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## Botany in children's literature: a content analysis of plant-centered children's picture books that have a plot and characters

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BOTANY IN CHILDREN'S LITERATURE:  
A CONTENT ANALYSIS OF PLANT-CENTERED CHILDREN'S  
PICTURE BOOKS THAT HAVE A PLOT AND CHARACTERS

A Dissertation  
Submitted to the Graduate Faculty of the  
Louisiana State University and  
Agricultural and Mechanical College  
in partial fulfillment of the  
requirements for the degree of  
Doctor of Philosophy

in

The Department of Curriculum and Instruction

By  
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M.A., Louisiana State University, 2000  
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## TABLE OF CONTENTS

ACKNOWLEDGEMENTS.....	ii
ABSTRACT.....	vii
CHAPTER 1: INTRODUCTION.....	1
Rationale.....	1
Goal of the Study.....	3
Research Questions.....	4
Gowin’s Vee Diagram of Research.....	4
Flow Chart Diagram of Research.....	5
Significance of the Study.....	7
How Picture Books Influence Science Literacy.....	7
Why Picture Books Appeal to Children Ages 4-8.....	12
Picture Books Can Provide a Means of Playfulness.....	13
Importance of Fictional Stories.....	14
Criteria for Fictional Science Picture Books.....	15
Human Constructivist Learning Theory.....	16
The Importance of Prior Knowledge.....	16
Definition of Terms.....	17
Innovative Graphics Terms.....	19
CHAPTER 2: LITERATURE REVIEW.....	21
No Child Left Behind.....	21
Improving Scientific Literacy.....	21
American Society of Plant Biologists.....	22
Human Constructivism.....	23
Ausubel’s Cognitive Assimilation Theory.....	24
Meaningful Learning Versus Rote Learning.....	24
Reception Learning Versus Discovery Learning.....	26
An Epistemology of Knowledge Building.....	27
Knowledge Construction.....	27
Knowledge Restructuring.....	28
Conceptual Change.....	29
The Colossal Role of Children’s Literature.....	30
Picture Books.....	30
The Power of Words.....	30
The Meaning of Words.....	30
Potential of Plant Science Picture Books.....	31
Qualities of Outstanding Children’s Literature.....	33
Literature Defines a “Sense of Place”.....	33
Literature Influences Life.....	34
Plant Awareness.....	35
Theory of Plant Blindness.....	35
Inattentional Blindness.....	37

A Dual Concept of Vision.....	38
Proximity.....	38
Visual Perception: Gestalt Laws.....	39
The Imbalance of Biology, Botany, and Zoology.....	41
Primary Children Talk about Plants in the Garden.....	42
Ethnobotany.....	43
A Bridge for Learning.....	43
Ethnobotany and Literature.....	46
Summary.....	47
CHAPTER 3: RESEARCH METHODS.....	49
Research Design.....	49
Research Methodology.....	50
Data Collection.....	51
Sample Characteristics.....	51
Sampling Procedure.....	52
Sample Size.....	55
Data Analysis.....	56
Measurement Procedures.....	56
Validity and Reliability.....	59
Defining Trustworthiness.....	61
Data Analysis Plan.....	61
Summary.....	61
CHAPTER 4: RESEARCH FINDINGS.....	64
Content Analysis.....	64
Analysis Techniques.....	64
Findings on Research Questions.....	66
Primary Question.....	66
Research Subquestion 1.....	71
Research Subquestion 2.....	78
Research Subquestion 3.....	97
Research Subquestion 4.....	100
Research Subquestion 5.....	103
CHAPTER 5: SUMMARY AND CONCLUSIONS.....	106
Statement of the Problem.....	106
Purpose of the Study.....	106
Delimitation of the Study.....	106
Methods.....	107
Summary of Findings on Research Questions.....	108
Primary Question.....	108
Research Subquestion 1.....	110
Research Subquestion 2.....	113

