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Using Picture Storybooks to Support Young Children's Science Learning

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Children's books are an important classroom resource for the study of animals because it is not practical for students to study many animals in their natural habitat. This article is the result of a collaborative research project undertaken by a science methods specialist and a children's literature specialist. We analyzed books about animals that contained both narrative and expository writing and determined the best books that facilitated science learning. We share our criteria for book selection and examples of books that meet these criteria. Many support science learning in classrooms allowing children to make observations, raise questions and form conclusions from evidence.

“Remember that story about the spider laying its eggs in the corner of a window where the birds couldn’t see them? That is a good example of camouflage,” recalled Katie as she and her partner were discussing a school assignment on camouflage. Katie remembered the science knowledge from a children’s picture book about spiders that she had recently read (Dewey, 2002). For children, learning about animals can and should be dynamic. They should be allowed to make observations, raise questions and form conclusions from evidence they have collected. This is the essence of science learning. However, children must be given a multitude of opportunities to probe, poke, and peek into their own backyards or galaxies far away (Fredericks, 2003). These opportunities can be supported by the wealth of information available in science picture books.

Picture books about animals, when scientifically accurate, have the advantage of presenting children with close up pictures. A picture book can do a lot that cannot be accomplished in a classroom. The pictures freeze time, so a reader can pore over the details in a way that would never happen if the animal were moving. Children, who are afraid of animals like spiders, can fearlessly explore a book on spiders and perhaps develop a reasoned appreciation of the arachnid. Illustrations can magnify size so that students can see a microscopic or tiny organism in observable detail. Animals rare in nature can be seen in a picture book. Picture books give readers a good description of events that are not usually seen even by a careful observer. The words provide readers with good science content in a structured, easy to follow way. Explanations accompany the illustrations. A story allows the reader to follow an animal’s life through time--through seasons, weather, and the quest for survival. A book can portray the whole life cycle of the animal whereas in class it can be told but not seen, for it might take a year. A book can raise questions, provide experiences for observation and carefully guide readers toward arriving at a valid conclusion.

Children’s books about science often contain information and stories not accessible from direct observation or other media. Many are high quality books that can support science learning in classrooms. Galda (2001) states that the selection criteria of accuracy and literary merit help teachers discover books that broaden and deepen the information

available to students in the science curriculum. Kaser (2002) discusses how scientific principles can be embedded in a rich foundation of literature and therefore attract student readers; students who read more learn more science content knowledge. Some books combine a narrative storyline with an expository informational piece, usually at the end of the book. Such books provide two different modes of learning science content.

This article is the result of a collaborative project undertaken by a science methods specialist and a children's literature specialist. The purpose of the project was to identify storybooks appropriate for supporting learning of science among young children and to suggest criteria that can be used by classroom teachers in selecting storybooks with science themes for use in their classrooms. Specifically, we focused on books related to animals. We analyzed books about animals that contained both narrative and expository writing and using the criteria identified, determined the best that support science learning. We share our criteria for book selection and provide teachers with examples of children's books for teaching science concepts and ideas.

Children's books are an important classroom resource for the study of animals because it is not practical for students to study many animals in their own habitat. However, as noted by Marriott (2002), who examined 1,074 picture books, most transform and domesticate animals and their habitats in ways that give students misleading information. Therefore, it is important to critically examine the existing books to make sure that the information they contain is correct and that any imbedded messages are valid science content knowledge.

The book formats that were examined move from a story form to an expository information page, usually at the end. Picture books appeal to all ages of students and they provide support for learning visually through both pictures and words. Further, the different types of text, narrative and expository, target different kinds of readers – those who typically prefer fiction and those who find nonfiction more satisfying. For these reasons we sought books with a storyline that would draw readers into the content, but also contain accurate information about the animal and its habitat. We veered away from books that embellish the

truth or modify it for aesthetics. If it is a book for science learning, it needs not only contain valid science knowledge but where possible allow the readers to make observations, and raise questions toward understanding their world. Ultimately a good science picture book not only satisfies a reader's curiosity but also leads to more questions being asked and answers pursued (Nevett, 2003). Our criteria for book selection include:

