

What Plants and Animals Do Early Childhood and Primary Students' Name? Where Do They See Them?

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Published online: 9 April 2011 Ó Springer Science+Business Media, LLC 2011

Abstract Children from England and the United States of America have a basic similar knowledge of plants and animals, which they observe during their everyday life. Nine children of ages 4, 6, 8, and 10 years, in each country, were asked to free-list plants and animals. Afterwards, they were interviewed individually about the plants and animals they listed to determine where they were seen. Additionally, children were asked to name animals they knew that were found in specific habitats or had specific characteristics. The results showed that children from the earliest years notice the animals in their everyday lives and 8 year olds were able to name the most animals. Plants were not named as often as animals and children in the USA found it difficult to name plants when questioned. This study shows that children are in touch with their everyday environment to varying extents, and that rich experiences can greatly contribute to their knowledge about plants and animals.

Keywords Early childhood □ Primary students □ Informal learning □ Knowledge of plants and animals □ Habitats □ Organisms

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Introduction

Even though the USA and England are similarly developed countries, they may have differing relationships with organisms in their everyday lives. This study is an international look at the differences in the knowledge of children ages 4, 6, 8 and 10 years old. An international study is important because it provides an opportunity to determine the differences in children's knowledge of organisms. This difference is important because it may lead to questioning and determining if there is a cultural or educational (formal and informal) difference in what children

know about plants and animals. For example, if children in England name more farm animals than children from the USA then it is important to do further studies to determine if these differences are due to education or culture. These differences may also point to the lack of a relationship with the environment (Louv 2006).

Children encounter some organisms or representations of organisms in their daily lives. For example, at school children have indirect contact with animals through classroom decorations. School also provides children with direct contact with domestic, farm and exotic animals through school field trips to museums, farms, zoos, and field/nature centers (Tunnicliffe et al. 2007; Tunnicliffe 1999). Additionally, the direct interactions children have with classroom pets have been found to influence children's ideas concerning animals (Prokop et al. 2007, 2008).

Conversely, research shows that experiences outside of the school are an important source of science literacy (Bell et al. 2009; Falk and Dierking 2010; Lucas 1991). Driver et al. (1994) explained that children develop a theory about natural phenomena before they experience

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any formal teaching. Therefore, real life, out-of-school experiences are paramount to learning about organisms. For example, keeping pets (Prokop et al. 2007) and playing in a creek are important real life experiences (Vadala et al. 2007). Significant experiences in the wild often lead to involvement in environmental conservation in adulthood (Tanner 1980). Moreover, Palmer (1993) describes how concern about the environment develops through formative, nature-based experiences. As children develop their knowledge of the natural world, through nature-based encounters, children cultivate their attitudes and concern towards nature. Children do have knowledge of nature (Carey 1985; Helm and Novak 1983; Metz 2010; Osborne and Wittrock 1983; Piaget 1983).

Even though knowledge in and of itself does not insinuate understanding, it frames our ability to evaluate and incorporate new ideas and experiences (Davenport and Prusak 1998). Moreover, knowledge is shared through (1) observation, imitation, and practice (Socialization); (2) verbalization and diagrams (Internalization); (3) models, hypothesis, and language (Externalization); and exchanges of information through conversations (Combination) (Nonaka and Takeuchi 1995). Moreover, the

constructivist idea of knowledge states that all learning is based on personal processing of information (Fraser and Tobin 1998), takes place within a context of social interaction, and is influenced by culture, personal interactions, and language (Solomon 1987). Therefore, if knowledge is defined as the ability to evaluate ideas and share them through observation, verbalization, hypothesizing, and conversation then we propose that children's knowledge of plants and animals may be ascertained through inter-views. Moreover, determining children's plant and animal knowledge by asking them to talk about where they have seen the organisms builds on Eshach's (2006) idea of social situations and participation as a link to learning. By determining children's ability to name and provide locations for plants and animals we determine that children learn mostly at home (i.e. informal and social situations). This base knowledge can then be used by teachers to design their lessons when teaching more abstract ideas concerning the interactions of plants and animals. This study incorporates free-listing and interviews to ascertain what children know about the natural world by determining their ability to name and describe the locations of plants and animals. The study will ask the following questions: (1) With which plants and animals are children familiar? (2) Which animals do children notice in their everyday environment? (3) What are the locations at which children say they observe plants and animals? and 4) From where have the children gleaned their knowledge about plants and animals?