Research Subquestion 3.....	116
Research Subquestion 4.....	117
Research Subquestion 5.....	118
Conclusions.....	120
Implications.....	123
Recommendations for Further Research.....	125
REFERENCES.....	126
APPENDIX A: REFLECTIONS ON CHILDREN’S LITERATURE COLLECTIONS.....	135
APPENDIX B: BOOKS CONSIDERED FOR SELECTION OF STUDY AND REASON FOR EXCLUSION.....	149
APPENDIX C: PLANT-CENTERED CHILDREN’S SCIENCE PICTURE BOOKS USED FOR THIS STUDY.....	157
APPENDIX D: CATEGORIZATION OF BOOKS USED FOR THIS STUDY ACCORDING TO PUBLICATION YEAR, BOOK TITLE, AND AUTHOR.....	161
APPENDIX E: THE PILOT STUDY.....	163
PILOT STUDY APPENDIX A: DESCRIPTION OF PILOT STUDY BOOKS.....	179
PILOT STUDY APPENDIX B: BOOKS OMITTED FROM PILOT STUDY, BY AUTHOR’S NAME.....	189
PILOT STUDY APPENDIX C: A RUBRIC TO ASSESS THE QUALITY OF PLANT-CENTERED CHILDREN’S LITERATURE.....	192
PILOT STUDY APPENDIX D: LIFE SCIENCE CONTENT STANDARD “C” OF THE NATIONAL EDUCATION STANDARDS.....	195
PILOT STUDY APPENDIX E: K-4 PRINCIPLES OF PLANT BIOLOGY BY THE AMERICAN SOCIETY OF PLANT BIOLOGISTS.....	196
PILOT STUDY APPENDIX F: IDENTIFICATION OF PLANT SCIENCE CONCEPTS IN PLANT-CENTERED CHILDREN’S PICTURE BOOKS.....	198
PILOT STUDY APPENDIX G: IDENTIFYING GRAPHICS OF PLANT SCIENCE.....	200

APPENDIX F: BOTANICAL SCIENCE ANALYSIS CODEBOOK AND CODING FORM.....	202
APPENDIX G: IDENTIFYING INNOVATIVE GRAPHICS FOR PLANT SCIENCE DATA SHEET.....	207
APPENDIX H: INDEPENDENT CODERS OF THE BOTANICAL SCIENCE ANALYSIS CODEBOOK AND THE DATA SHEET: IDENTIFYING GRAPHICS OF PLANT SCIENCE.....	209
APPENDIX I: A RUBRIC TO ASSESS THE OVER-ALL QUALITY OF PLANT-CENTERED CHILDREN’S LITERATURE.....	210
APPENDIX J: A RUBRIC TO ASSESS BOTANICAL SCIENCE IN CHILDREN’S PICTURE BOOKS.....	212
VITA.....	214

## ABSTRACT

This content analysis study examined 36 plant-centered children's science picture books that have a plot and characters published from 1950 to present. Botanical subject matter and learning opportunities offered by these books were analyzed, along with the range and frequency of the National Science Education Standards-consistent and age-appropriate plant science concepts and principles. The science graphics, artistic innovations, and story plot of these books were also examined. Rubrics and research-based recommendations were developed to offer parents, teachers, and librarians assistance in identifying, evaluating, and using such books to help children of ages 4-8 learn about plants and enjoy plant science.

This genre of children's literature was identified and selected primarily through extensive research at four major, nationally recognized children's literature collections: The Kerlan Collection, The de Grummond Collection, The Center for Children's Books, and The Central Children's Room at the Donnell Library.

This study determined that there was a substantial increase in the number of books written in this genre of children's literature from 1990 to 2000. Botanical subject-matter knowledge and learning opportunities offered by these books include biodiversity of plants; characteristics of plants; life cycles of plants; economic botany, ecology, and ethnobotany. The range and frequency of National Standards-consistent and age-appropriate plant science concepts and principles identified within these books, in part, though not exclusively, included the emergent categories of the process of photosynthesis; basic needs of plants; plant structures; external signals affecting plant growth; environmental stress to plants; biodiversity of plants; plants as animal habitats; and common uses of plants.



