Overcoming "ecophobia": fostering environmental empathy through narrative in children's science literature

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Efforts to communicate with children about ecological themes often emphasize environmental threats. For some children, however, this approach can backfire, as they try to avoid continued exposure to problems they cannot solve. Another innovative approach is to promote the development of environmental empathy and environmental literacy through the use of narrative. Children's books that use narrative to convey key concepts about a given ecosystem could potentially reach a broad audience by making information about the books available on the internet. Examples of this approach are a special New York City edition of a book in the *Magic School Bus* series (Scholastic Press) and the *Schoolyard Book* series produced by the Long Term Ecological Research Network program.

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For many ecologists and environmental scientists, concern for the natural environment was a motivation when they chose their field of study and future career (Chawla 1998). Concern for the environment has remained a motivation for many ecologists, especially as a growing body of research has revealed the threat posed by climate change to human populations and ecosystems. Furthermore, many environmental scientists believe that raising alarms about future, large-scale environmental destruction will encourage members of the public to embrace pro-environmental behavior. However, as pointed out by Stern (2000), evidence suggests that such "fear appeals" (messages that create anxiety, and thereby cause the recipients to change their behavior) can have unintended effects, leading people to ignore or minimize environmental problems, depending on their perception of individual vulnerability and their ability to take positive action.

Consequently, it is not surprising that environmental scientists and educators sometimes emphasize the threats that face the planet when presenting ecology to children. As in the use of fear appeals with adults, the expectation is that awareness of these threats will capture children's attention and inspire them to learn about the environment and ecological concepts. Compelling accounts of impending doom for a particular species can indeed have a profound impact on children, especially when the species elicits an inherent fascination. I remember finding my young daughter in tears one morning, because she believed that there was only one living Galapagos tortoise; she explained to me that when that one died, there would be none left.

Here, I present an alternative approach that uses narrative to engage elementary-age children in learning about ecological relationships in the natural world and in mastering ecological language. Such experiences may provide a foundation for future learning and development of environmental empathy. I then describe my experience in applying this approach in the *Schoolyard Book* series, published by the National Science Foundation's (NSF) Long Term Ecological Research Network (LTER).

In a nutshell:

- Elementary-age children can be alarmed when they learn about the potential disruptions due to climate change and develop "ecophobia"
- One approach to counter these reactions in children is to foster environmental empathy for their own natural environment through books that use narrative to engage their interest
- Examples from the *Magic School Bus* series and NSF's Long Term Ecological Research Network program's *Schoolyard Book* series are described

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"Ecophobia": a natural reaction in young children

As pointed out by Sobel (1996) in his book *Beyond Ecophobia*, there is evidence that the use of fear appeals may backfire with elementary-age children, creating barriers to development of environmental empathy. Sobel likens "ecophobia" to "math phobia", which can result from "too much abstraction, too early". Sobel discusses several examples of situations in which educational exposure to environmental problems resulted in children feeling "hopeless and disempowered", ranging from an environmental education initiative conducted in Germany in the 1980s to a comparison of children's attitudes in classrooms where Earthweek had been either emphasized or

ignored. Sobel argues that it is a natural reaction for children to avoid continuing exposure to the painful emotions they experience when told about environmental problems that are remote but fully comprehensible, such as the possible extinction of Galapagos tortoises and polar bears, and yet completely beyond their control. In his book *Beautiful Boy*, Sheff (2008) relates an incident that illustrates the origins of ecophobia. He describes how his young daughter had become distressed by watching an environmental documentary and was then comforted by her older brother: "At home, Jasper is sitting on the deck with Daisy, consoling her. She is upset because she watched a video about global warming. 'I feel like I'm standing against a wall and a giant monster is coming slowly toward me and I want to stop it but I can't', she says. She's actually teary."

Development of environmental empathy

Sobel argues that an effective way to engage children in ecology and environmental science – and avoid ecophobia – is to build upon their interest in, if not fascination with, the natural world in their own community, which they can experience as being alive and dynamic. Elementary-age children who gain an appreciation and sense of wonder for their natural environments (eg the stream or park near their home or school) can build upon those experiences as they mature to appreciate and understand other diverse ecosystems. Learning about the plants, insects, birds, and mammals in their local environment through direct observation will lay the foundation for concern for the natural world in other locations, as children progress from concrete to abstract reasoning. This approach emphasizes the development of "environmental empathy" and can be carried out in settings that allow for exploration and discovery. Experiences that provide a personal understanding of ecological knowledge are recognized as central to the first phase of environmental education (Hungerford 2006; Farmer *et al*. 2007).