Theoretical Framework

The USA National Science Standards (National Research Council 1996) state that children, ages five to ten, should be able to identify organisms and their characteristics, life cycles, and habitats. England's National Curriculum provides a bit more detail. The English Curriculum states that children should relate life processes to organisms in the local environment, recognize similarities among organisms, group organisms based on their characteristics, identify the organisms in their local environment, and care for the local environment (England National Curriculum 2011). These science curriculums require children to know organisms and their characteristics, including their habitats. Therefore, it is imperative that when children enter school teachers have a clear understanding of children's knowledge of plants and animals. This study initiates a look at the baseline knowledge of children as they begin school.

In countries where children and adults are out of touch with the natural world, the general public has a low level of awareness about local environmental issues, a poor understanding of ecosystems, and a general lack of care and apathy for the environment (Evans et al. 2007). Louv (2006) blames the technological age for the loss of our development of environmental and biological awareness. Prior to the current digital age, children developed their understandings of the natural world

through books, personal observations, storytelling and their parents and grandparents. However, schools are not highly ranked as a source of information concerning the natural world (Gatt et al. 2007; Reiss and Tunnicliffe 1999; Tunnicliffe and Reiss 2000). In fact, children, in developed countries, are acquiring their information about the natural world second hand through the media (Pergams and Zaradic 2006, 2008; Zaradic and Pergams 2007).

Children do not come to the classroom as a blank slate. They have personal experiences, which they bring to the classroom. However, children's ideas about nature are not always correct. Therefore, teachers must be aware of children's knowledge concerning the natural world and the children's misconceptions (Tull 1992) and restructure their teaching. Simply adding information to children's existing knowledge does not change their mental constructs (Osborne and Wittrock 1983). Teachers do not address prior knowledge, because they use a restrictive range of resources (Sanders 2007), use a narrow view of the organisms they teach, have a lack of confidence (Braund and Reiss 2004) in their science knowledge (Osborne et al. 1998), and feel hindered by the demands placed on them by testing (Keiler and Woolnough 2002; Krueger et al. 2002; Reiss and Tunnicliffe 1999; Toplis and Cleaves 2006).

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Children's Conceptions of Plants

Plants are important to humans and the consumption of plants is increasing. Sanders (2007) states that a loss of biodiversity and the demands humans place on the environment are important environmental reasons humans should consider plants. Moreover, modern societies are blind to the value and nature of plants (Schneekloth 1989). In 2010, the earth's human population was 6.8 billion and rising (Population Connection 2010). The rise in global population is responsible for diminishing green areas and triggering the demand for produce and trees to rise to unprecedented levels (Fujiwara and Matoh 2009). Twenty-five of the best selling pharmaceuticals originate from plants (BGCI 2010a). The demand for plants has caused an over-exploitation of plant species, which is the most significant cause of extinction (BGCI 2010a). Today, approximately 25% of plant species face extinction, posing serious and life threatening consequences for all life on earth (BGCI 2010b). Plant decline is an important aspect of teaching, because the food sources, green areas, and pharmaceuticals we need to survive are being depleted. Therefore, teachers need to involve pupils in discussing

controversial issues, such as deforestation, genetically engineered crops, and the use of plants to manufacture pharmaceutical drugs (Braund and Reiss 2004). The good news is that the educational institutions possess the power to change the way children think and feel about real-world issues (Richardson and Blades 2001).

Young children, worldwide, have an innate interest in plants, but as they grow older their attitudes change and they do not notice plants and do not believe plants have value (Schneekloth 1989). This phenomenon of ignoring plants as if they are not there is referred to as plant blindness (Wandersee and Schussler 2001). However, plant blindness should not be an issue in a country such as England, where approximately 20 million households have a garden (Braund and Reiss 2004). In fact, gardening is listed as the British citizens' most favorite pastime (Sanders 2007). Yet, plant blindness is a concern. Children do not find any value in learning plant names Bebbington (2005) and plants on display at places of informal learning are ignored (Braund and Reiss 2004). Plants are not given the wonderful, exciting descriptions placed on animals. Plants are described as immobile, faceless objects with a non-threatening presence, which causes the public to view them as inconsequential (Wandersee and Schussler 2001). Such unremarkable attributes have given rise to the common belief that plants are inferior to animals. Teachers, who spend more time focusing on the animal kingdom, further invoke these plant misconceptions. Teachers of the biological sciences have been labeled "zoochauvinists" (Hershey 1996), because they allow their teaching of

animals to overshadow plants. Overlooking plants in the curriculum is easy for teachers, due to children's disinterest (Sanders 2007). Even though, plants are an important part of the ecosystem, they are essentially neglected in the classroom (Barman et al. 2006; Tunnicliffe and Reiss 2000). Two reasons that botanophobia and a lack of plant knowledge and care have evolved are: (1) Research shows that the human brain picks out movement around the immediate environment; therefore, it may be that immobile, non-threatening plants do not gain our attention (Strgar 2007). and (2) Because humans are animals, this may trigger an innate interest in other animals (Tunnicliffe 2001).