With regard to plant science graphics, 13 books were identified as presenting some type of science graphic, beyond simple illustrations. The most frequently used graphics were cutaways, sequence diagrams, and zoom graphics.

The findings relative to story plot and characters revealed that the majority of story plots involved a problem followed by a solution, rather than merely a series of events. The main character(s) of these stories were most often Caucasians (44%), followed by plants (28%), Hispanics (11%), animals personified (8%), African Americans (6%), and indigenous peoples (3%). Most often the stories took place in rural settings.

CHAPTER 1:  
INTRODUCTION

Rationale

“Our knowledge about the world around us is incomplete if we do not include plants in our discoveries, and it is distorted if we do not place sufficient emphasis on plant life” (National Research Council [NRC], 1992, p. 2).

Plants are the material basis for human culture. Plants, rather than animals, provide us with the life-sustaining elements to survive on this planet (Lewington, 1990). The associations with plants are deep in our culture and can be traced back to prehistorical stages of our western civilizations (Balick & Cox, 1996). The relationship between people and plants has always been and always will be profoundly important. Plants affect every aspect of our lives and indeed, without them, life as we know it would not be possible. They impact human affairs in almost every aspect of life in one way or another: food, energy from fossil fuels, fibers, wood, spices, medicines, oxygen, and biotechnology products (Wandersee & Schussler, 1998).

Plants also influence our lives in less dramatic ways. They prevent soil erosion and provide windbreaks and shade (Daisey & Dabney, 1997). Large trees absorb sound, which serves as a defense against sound pollution.

By far the largest portion of the biomass on the earth is that of plants and other photosynthetic organisms (Hoagland & Dodson, 1995). Why don't we notice this? Today, many of us live in a society removed from the lands and the rhythms of nature, largely protected from the vagaries of the outdoors (Cooper, 1998).

Although children may initially appreciate plants, it is no surprise that they soon come to adopt the ideas and values of adults that vegetation is worthless or utilitarian

(Schneekloth, 1989). Children need personal experiences with plants to realize the essential role that plants play in their everyday lives.

It is important that researchers explore ways in which the relationship between children and plants become more personal and meaningful. Through an extensive search to date, it appears that only two sources of research relate to children and their interactions with plants.

Dr. Sue Dale Tunnicliffe and Michael Reiss of Cambridge University have conducted studies that investigated children's conceptions about plants. In "Building a Model of the Environment: How Do Children See Plants?" (Tunnicliffe & Reiss, 2000), they conducted interviews with 36 children, ages 9-14, recording their comments and reasoning. The results indicated that as children age, their reasons for grouping plants become more complicated: in addition to relying on shared anatomical and habitat features, they begin to show evidence of a knowledge of taxonomy and use this knowledge to group plants.

Tunnicliffe and Johnson also report on an investigation in which they recorded the spontaneous comments of children as they interacted with plants at the Royal Horticultural Society Gardens at Wisley, Surrey, England. The results of this study are presented in "How Primary Children Talk about Plants in the Garden" (Johnson & Tunnicliffe, 2000). They found the quality of children's interactions with plants, when accompanied by adults, strongly influences the science learning and curricular objectives gained.

Wandersee and Schussler conducted studies on visual cognition and public understanding of plants in the United States and abroad (Wandersee, 1986; Wandersee, 2001; Wandersee & Schussler, 1998a; Wandersee & Schussler, 1999; Wandersee &

Schussler, 2000). The results of their studies have led to the introduction of a new term- *plant blindness*: the inability to see or notice plants in one's own environment.