In the context of understanding climate change, education in ecology and environmental science during the elementary years may provide an important foundation as children go on to study more specific topics in middle school, high school, and college. From this perspective, there is also a risk in being too abstract, by focusing on climate-change issues that may not be meaningful to elementary-age children. For example, rising sea levels and loss of arctic ice cover may be too conceptually abstract for a child who has never seen the ocean. There may, however, be opportunities for ecologists to explain to teachers and elementary-age children some of the changes that may be currently happening in their local environment and that can be more readily understood (Sanger 1998). For example, in the Rocky Mountain region of North America, older children may observe when the snow is melting in the mountains and can be encouraged to think about whether that event is happening earlier now than it did before.

Development of environmental empathy is also important because today's children may experience the impacts of climate change in more diverse ways in the future, when they have adult responsibilities. Depending on the success of current actions to mitigate greenhouse-gas emissions, substantial sea-level rise may bring about catastrophic impacts and displacements, with subsequent repercussions of large geographic extent. Thus, for present-day children, an understanding of the natural world may be one of the most important actions that educators can take to prepare them for the difficulties and decisions that they may face as adults. Scientists can help to address this daunting challenge by pursuing opportunities for collaboration with educators in innovative ways. One way that scientists can potentially contribute would be to help children gain environmental literacy (Saul 2000; Snow 2010).

Picture books: an innovative use of a traditional medium

One innovative approach is to combine a traditional medium, such as a picture book, with a narrative that fosters environmental empathy and scientific understanding in young children. The highly successful *Magic School Bus* series published by Scholastic Press is an excellent example of how engaging narratives can help children learn about many different scientific themes. In developing a picture book for use in the classroom, scientists must recognize that school teachers face many demands on classroom time and that there are barriers to the addition of new material in ecology and environmental science. In some cases, recent educational policies have had the effect of squeezing science out of the elementary curriculum, with more emphasis placed on reading and math (Ernst 2007). Furthermore, there may be long-term challenges for teachers collaborating with local scientists who develop "hands-on" or internet-based curricula for the classroom; over time, resources required to maintain a useful website or acquire instructional materials may become less available. Books have the potential to augment the learning experiences provided by these highly valuable curricula and add stability as personnel change over time.

A particularly relevant example can be found in a special New York City edition of *The Magic School Bus at the Waterworks* (Cole 1988), in which Ms Frizzle and her students are taken on a colorful, raindrop-to-faucet tour of the New York City drinking water supply system. This special edition – which includes maps and is available exclusively through the New York City Department of Environmental Protection (NYC DEP) – is an example of a "localized narrative of place", which Sandlos (1998) argues can provide a context for learning that is often missing in the modern world of sound bites and video

Figure 1. *Webpage for the LTER* Schoolyard Book *series, showing the covers of the three books published to date (http://schoolyard.lternet.edu/book_series/).*

clips. As a whole, the *Magic School Bus* series also illustrates how a direct partnership involving authors, scientists, and educators can help achieve specific educational objectives. This particular book is highlighted on the website of the NYC DEP, under the heading "Educational Resources for Students and Teachers" (www.nyc.gov/html/dep/html/environmental_education/educres.shtml, and shows how effective the internet can be in making such educational resources easily available. Of course, the original edition of the book, published in 1988, can be readily obtained through commercial websites, such as Amazon.com, which also extend the influence of children's science literature by potentially reaching children in many diverse communities.

In a similar approach, as a member of the LTER network, which includes 26 sites in the US, I have recently been involved in the continuing development of the network's *Schoolyard Book* series, which has the goal of promoting environmental empathy in the local community and beyond (http://schoolyard.lternet.edu/book_series/). The School-yard Program of each LTER site seeks to connect scientists with educators in local communities by presenting the LTER site as a "schoolyard" for exploring and understanding ecology and environmental science (Figure 1). The mission statement developed for the book series is "to engage children and their families in learning about the Earth's ecosystems, both locally and internationally, through narratives that reflect the dynamic research being conducted at the National Science Foundation's Long Term Ecological Research Sites". The *Schoolyard Book* series is designed to address four themes: (1) the schoolyard approach (ie connecting scientists to the local community); (2) integration of ecology and Earth science; (3) a long-term perspective; and (4) a connection to a scientist and/or to scientific questions that are being studied at the LTER site. To date, the LTER network has published three books in the *Schoolyard Book* series. These are 9¼ × 10¼ inches, illustrated hardcover and paperback books, intended for children ages 5–10. Included in every book is a page that provides information about the LTER program.