Even though teachers find it difficult to maintain pupils' interest in plants, lessons that are engaging and promote long-term learning have the potential to raise interest and appreciation (Lindemann-Matthies 2005). For example, teachers should use real plant and animal specimens to teach similarities and differences (Tunnicliffe 2001). Lessons have been developed that show the interdependence of plants and animals and plant growth (e.g. Amsel 2009; Jones 2009; Quinones and Jeanpierre 2005). These lessons offer a more in-depth and relevant botany context.

Little research is available concerning young children's ideas concerning plants

and their understandings of the concept 'plant' (Boulter et al. 2003; Tunnicliffe 2001; Tunnicliffe et al. 2008). Instead, research in children's understandings of plants has focused on their knowledge of plant growth and photosynthesis (Barman et al. 2006; Russell and Watt 1990; Osborne et al. 1992). As early as the 1970's, research has documented the lack of United States children's plant knowledge in comparison to the plant knowledge of children in other countries (Dougherty 1979). Additionally, research within the United States has shown (1) a significant difference in plant knowledge between children and their parents and grandparents (Nabhan and Antoine 1993; O'Brien 2008), and (2) that elementary and college students have a low level of specific plant knowledge, especially wild plants (Cooper 2008; Wagner 2008). In Brazil Natarajan et al. (2002) found that tribal students, ages 10–15 years, have a base knowledge of plants that is richer in ecological content than the plant knowledge of urban students. Chitra, et al. showed that simply having plants in the environment did not make students aware of plants. Even though the literature shows that there are some differences in children's plant knowledge regionally or culturally (Bebbington 2005; Bell 1981), children worldwide still share common beliefs about plants. For example, a common misconception held by children worldwide is that the plant is not a living entity (Stavy and Wax 1989).

Young children do not recognize plants as living things and construct their own ideas about natural phenomena,

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based on their sensory and personal interactions with their environment (Tunnicliffe 2001). Additionally, children use their own strategies to identify plants (Uno 2009). Therefore, it is essential that children have direct interactions with plants to make a significant difference in their knowledge (Askham 1976). This study elicits the knowledge children acquire from their everyday lives and from where they believe they acquire the knowledge. Therefore, the aim is to determine what children intuitively think of as a plant and an animal and ascertain where that source of knowledge is acquired.

Children's Conceptions of Animals

From their earliest moments, children are learning about animals and plants (Keil 1979). Children are introduced to animals in their everyday lives through encounters with animal images at home and in the media (Tunnicliffe et al. 2008).

Additionally, they have personal interactions with animals as pets (Prokop and Tunnicliffe 2008) and as livestock, which are kept for meat, milk, eggs, honey, and transport. Animals are featured in various ways depending on the culture. Children in developed countries come in contact with animals in gardens, parks, zoos, forests, farms, and nature centers, which may allow them contact with exotic animals. In less developed countries the local animals are as much a part of the lives of the inhabitants as the children. The children from these countries have an ecological understanding of animals superior to that of children from developed countries (Bang et al. 2007). However, worldwide children have the same difficulties in learning about the life histories, adaptations, and habitats of animals (Atran and Medin 2008).

The opportunity for exposure to wild and exotic animals is mostly limited to visiting a zoo. In fact, teachers and parents believe that the primary reason for visiting a zoo is for the educational benefit of children. However, zoo visitors' knowledge of animals has been shown not to be significantly different from those of non-visitors (Kellert 1980). Tunnicliffe (1996) determined that when children look at animals in exhibits, they mention anatomical features such as the size, shape and color. They do not mention conservation issues or habitat. People who belong to wildlife and/or environmental organizations or watched animal-related television programs are more likely to have knowledge of animals, conservation issues, and habitat (Ascione 1992; Kellert 1980). The issue is that animals in zoos and museums do not provide a realistic view of the natural world, because they are not diseased or suffer from malnutrition. Animals are shown as healthy and physically fit (Reiss et al. 2007). These are not natural situations in which children may learn about the reality of animals'

lives. Therefore, activities geared toward wildlife in their natural environments are important in the development of knowledge (Eagles and Muffitt 1990; LaHart 1978; Westervelt and Lewellyn 1985).

