to understand. Most basic knowledge of ecology required to understand the book is missing. Most information and messages are gloomy, causing children to feel threatened.
- 1: Sentences are difficult to understand and theoretical concepts are too abstract for the suggested reading age. No basic knowledge of ecology required to understand the book is provided. The ecology problem is presented in a manner that is threatening to children. For example, a book that tells children that the Earth is being destroyed but fails to provide any solutions will likely only serve to discourage and alarm children.