Many outreach activities developed by scientists as a component of their research programs involve a direct relationship with teachers and their students in local schools, and this is the case for many LTER outreach activities as well. As in the example of the *Magic School Bus* series, the *Schoolyard Book* series facilitates these interactions by taking advantage of the fact that children still read hardcopy books and are read to by their family and friends. This is true despite the spread of computers and e-book readers into the classroom and the home. Arguably, the moment of intimate engagement that occurs when a child opens a book and begins to look at the pictures or read the text is not reproduced by most online learning experiences. Furthermore, a book that has been read by one child can be read by another child some time later, without any software upgrades or other technical issues. Finally, because books are readily available, anyone can purchase a book recommended to them by a friend or relative, even though they may not live in the same area.

Importance of narrative

Through narrative, the books in the *Schoolyard Book* series are more similar to those in the *Magic School Bus* series than to more encyclopedic books that present "10 facts

per page". In the context of avoiding ecophobia, the *Schoolyard Book* series focuses on the interpretive narrative and does not raise an alarm about an environmental disaster or advocate any particular point of view or environmental action. Authors strive to make the books engaging, pleasurable, and accessible by creating a storyline that connects the reader to a character, animal, or situation. The storyline has a beginning and an end, and is based on real environmental relationships or an actual incident or situation; this provides a framework for the presentation of concepts and for acquisition of an academic language for learning about environmental science (Snow 2010). The books have realistic illustrations and do not use anthropomorphism (Figure 1), and are therefore suitable for use in a classroom setting, where a teacher may read the story to a class or discuss the story with children after they have read the book for themselves.

Name: Lela
School: Ponderosa
Description: The snow is melting off of the mountain and making a bigger river and the animals are eating grass and drinking water in my picture.

Name: Jacob
School: Highland Park
Description: My project is about irrigation. Irrigation has to do with watersheds because we need the water from the mountains to irrigate and the mountain water is our watershed.

Figure 2. *Examples of children's artwork and comments from the website associated with* My Water Comes from the Rocky Mountains *(http://culter.colorado.edu/MyWater/).*

Narrative about animals that children find engaging can provide a means for teaching them about associated organisms that they may find less interesting, but may be central to the educational goals of the local Schoolyard program. For instance, in the third book in the series, *Sea Secrets: Tiny Clues to a Big Mystery* (Cerullo and Simmons 2008), a sequence of narratives about studies of changing populations of auklets (a Californian shorebird), penguins, and whales serves to engage children in learning about krill, the species that connects all of these populations (Figure 1). The auklets, penguins, and whales are the central cast of characters that teach young readers about the ecological role of krill, in a manner that may be more appealing than would an equally well-illustrated book with pages full of facts.

The use of narrative broadens the book's appeal and increases the potential for extending the outreach beyond planned or intentional science education activities. For example, the second book in the series, *The Lost Seal* (McKnight 2006), was on the shelves in the children's fiction section of the local store of a major chain bookseller, even though the story recounted in the book is true (Figure 1).

Although books with narrative may be effective in encouraging children to appreciate a nearby natural environment, they may also provide a gateway to appreciating remote environments. By stirring the imagination, narrative may encourage children to learn about animals and habitats that they may not have the opportunity to see or visit. Reading an engaging story set in a far-off place may have some similarities with a trip to a site, such as a nature center or a zoo, where children encounter animals endemic to habitats that are different from the setting of the child's own community. In a meta-analysis of studies of the impact of marine wildlife tours, Zeppel (2008) showed that visitors gained both emotional empathy and knowledge during guided encounters with marine wildlife. Thus, if an enjoyable and interesting narrative in a book evokes a similar response as a guided encounter or tour, it may contribute to advancement of science literacy. Furthermore, Zeppel (2008) showed that the guided tour experience contributed to participants' onsite behavioral changes and some longer-term intentions to engage in marine conservation actions. The constructive engagement occurred in many ways, including involvement by families and children in conservation activities.