Compared with adults, young children should possess a different understanding of animals. However, there may only be slight differences in their knowledge. Young children are concerned with shape, form and size (Braund 1998) and employ anthropomorphic terms in their explanations (e.g. Carey 1985). Prokop and Tunnicliffe (2008) found that elementary school children did not have positive attitudes towards bats and spiders. Children were more negative towards the spider than the bat, but this could be because they had more interactions with spiders. Shepardson (2002) have determined that 5–11 year olds understand how insects feed, their locomotion, and their physical characteristics, such as size and shape. Tunnicliffe and Reiss (1999) have discovered that young children rely on anatomical structures to group animals, while older children use taxonomy, habitat and behavior in addition to anatomical structures. Cardak (2009) has explored

preservice science teachers' understandings of birds. He uncovered at least 10 misconceptions. For example, preservice teachers stated that a bat is a bird and a penguin is a fish or mammal. Prokop and Rodak (2009) established that when identifying birds "elementary school pupils and biology majors did not significantly differ (p.131)." Furthermore, they stated "This supports the idea that knowledge of biology on this topic is rapidly acquired before the age of 10 (Carey 1985; Jaakkola and Slaughter 2002) and further acquirement is somewhat slower (p. 131)." Therefore, it is important to focus on animal study in the early childhood classroom or at the very least to determine what children know about animals at the early childhood level and primary level. Educators must be cognizant of these findings and mindful that children bring their own mental concepts and ideas of animals, which they have built from previous experiences.

Children learn to identify organisms from the everyday names used within the culture in which they are living (Brown 1958; Rosch and Mervis 1975). Consequently, listening to children talking about their own experiences, interests, and knowledge is an important aspect of understanding the cultural roles in defining their mental models (Tunnicliffe et al. 2007). Furthermore, naming organisms allows children to make sense of the world around them and provides opportunities for discussion and inquiry (Tunnicliffe 2001). This international study uses language to determine the development of children's abilities to name plants and animals, name animals in particular habitats, the students' sources of information, and cultural perspectives.

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Methodology

In order to better understand children's plant and animal knowledge, this research focuses on differentiating between types of knowledge like naming the organism and determining where it has been seen. For example, determining that a child can say the word "tree" when asked to name a plant may not define their level of knowledge. Therefore, it is important to probe the child's knowledge by asking them to tell where they saw the plant. Additionally, asking children to name plants found in certain habitats may be useful to glean knowledge that was not otherwise available by only asking them to name plants. Asking probing questions such as, "Can you name a plant that lives in water?" and "Where did you see that plant?", may produce an argument for identifying key childhood experiences, in which learning about the natural world takes place. Exploring where children see

plants and animals and the plants or animals children associate with different habitats, may underscore the importance of childhood place-based experiential education programs into school curriculum.

Many different methods have been employed to determine salient themes in children's perceptions. Studies have used open questioning (Dikmenli 2010), pre- and post-test techniques (Haslam and Treagust 1987), concept mapping (Novak 1990; Novak and Gowin 1984), drawings (Bahar et al. 2008; Erdogan and Erentay 2007; Kose 2008; Prokop and Fanoviova' 2006; Prokop et al. 2009; Reiss and Tunnicliffe 2001; Reiss et al. 2002; Teixeira 2000), and a word association questionnaire based on keywords (Cardak and Dikmenli 2009; Sato and James 1999; Torkar and Bajd 2006). The data collection for this study is a structured three-layered interview. The first layer uses free-listing and asks children to list all the organisms they know in 1 min. The second layer asks children to state where they saw the organism. The third layer provides children with a habitat and asks them to identify an organism found in that specific habitat. For example, "Name an animal that lives in the water." The three-layer approach is important, because asking children to name organisms does not provide information concerning their knowledge constructs. Children may be repeating names they have heard others use. They may have no deeper understandings of organisms. However, asking children to describe where they saw the organism provides a reference point to determine the relationships children see between organisms and habitats. Additionally, if children are asked to name organisms living in specific habitats and they are not able to provide answers, this may mean that they are not able to cognitively determine environmental relationships between organisms and habitat.