- Accurate science content
- Accurate, realistic illustrations with photographic quality
- Accurate relational sizes and proportionality for illustrations; magnification needs to be obvious
- Different perspectives of the animal – illustrations or narrative
- Animal in natural habitat (setting)
- Well-written and entertaining, but with good science knowledge text
- Writer's ability to tell a story without embellishing the truth
- Precise accurate scientific terminology
- Communication of accurate science information

Book Examples

Themes of Observing Nature

There are two kinds of books that share the wonder of observing nature. One is a backyard nature book that depicts the interesting wildlife in our everyday world. The other introduces children to exotic or nocturnal animals and their environments. Many books have story characters that are actually observing animals. Since observation is a scientific skill and a key to learning about natural phenomena, this factor could be an influential aspect of some books. The implication that it is important to observe animals could leave a lasting impression upon student learners.

“Backyard Science”

A number of books portray story characters that explore animals in environments near their homes. In a dual plot book, *Once I Knew a*

Spider (Dewey, 2002) an NSTA Outstanding Science Trade Book winner, a pregnant woman describes the life cycle of a spider to her unborn child. The arachnid builds a web and catches prey as the woman watches from her window each day. The verbal description of the spider, web creation, and reproduction are accurate, with the eggs being “each the size of a pinhead” (p. 8). The spider places the egg sac in darkest corner of the window frame where birds cannot see it. The book contains good science content and attractive, accurate illustrations by Jean Cassels, yet is an engaging, dramatic story of the lifecycle and survival strategies of a spider. Author Jennifer Dewey has written 50 books with natural history content. On the last page are author’s notes with science content knowledge about spiders.

A squirrel teaches an anthropomorphic groundhog how to plant his own garden in *How Ground Hog’s Garden Grew* by Lynn Cherry (2003). Typically the animals-as-people technique, signals that the book will be fictional and not scientifically accurate, but this book is an exception. Author/illustrator Lynn Cherry uses the borders to accurately display many different kinds of seeds. Tomatoes stand out as different from peppers, and the many varieties of peas and beans are distinctive. Ground Hog collects seeds from a variety of fruits and potato cuttings, prepares the soil, and composts leaves. They make potato cuttings from sprouts, plant seeds and label the vegetable patch. Both animal characters water the seeds and seedlings emerge, so they replant the seedlings to give them more room. More animals come into the picture; a wren, praying mantis, bees, and butterflies. The praying mantis says – “if you promise not to harm us with bug spray we birds and insects will help you with your garden. We will eat the harmful insects that hurt your plants” (p.24). Again animals talk, but they define interdependence.

In *Butterfly Count* (Collard, 2002), Amy and her Mother visit the Nora Belle Prairie Restoration Project, named after Amy’s great-great-grandmother who settled in the tall grass prairie at a time when thousands of regal fritillary butterflies danced in the sky. During the annual Butterfly Count, Amy spies one of the rare fritillaries in the Prairie being restored to attract the native animals. The butterflies in the illustrations are pictured and described at the end of the book. The

illustrator consulted scientists and visited the prairie reserve to create accurate portrayals of the butterflies and their prairie environment.

In *Crawdad Creek* (Sanders, 1999), a girl narrates her frequent visits to the creek behind her house with her brother where they find fossils, an arrowhead, a salamander, crayfish, dragonflies, turtles, frogs, fish, whirligigs, beetles, damselflies, and “critters so small we had to spy them with a magnifying glass” (p.23). The large watercolor scenes by Robert Hynes are appropriate to the portrayal of a creek. These are complemented with close-up pictures of a variety of animals and also to compare size relationships. While this book might be good for inspiring children to be curious and to take an inquiry approach to the study of science, it lacks additional scientific information on the many animals that call the creek home.

In *Whales Passing* (Bunting, 2003), a father and son holding binoculars, observe a pod of orca whales. The father explains that they may have come from cooler seas and the exquisite ocean paintings by Lambert Davis show the variations of blue in the ocean. The boy points and counts five whales. The father, with more experience identifies the pod, the type of whales and makes inferences about where they could have come from. The son observes, “I watch the drifts that are the breath” (p. 6), as the illustrations show them diving above and below the water. The boy questions, “How do they know which way to go?” (p. 11). Drawing on his experiences and observation, the boy infers that the whales have signposts like a sunken ship or an ocean mountain, below the surface of the water to guide them. He wonders if whales talk and his father explains that they don’t, but they do communicate by whistling, making clicking sounds and squealing. The questioning approach is a great way to learn science as the observation, and questions raised at the beginning become clarified toward the end of the story. An information page on Orcas is at the end including a clarification of them being dolphins and not whales.