Plant science picture books written in story form can be a medium by which children construct a personal understanding of plants. Such picture books have this ability because "interest is sustained and the story structure helps [children] to comprehend and draw relationships between the material world and their own personal world" (Butzow & Butzow, 2000, p. 4).

The characters of such picture books have a special appeal to children ages 4-8 because they provide a thoroughfare for them to experience the lives and thoughts of different people. Children often identify with a character and may see the character as a mirror of themselves (Nodelman, 1992). As child psychoanalyst Selma Fraiberg (1959) put it, "the child's contact with the real world is strengthened by his [sic] periodic excursions into fantasy" (p. 53).

Plant science in picture books can serve as a tool to reinforce the idea that plants are part of our every day lives, and enable children to understand and remember scientific plant concepts in a more meaningful manner. Plant science picture books have the ability to enlighten young minds in momentous ways. Regretfully, however, it appears that plant science picture books are, for the most part, under-represented in the category of children's science picture books.

### Goal of the Study

The goal of this study was to travel to, and spend a significant amount of time searching within, four selected, major, nationally recognized children's literature collections in order to locate, examine, categorize, describe, and pinpoint the plant science learning potential and pitfalls (both verbal and visual) of children's science

picture books that have a plot and characters. As was anticipated, the search moved outward from these four collections and involved visiting physical sites and web sites of other collections, as the research process unfolded, and as recommendations of the four collection librarians warranted.

### Research Questions

The primary research question that guided this study was:

What will an exhaustive search for, and a focused content analysis of, plant-centered children's science picture books that have a plot and characters reveal about this emergent genre of children's literature?

The subquestions were:

1. What types of botanical subject-matter knowledge and plant science learning opportunities are offered by these books?
2. What is the range and the frequency of occurrence of national standards-consistent and age-appropriate plant science concepts and principles found in these books?
3. What types of science graphics, artistic innovations, and story plots are found in these books?
4. What resulting research-based recommendations and rubrics can be offered to assist parents, teachers, and librarians in identifying, evaluating, and using such books to help children of ages 4-8 learn about and enjoy plants and plant science?

### Gowin's Vee Diagram of Research

A Gowin's Vee Diagram (Gowin, 1981) guided the inquiry processes of this study. The center of the Vee contains the focus research question along with its subquestions. These questions point directly to the events and objects that will be used to derive the answer to the main question. The far left side of the Vee diagram specifies the

theoretical aspects of the study, which include the relevant concepts, principles, theories, and worldview driving this study. The right side of the Vee specifies the methods, records, and transformations of data that this investigation employed in order to ultimately yield a set of knowledge and value claims. The initial data set was obtained primarily through on-site, archive-and collections-based searches conducted by the researcher at four renowned institutions nation-wide, namely: the de Grummond Children's Literature Collection at the University of Southern Mississippi, Hattiesburg, MS; the Kerlan Collection at the University of Minnesota, Minneapolis, MN; the Center For Children's Books at the University of Illinois at Urbana-Champaign, IL; and the Central Children's Room at the Donnell Library Center, New York Public Library. Additional children's plant science picture books were included in the initial data set via the snowball technique--following-up on leads generated during the researcher's work at and with experts at the four national sites.

#### Flow Chart Diagram of Research

A flow chart diagram of this research provides an overview and timeline for this research project. It divides the research into phases, and it establishes the major benchmark of each phase. The first phase was to conduct investigations of library and collection searches of relevant literature. Later phases include: the compare/contrast of the American Society of Plant Biologists (ASPB, 2002) principles to the National Science Education Standards (NRC, 1996); locate a benchmark Plant Kingdom diagram; define the categories of graphics in popular science writing (using a National Geographic publication); determine content analysis approach to be used in study (Neuendorf, 2002); develop proposed analysis data instruments for pilot study; identify plant science picture books in story form (PSPB-ST) for pilot study through intensive on-site research at a