This study included 108 early childhood and primary school children. Seventy-two were from England and thirty-six were from the United States (US). Nine children, in each of four age groups, were chosen for this study by preschool and classroom teachers, who had each had more than 7 years of experience. Teachers of 4, 6, 8 and 10 year olds were asked to choose three children from each of the following abilities: low, middle and high. The teachers were asked to select as equal as possible a distribution of males and females. The study was limited to nine children in each age level, because this study was unfunded and it proved difficult to find teachers who would allow children to miss class instruction. The number of children was greater in England than the US, because the same 36 children were employed in the US study for both the plant and animal interviews, whereas, 72 children were in England study, because a different set of children participated in the plant interviews than those interviewed concerning their animal knowledge. The English schools were located in North London. The US schools were located in a metropolitan area in central North Carolina. The selection of settings was purposeful in that children would have similar interactions with the natural world. For example, it would not make sense to interview children from a metropolitan

area and a rural area, unless they were from the same country.

Research data was collected by conducting structured interviews (Figs. 1, 2) with 72 English children and 36 US children. The English interviews were conducted by one of the authors. The US interviews were conducted by the author's second year research assistant, who had been trained in interviewing techniques and the interviews used in this study. Children were interviewed separately in a quiet location within the school. The same 36 US children were interviewed to gather the plant and animal data. However, the plant interview and animal interview were done on different days. The same children were not available for the England interviews. Therefore, for the England interviews 36 children were interviewed for plant data and 36 children were interviewed for the animal data.

Prior to the interviews, the researchers told the children they were interested in determining their ideas concerning plants or animals. The researchers assured the children that all of their answers were acceptable and no right or wrong answers existed. Technical biology terms such as invertebrate were explained as necessary during the interviews.

Data Analysis and Results

The data presented here exemplify the overall findings and give some indication of the different cultural influences on English and US children's knowledge. After the data sheets

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Fig. 1 Questions asked during the plant interview

Child's Age: _____

Ask children the following questions. For number one, make sure to allow children one minute to answer. Write children's answers below each question.

1. Name as many plants as you can (give students one minute).
2. Where did you see the _____? (Name each plant and ask the student where they saw it.)
3. Tell me what plants live here at school? Where have you seen them?
4. Tell me what plants live around your home? Where have you seen them?
5. For each of the following ask the student if they can name a plant in that category and ask them to name the places they have seen it (e.g. TV, books, garden, etc.).

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Category

Plant Named

Location

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In garden

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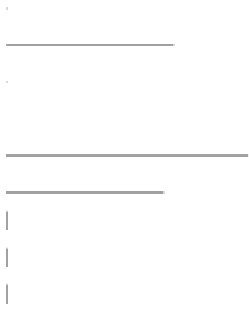
|
|
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Inside house

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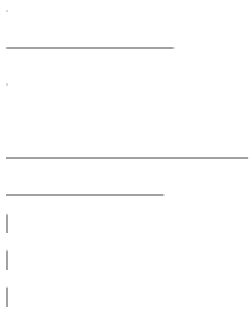
Outside house



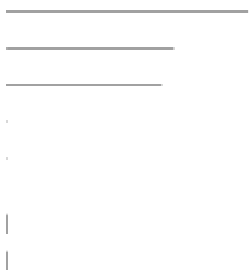
Has flowers



Is green but does not have flowers



Lives no walls



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Lives on water

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Lives in water

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Seen insects on it

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Smells/Has a smell

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You may eat it

Lives on the ground

were read and the data was placed in an Excel file, categorical responses emerged. The plants and animals named by the pupils in 1 min were grouped in the following categories: Exotic (to that country), Endemic Wild, Domesticated for Pleasure, and Farmed. Additionally, the plants and animals named in 1 min were divided by using a scientific identification, which was developed by the authors. The plants were divided into Bryophytes, Vascular Seedless, Gymnosperms, Monocots, and Dicots. The animals were divided into Mammals, Birds, Reptiles, Amphibians, Fish, Arthropods (Arachnids), Arthropods (Insects), Mollusks, and Annelids. The children's responses to where the plants and animals were seen, were dispersed into the following

categories: Zoo, Media, Pet Shop (Shop/Store for plants), School, Outside, Home/Garden/Yard, and Visit to Natural Area. To determine if children were able to make connections, the interviewers asked the children to name a plant or animal based on its characteristics or habitats.