In *Swimming with Dolphins* Lambert Davis (2004), tells the story of dolphins as observed by a girl and her mother. Using simple language, he describes the grace and beauty of a pod of dolphins as they spin, turn, glide and slap their tails through the clear blue water of the ocean. The

author's note provides extensive information about dolphins, their habitats and life history, and also mentions other marine mammals such as whales and porpoises.

In a stunning photo essay by Bruce McMillan (1995), two children in Iceland join many others who stay up late at night to help baby pufflings who accidentally land in the village, fly back to the sea. A fact sheet on Puffins and Pufflings and a bibliography are on the last page of the book. This book goes a step beyond close observation of animals to share the experiences of children who take action to save the lives of the birds that become confused by night-lights in their town.

What is notable about these books about observing animals is the way they draw the reader into the setting and habits of the animals while inspiring curiosity. The sense of wonder about the animals and their actions can set the stage for young scientists to be more observant of their local natural environments.

Exotic Ecosystems

Similar stories about observing animals occur in books with exotic ecosystems. The most common ecosystem we found in this type of picture book is the rain forest. *Red-eyed Tree Frog* (Crowley, 1999), a NSTA Outstanding Science Trade Book winner, describes a night in the life of a red-eyed tree frog, photographed by Nic Bishop. Unlike the macaw and the toucan that will soon go to sleep, the nocturnal, red-eyed tree frog wakes up and goes through a process of food selection. Photographs and illustrations show a variety of potential food sources for the red-eyed tree frog.

At the same time, the frog is a source of food for the boa snake. Luckily, he leaps out of the path of its flickering tongue. The frog's graceful leap with the extended legs, the landing, the perch and the capturing and devouring of the moth, are shown in the photographs. These captivating photographs also bring into vibrant focus the greenery of the rain forest in which the color of the frog is camouflaged. The author's note takes the form of – "*Did You Know?*" (p.30), and provides information about red-eyed tree frogs, noting that the close-up

illustrations in the book make the red-eyed tree frog look bigger than its actual size of about two inches.

The ultimate observation of an exotic environment is likely to occur during an eco-tour. Ted and Betsy Lewin took an eco-tour in Uganda in 1997 and describe their observation in *Gorilla Walk* (1999). The book starts with a three-page introduction to mountain gorillas. Then, the Lewins take readers with them on their eco-tour, describing the vegetation, the gorilla tracks and other animals in the ecosystem. The watercolor illustrations extend across full-page spreads and include labeled drawings of the animals and the vegetation as they trek through Uganda's national forest. A two-page Mountain Gorilla Fact Sheet is at the end of the book.

Close observation of animals in their habitats is an important route to developing science knowledge. Reading books in which characters observe their environment, participate in community activities toward preservation or take a tour or fieldtrips reinforces the notion that observation is an essential skill in learning about one's environment.

Animal Biographies

Another type of book that includes both a story and information about animals is what we term "animal biographies." These books imply observation, but because animals move and mature over time, are really more like a biography of the animal or a year in the life of the animal. They emphasize the changes that take place across time in an animal's life.

With sparse text, Johnathan London writes about a year in the life of a ptarmigan, the Alaska state bird, in *Gone Again Ptarmigan* (2001). The emphasis is on the characteristics of the Ptarmigan that allows him to escape the predators along his migratory path. For example, having the feathers that change with the landscape and "having molted from winter to white to summer brown they settle down disguised as a jumble of barren rocks" (p. 17). On each full spread page Jon Van Zyle, the artist, carefully includes inset pictures that support and capture the key ideas being discussed.

At the beginning of *Flute's Journey: The Life of a Wood Thrush* (1997), Cherry tells readers about the wood thrush "whose existence depends upon the tropical rain forest in Monteverde, Costa Rica, the northern forest of the Belt Woods in Maryland, and all the places in between" (p. 2). After thanking a huge list of people who helped her research this book, she shows two children observing the behavior of a fledgling that they name Flute and tells the story of this individual wood thrush through his migration back to the same spot where he was born. This is a highly detailed story with realistic watercolor paintings, maps, and birds in borders around the end pages. Chock full of information, the book is equally about the environmental message of a vanishing ecosystem and about the bird's life.