Including a child's perspective

Another way in which a children's science book can facilitate outreach is through the incorporation of children's artwork and comments within the book itself and/or on the associated website. In the first book of the *Schoolyard Book* series, *My Water Comes from the Rocky Mountains* (Fourment 2009), artwork and comments provided by children are included as sidebars on many pages of the book and are organized by state and classroom in a searchable manner on the associated website (Figure 2). The children participating in the artwork project were from classrooms in the seven western US states through which the Colorado River flows. They

Figure 3. *Example of activities in the My H2O curriculum associated with* My Water Comes from the Rocky Mountains.

were asked to draw a picture and comment on what they found interesting about the water cycle. These pictures and comments represent a shared experience for the classrooms participating in this aspect of production of the book, which is completed when copies of the published books are distributed to their teachers and school libraries as a classroom set. The pictures and comments also provide another dimension to the book, which children can explore on a second reading. In addition, teachers can use the artwork in the book, or artwork created in an in-class art project, to find out whether many students are reacting to one particular piece of a story strongly and then to build from that in future sessions. Moreover, children can search the website based on first name, which represents another shared experience (eg discovering what another "Sarah" in a different state thought was interesting about the water cycle).

Inclusion of children's artwork and comments in the sidebars of a book can also be effective in demonstrating to scientists and educators which detailed aspects of the story may be of particular interest to children. For example, in *The Lost Seal*, artwork and comments provided by children highlight points of scientific interest, such as the thickness of the frozen ice-cover on the lake in the valley floor being equivalent to three people standing one on top of another, and aspects about the Antarctic experience, such as the scientists wearing red coats so that they could be more easily found if they got lost. The pictures can also be useful in showing scientists that some seemingly advanced concepts can be particularly interesting to elementary students, and can be included in educational materials. For example, one girl from a school in Ohio contributed a drawing of herself looking at bacteria under a microscope in a tent in the Antarctic Dry Valleys, showing that she had been able to understand and visualize the process of studying microbial life at that field location. Another aspect of the sidebars in *The Lost Seal* was to illustrate that children around the world are fascinated by Antarctica. *The Lost Seal* was published as an outreach activity for the International Polar Year and included artwork and comments from children in the US, New Zealand, Australia, and the UK.

Working with educators

Publication of a book in the *Schoolyard Book* series may be one step in the strategic plan for educational outreach of an environmental research team that seeks to involve students and their teachers throughout their elementary to high-school experience. For these reasons, the LTER sites participating in the *Schoolyard Book* series may also develop curriculum materials that can be used in the classroom or adapted for use in other educational settings (Figure 3). The usefulness of these materials can be enhanced by connecting the content explicitly to state-level or national-level educational standards. These curriculum materials can be further distributed broadly through the publication of teacher editions of the books containing a compact disc with materials for use by teachers. An example of an extension of the environmental empathy concept that is similar to the special New York City edition of *The Magic School Bus at the Waterworks* is the publication of a more geographically focused book, *My Water Comes from the San Juan Mountains*. This latter book serves the needs of educators in southwestern Colorado, who planned to use aspects of the already developed curriculum, but who wanted their own book for children in the region. Fortunately, these educators were able to obtain supplemental funding for the special edition through the Southwestern Water Conservancy, a regional stakeholder's group.

Books for planned outreach and beyond

As pointed out by Gruenewald (2003) and Hungerford (2006), environmental educators are faced with the changing role of natural environments in the lives of children and must consider these changes when helping children to develop a sense of place and environmental empathy. Based on my experiences with the *Schoolyard Book* series, I believe that scientists can contribute to this process by interpreting their ecological research for their youngest constituents, using narrative in a manner that does not frighten children about the future.

Furthermore, ecologists and other Earth scientists can contribute to development of environmental empathy among local students through the publication of a children's book that increases the effectiveness of their outreach program and augments ongoing classroom connections. For elementary-age children, books that include both a narrative and children's comments and artwork may help students become literate in environmental science. At the same time, by engaging in the real world of children's literature, scientists may reach a broad and diverse audience – given the accessibility of books via the internet. Once published, a book may be read by different children in different settings over time. For example, an attractive book in a school or public library may be picked out by a child based on his or her own interests. Or, a book may be discovered by a parent or a child at a garage sale, after sitting on a shelf for many years, and may once again provide a child with an engaging learning experience in ecology.

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