A qualitative analysis approach was taken, because there was not enough data to perform a quantitative analysis. Even though the data is presented quantitatively, statistical analyses were not possible. The children's responses for each question were placed into an Excel file and totaled. In question number one all the answers were counted separately, unless a child named the same organism twice. For example, if a child named a cat, lion, dog, blue jay, seagull,

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Fig. 2 Questions asked during the animal interview

Child's Age: _____

Ask children the following questions. For number one, make sure to allow children one minute to answer. Write children's answers below each question.

1. Name as many animals as you can.
2. Where did you see the _____? (Name each animal and ask the student where they saw it.)
3. Tell me what animals live here at school? Where have you seen them?
4. Tell me what animals live around your home? Where have you seen them?
5. For each of the following ask the student if they can name an animal in that category and ask them to tell the places they have seen it (e.g. TV, books, garden, etc.).

_____ .

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Category

Animal Named

Location

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A bird

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A small mammal

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A domestic animal

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A flying invertebrate

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A walking invertebrate

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An invertebrate that lives in the ground

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Lives in water

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Lives on water

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Nocturnal animal

and bird; they received a total count of five for the animals named. The word “bird” was not counted, because the blue jay and seagull are examples of birds. Question number two asked children to tell where they saw the animal. All data points were counted separately. For example, if a child said they saw the cat-home, lion-TV, dog-home, blue jay- home, seagull-beach, and bird-school, they received the following counts: 3-home, 1-media, 1-visit to natural area, and 1-school. The “bird” data was counted in this data, because it was a different location than the others. Each location or characteristic listed in question number five was coded once for the plant or animal named. Therefore, none of the answers would have a count of more than nine, because only nine children were interviewed for each. However, when children were asked where they saw the organism, they may have answered “the grocery store”,

“my backyard”, and “at school”. Each of the previous answers would have been

counted; therefore, an answer for where the children saw the organism could have a total of more than nine. If a child answered, “I don’t know” the answer was not coded.

Plants

Even though the total number of plants named by children in England (154) and USA (126) were similar, domesticated plants were named by children in England (58) more than exotic (9), endemic wild (49), and farmed (50) (Table 1). Children in the USA named farmed plants (47) more often than exotic (7), endemic wild (38), and domesticated (33). When the plants named by children were broken down into scientific categories the results for

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Table 1 Total number plants named in 1 min and where they were seen

Category of plants named by children

Age of students Exotic (to the country) Endemic wild Domesticated for pleasure Farmed Total

Country

USA

4 years 1 3 1

6 years 2 7 5

8 years 10 years 3 1 12 17 12 15

England

Total 4 years 7 1 39 9 33 3

6 years 4 5 13

years

Where plants were seen Zoo Media 0 Shop/store 0 School 0 Outside 0 Home/garden/yard 3
 Visit to natural area (beach, park, woods, etc.) 0

N = 9 for each age group in each country

8 years 10 years

England Total 4 years

8 years 10

years

2 7 USA 4 years 0000000000

10 24

6 years

0 12

0 2

3 1

0 3

10 38

5 12

3 25

6 years

21 23 0 0 4 6 0 0 2 6 0 2 2 5 13 4 45 96 21 7 19 36 3 3

13 22 40 55

47 16 29

Total 9 49 58 50

Total

3 4 7 3 8 11 1 10 13 9 7 33 29 42 99 5 12 23

8 years 10 1 3 10 25 16 14 12 19 39 61

the two countries were nearly the same. Dicots (England- 124, USA-99) and monocots (England-23, USA-35) were named more often than any other type of plant (Table 2). The most frequently named dicot was the rose. The most frequently named monocot was grass. Bryophytes were not identified by children in the US, but four bryophytes were named in England. Plant knowledge increased with age in both countries, except for the slight decrease in English data between 4 and 6 year olds (Table 1). All age groups identified home/garden/yard (England-99, USA-96) as the location they see plants most often. School was mentioned as the fourth location in England (13) and fifth in USA (6). Zoos were not named as a

place to see plants. The children's ability to name plants when provided with a habitat did increase with age (Table 3) and home/garden/yard remained the number one place to see plants.