April Sayre, a birdwatcher, explains what you should do if you hear a honey guide bird in Kenya. In *If You Should Hear a Honey Guide* (1995), readers follow the bird past many animals created in elegant watercolor, gouache, and pastel media, to the source of the honey. The story indicates that the bird knows where the honeycombs are but is unable to reach them for food; hence he guides the reader on a journey to procure the honey and be favored with honeycomb. Readers are urged to take some of the honeycomb out of the nest and place it where the honey guide can eat it. The last page gives information about the honey guide bird and the state of its natural habitat.

Books on animal biographies contain the life histories and tell the stories of the animals' growth, development and survival. They provide a rich avenue for readers to observe the animals and to note important details that are captured in time.

Themes of Preservation

Many of the books that tell a story about an animal in nature involve preserving animals from extinction. There is a definite attempt to raise global awareness of the interrelationship that exists among all animals and the place of humans in impacting the delicate balance. The information the authors share at the end of the books includes organizations established to preserve the species and some history about the events that led to the animals' demise.

Lonesome George the Giant Tortoise (Jacobs, 2003) describes how George, the last surviving Pinta Island giant tortoise lives as his environment is destroyed. In addition to information about this specific tortoise, such as weight, structure, function and habits, we learn general information about the species. Vivid description of tortoise and the environment are supported by the illustrations. Three goats are introduced to the island and soon increase in number, stripping the island bare of vegetation so that tortoises are forced to climb steep slopes in search of food. This is dangerous and the other tortoises do not survive. Wardens from the National Park stumble upon George who is transferred to a research station on another island in the Galapagos. The author's note contains information about activities that lead to the extinction of the tortoise, with a map of the Galapagos Islands on front and back endpapers of the book.

Several books by Jonathan London follow the quest for food and survival of a condor, a whale, a grey wolf, a red wolf, and a panther. In *Condor's Eggs*, (London, 1994) with illustrations by James Chaffee, two California condors live among the rugged slopes of an inland cliff. There is a vivid description of the condor in flight, riding the warm air above the clouds then gliding over a hidden lake, circling and finding his meal. A bird of prey, he is described as, "carrion-eater, bone picker and nature's cleaner" (p. 9). After his meal, he flies back to his high cliff cave, where his mate has supported their egg with pebbles, and they take turns keeping it warm. The illustrations capture well the size of the birds and the height that they usually fly. The Afterword is provided by Robert Mesta a condor recovery program coordinator. The California Condor is the rarest and largest bird in North America. Today, there are only 27 remaining birds, all living in zoos.

In *Baby Whale's Journey* (London, 1999), sparse text and large colorful illustrations with many shades of blue in the water, show the mating and birth 16 months later of a baby sperm whale. The book discusses the safety of whales swimming in a pod, and depicts an encounter with a squid. An Afterward gives factual information about the sperm whale and guidelines for sharing the book with children.

In *Panther: Shadow of the Swamp* (London, 2000), a panther nestles among the saw grass of the Everglades. The oil paintings, by artist Paul Morin, bring to life the saw grass surrounding the swamp with palm and other woody trees in the distance. As the panther moves out of hiding to hunt for food, other animals are introduced. He moves silently through the cypress and strangler fig plants, scouts the wetland and finds a wild hog. The panther then glides through the cypress swamp and back to her hidden den where her three kittens await to be fed with their mother's milk. At the end of the book is a map of the United States showing Southern Florida and the Everglades. Information about the Everglades as a fragile ecosystem of interconnected lakes, rivers and wetlands and home to the panther is also included.

In a similar story, *The Eyes of Gray Wolf* (London, 1993), the illustrations by Jon Van Zyleare are spectacular, supporting the simple poetic text of a Gray Wolf as he travels along the snow clad ecosystem in search of food but ultimately finds a mate. Gray Wolf's pose against the backdrop of a large golden moon is one that readers will remember for a lifetime. The piercing eyes of the wolf and the color scheme of the Alaska's snow clad terrains draw readers into the beauty of the ecosystem as well as the story of survival. The note from the author provides a list of organizations working to preserve the wolf and reintroduce them into their native habitats. A map of North and South America shows where the wolves can now be found.

In *Red Wolf Country*, by Jonathan London (1996), the reader follows two red wolves that roam the coastal wetlands in search for food during the spring. They encounter a skunk and a farmer who tries to shoot them. They find the perfect spot for a den where She-Wolf delivers wolf pups. Robert San Souci, a noted wildlife illustrator paints glowing portraits of these animals in their native habitat. The publisher (Dutton) donates a portion of the proceeds from the book to further the work of those protecting the red wolf.

Children are naturally curious and have many questions about the world around them. Some of these questions are about natural phenomena, changes in nature and about plants and animals. Many are answered in formal classrooms but the judicious use of high-quality

nonfiction books can open up doors of understanding and comprehension of nature (Fredericks, 2003). Books about animals offer opportunities for science learning beyond the formal learning environment. Not only do they provide information about the animals, but good books explore the animals in their natural habitat, and bring to the fore other science related concepts such as predator/prey relationships, adaptations and lifecycles. These books also can be understood without fostering alternative conceptions.

Each of the books in this section highlights an endangered species and describes its habitat and the reasons for its endangerment. These books invite activism. Their stories move readers to want more information, but they also want to lend a hand to try to save the animals. Therefore these make great books for classroom projects to support the organizations working to rescue the animals from extinction.

Conclusion

We have provided here convincing evidence that picture books that tell a story about animals can also be useful as a part of a science curriculum because they contain accurate information both in text and illustration. We utter a caution here. When writers create a story there is license to use interesting prose. For science books, the prose needs to be specifically tailored to contain accurate scientific terminology. For example, in describing the movement of a panther through a swamp, London (2000) writes, "She glides silently and melts into the green silence of the swamp" (p. 5). Melts in science is a change of state from solid to liquid and could be a source of a later alternative conception. The idea to be communicated seems to have been camouflage. Authorial license could create alternative conceptions if not edited carefully by a science educator. Many of these books anthropomorphize animals to the extent that the animals are given names, such as Lonesome George for the last land turtle on one of the Galapagos Islands. As long as the rest of the story is scientifically accurate, this name-labeling does not appear to be a problem. As educators, we note however that it is important that information in books does not initiate the development of alternative conceptions. Researchers have highlighted the negative impact that such alternative conceptions can have on children's learning (Barnett, 2002;

Henriques, 2002; Osbourne & Freyberg, 1985; Posner, Strike, Hewson & Gertzog, 1982; Stofflett & Stoddart, 1994). They contend that alternative conceptions are persistent and despite carefully planned teaching strategies they have the capacities to interfere with learning in science.

A growing number of educators have embraced the enormous value and impact that books have on science learning (Frederick, 2003; Kaser, 2001; Rice, (2002). Specifically, Kaser (2001) points out that literature in the field of science should not be the end of curiosity but should lead readers into a personal interaction with nature (p. 349). 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. For example in the book, *Once I Knew a Spider* (Dewey, 2002), the vivid description of the lifecycle of the spider, and the intricacies of spinning the web in preparation for catching food and laying eggs provide both a foundation and a launching pad for students' self initiated discoveries. The foundation is set for the reader to become immersed in the dynamics of specific science topics, such as arachnids or an exploration of patterns of nature. Very important, too, is understanding the science background of both author and illustrator of the book.

Picture books can provide readers with an array of science information in a welcome and familiar format. These visual cues/illustration can enhance our understanding of the animals within their habitats and their relationships with factors such as rain, snow, changing seasons or predator/prey relationship. Books cannot replace first hand experiences with learning about animals, however they can bring to students the world of animals that would not necessarily be readily accessible. They can also encourage observation, and be the catalyst for the kind of dialogue that is essential to critical thinking. When selecting books for classroom, teachers should consult the award winners in National Science Teachers Association's Outstanding Science Trade Books for Children list that is published annually in the March edition of *Science and Children*, and can be accessed at www.nsta.org. Noting publishers such as the national Geographic Society can be another source to selecting appropriate picture books to enhance science learning.

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