Animals

The results indicated that the English children were more likely to name exotic animals (191), while the USA children were more likely to name endemic animals (149) (Table 4). Eight year olds in England (132) and USA (134) identified more animals than any other age groups. The frequency of pets/domesticated animals (England-63, USA-67) were similar in both countries. Additionally, the children listed farm animals less than any other group (England-46, USA-30). Animals were seen in the media, at home/garden/yard, at the zoo, and at school (Table 4). Vertebrates were cited more often than invertebrates (Table 5). The most named scientific category was mammals

(England-224, USA-284). The invertebrates encountered everyday were mollusks, arachnids (all spiders) and insects. Children in the USA found it difficult to name a flying invertebrate (1) (Table 6) and animals that live on water (2). Even though 8 year olds named more animals in 1 min than any other age group, 10 year olds were more likely to correctly identify an animal when asked about habitat and characteristics (Table 6).

Conclusions and Discussion

The English and USA national curriculums state that children must understand organisms and their habitats and how organisms are important in the local environment. Understanding children's knowledge of the characteristics, habitats, and locations of everyday plants and animals is the beginning of understanding children's zoological, ecological and environmental knowledge. Even though much attention has been afforded children's understandings and interpretations of animals, during visits to zoos and natural history museums, little attention has been given to children's informal encounters and knowledge of everyday plants and animals. Children's informal observations and interactions within their local community form part of their real world knowledge concerning biological phenomena (Gelman 2009). This study shows that English and USA children learn about plants and animals in their everyday lives, some of them exotic, but many are endemic or domesticated pets. These personal observations are often

Table 2 Total number of plants named in 1 min placed into scientific classification

Scientific classification

Age of students Bryophytes VascularSeedless Gymnosperms Monocots

Dicots Total

Country

USA

4 years 6 years 8 years 10 years Total 0000000134

England

0 0 0 1 1 1 4 8 6 19 1 5 10 12 28 5 15 22 36 78 7 24 40 55

0 1 2 5 8 1 1 2 0 4 9 5 5 4 23 19 18 29 49 115 29 25 39 61

4 years 6 years 8 years 10 years Total

N = 9 for each age group in each country Table 3 Plants named when students were asked for specific plants and where they were seen

Description of animal

Age of Students In the garden/yard Insideyourhouse Outside your house Lives in wet places
Livesonwater Livesinwater Lives in the ground

Where plants were seen Zoo Media Store

School Outside Home/garden/yard Visit to natural area (beach, park, woods, etc.)

N = 9 for each age level in each country

Country

USA England

4 years 6 years 8 years 10 years 4 years 6 years 8 years 10 years 02691375 00122137 03281547
00110026 01121217 00111436 00010028

USA England 4 years 6 years 8 years 10 years 4 years 6 years 8 years 10 years 00000000
00010116 01120120 01128549 11245467 16790999

often than children in the USA. However, children in both countries do not list zoos as places to see plants. This may be due to the perceptions people hold that zoos are places to see animals.

Children in both countries name farm raised plants more than any other group and children mostly see them at home/garden/yard. This may be a consequence of home gardening or that children are most familiar with farm raised plants, because plants are normally included in a meal. Additionally, children's prior experiences with family, in which they ate plants or planted, seemed to make a difference in children's plant knowledge. This is an important finding for teaching plant concepts. When teachers teach about plants it is paramount that they include hands-on interactions such as planting, dissecting

unused in formal science education. Therefore, an important part of teaching children biological concepts is providing children's misconceptions to the educators who teach the children.

The plant and animal data suggests similar findings in the English and USA children's ability to name plants and animals, but there are also some interesting differences. These differences seem to be culturally influenced. For example, the role zoos play in children's lives seems to differ between the two countries and between plants and animals. Children in England are more likely to name Bryophytes and seedless vascular plants than children in the USA. This finding may show that the local community does play a large part in what children know about plants. Children in England state they see animals at the zoo more

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Table 4 Total number animals named in 1 min and where they were seen

Category of animals named by children

Age of Students Exotic (to the country) Endemic wild Pets/Domesticated for pleasure

Farmed Total

Where animals were seen Zoo Media Petshop

School Outside Home/garden/yard Visit to natural area (beach, park, woods, etc.)

Country

USA

4 years 11 13 11

4 39 USA 4 years 12 22 2322900000

N = 9 for each age group in each country

6 years 18 23 16

8 years 35 65 23

10 years 25 48 17

England

Total 4 years 89 38 149 10 67 10

6 years 50 5 12

8 65

146213 00011 510202762 3551932

8 years 10 58 45 28 18 25 16 21 7 132 86

6 years 13 25

8 years 12 30

10 years 14 29

England Total 4 years

6 years 28 20

8 years 10 30 28 32 55

years Total 121

11 134

7 97

30 8 66

10 77

0 1 1 1 0000010023 0000000123

3 7 5 4

flowers, touching seeds, and comparing real plant parts (not plastic).

This study supports other findings that children have a wide understanding of the animals they encounter in their everyday lives (Palmer 1993; Gelman 2009). Additionally, the USA data supports Kellert and Westervelt's (1981) and Lindemann-Matthies (2005) findings that children are interested in local animals more than national or international animals. The most commonly named animals in this study are the mouse, dog, and cat. However, based on the data from this study it should not be assumed that the children are more interested in these animals. The children may have free-listed these animals more often, because these animals are seen more often in the child's local

3 2 1 4

5 7 4 4

2 2 0 0

environment. The opposite was true in England. The giraffe, elephant, and tiger were named most often. In fact, the African elephant represents one of the most familiar and popular animals in the United Kingdom.

English and USA children named farm animals less than any other group of animals. Moreover, the USA children in this study live near farms, but still fail to mention farm animals. This may be a consequence of families no longer maintaining and slaughtering food animals, such as pigs, sheep, chickens, and cows. Due to large scale dairies, chicken houses, and hog farms, children no longer help the family nurture animals as food products. This may point to a disconnect between food and its origin as a result of social changes and is worthy of further study.

11 0 17 3 11 0 13 2

4 6 1 5

1 7 2 13 1 6 3 10

51 35 106 34

years Total 191

61 63 46

141

0235 10 1257 15

10 10

35 1

8 years 99 9 7

30 85 2 6

10 years Total 67 284 6 22 2 17

2

1

6 years 64 5 4

N = 9 for each age group in each country Table 5 Total number of animals named in 1 min placed into scientific classification

Scientific classification

Age of Students Mammals Birds Reptiles Amphibians Fishes Arthropods (Arachnids)
Arthropods (Insects) Mollusks

Annelids

Country

USA

4 years 28 4 4

6 years 41 8 6

8 years 91 14 10

10 years 64 7 6

England

Total 4 years 224 54 33 2 26 4

Table 6 Animals named when students were asked for specific animals and where they were seen

Description of animal

Age of Students Flyingbirds Smallmammals Domesticanimals Flying invertebrates Ground dwelling invertebrate Livesinwater Livesonwater Nocturnalanimal

Where animals were seen Zoo Media Petshop

School Outside Home/garden/yard Visit to natural area (beach, park, woods, etc.)

Country

USA England

4 years 6 years 8 years 10 years 4 years 6 years 8 years 10 years 57584578 10485777 46455666
00013657 32232324 27793789 10011267 34582467

USA England 4 years 6 years 8 years 10 years 4 years 6 years 8 years 10 years 00010011
12220024 00020020 11000110 42774878 36674777 0 1 1 1 0 0 1 1

N = 9 for each age level in each country. The England's primary school had a natural area with a pond

Even though the classroom is a place of formal learning, some informal learning must take place for children to learn about plants and animals. This may be accomplished by designing hands-on activities in which the teacher is an active participant. Science education has been pushing teachers to become hands-off and allowing children to be hands-on and minds on in discovering science concepts (Doherty 1992). This study suggests that teachers must be hands-on when developing young children's biological understandings of plants and animals. Children remember plants and animals that have been introduced to them outside of school. The research presented here demonstrates that school does not have a considerable influence on how children understand objects in the natural environment, especially at younger ages. Therefore, when teaching children about plants and animals, teachers need to become hands-on teachers and mentors, who

work closely with young children.

This study shows that children are in touch with their everyday environment to varying extents, and that rich experiences can greatly contribute to their knowledge about plants and animals. Early childhood and primary teachers need to remember that children are tabula rasa. Children at all ages come to the classroom with their own ideas about and experiences with animals. To provide children with a valuable, effective learning experience within the formal educational setting, teachers need to bring living plants and animals into the classroom.

Children should be allowed to interact with the organisms and ask questions. Additionally, teachers need to utilize the out-of-doors on the school campus, by taking children outside to look at plants and locate organisms such as birds and spiders. This study shows that children say they learn about organisms at home; therefore, teachers may ask children to interact with family members when learning about organisms. Children may be asked to interview parents about their favorite organism or asked to bring in something from their yard (i.e. leaf, twig, grass, insect, etc.). Students may also be interested in sharing experiences they have had with their pets (Prokop and Tunnicliffe 2010). Teachers need to use parents, the school grounds, and classroom organisms to elicit children's knowledge and understandings of plants and animals.

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