## CONCEPTUAL

### WORLD VIEW

Plants are the material basis for human culture. All life depends on plants. We owe our green and habitable world to photosynthesis. (Lewington, 1990; Balick & Cox, 1996)

### THEORIES

Novak (1984)

Learning how to learn

Ausubel (1968)

Rote and meaningful learning

Wandersee & Schussler (1998)

Plant Blindness

Mintzes, Wandersee, &

Novak (1998, 2000)

Human Constructivism

Vygotsky (1934, 1967) Zone of proximal development (ZPD); social construction of knowledge

### PRINCIPLES

People often exhibit an inability to see or notice plants in the environment; importance of plants in biosphere & to human affairs; plants seen as inferior to animals due to misguided anthropocentric ranking; plants have unique aesthetic and biological features.

### CONCEPTS

Plant blindness, children's literature, plant, Plant Kingdom diagram, ASPB plant biology principles, NRC science education standards, National Geographic science graphic categories, genre, plot, botany, graphic artist, story plot, rubric, meaningful learning, knowledge construction

## RESEARCH QUESTION

What will an exhaustive search for, and a focused content analysis of, plant-centered children's science picture books that have a plot and characters reveal about this emergent genre of children's literature?

### SUBQUESTIONS

1. What types of botanical subject-matter knowledge and plant science learning opportunities are offered by these books?
2. What is the range and frequency of occurrence of national standards-consistent and age-appropriate plant science concepts and principles found in these books?
3. What types of science graphics, artistic innovations, and story plots are found in these books?
4. What resulting research-based recommendations and rubrics can be offered to assist parents, teachers, and librarians in identifying, evaluating, and using such books to help children of ages 4-8 learn about and enjoy plants and plant science?

## METHODOLOGICAL

### VALUE CLAIMS

To help children value the entire plant kingdom, more children's science picture books are needed to fill in current gaps in the genre's plant science coverage and help bridge plant science knowledge from home to school. This genre also can be improved by re-discovering some its past graphic and story plot innovations. Rubrics derived from this study can help authors, parents, teachers, and children's librarians chose the best books in this genre.

### KNOWLEDGE CLAIMS

Plant science picture books in story form (PSPB-ST) can contribute to improving the nation's science literacy. PSPB-ST can help children to appreciate what botanists study and imagine themselves doing science. PSPB-ST are currently under-represented (and botanical-content-skewed) in children's literature .

### TRANSFORMATIONS

Neuendorffian content analysis (2002), time-series data plots, correlation statistics, descriptive statistic tables, innovation summary tables, identifiable pattern tables.

### RECORDS

Initial book set--Targeted books identified through intensive on-site searches of 4 national children's literature archives and collections. E-mailed and on-site advice of experts in the field. Feedback from independent, trained raters on data validity and reliability. Instruments to be developed: Rubrics to help parents and professionals evaluate PSPB-ST and to allow raters to judge graphic categories.

## EVENTS/OBJECTS

Researcher identifies, locates, and examines four national collections containing the targeted children's plant science picture books published from 1950 onward. Researcher content analyzes (with cross-checks by trained raters) those books and extracts the data needed to answer Research Subquestions 1-4. Researcher consults with children's literature experts and gathers data from qualified, trained independent raters.

nationally renowned children's literature archive and collection; compile sample for pilot study; conduct content analysis of pilot study; present prospectus proposal; conduct intensive on-site research at additional prestigious children's literature archives and collections; locate and compile final selection of plant science literature; revise data instrument to ensure mutually exclusive coding scheme of national standards-consistent and age-appropriate plant science concepts and principles and mutually exclusive National Geographic science graphic categories; train independent coders and conduct content analysis; determine the gaps in coverage of the Plant Kingdom in this genre of children's literature; develop research-based recommendations and rubrics to assist interested persons in identifying, evaluating, and using PSPB-ST; compile results of study; and present final analysis and evaluation of research study with dissertation.

### Significance of the Study

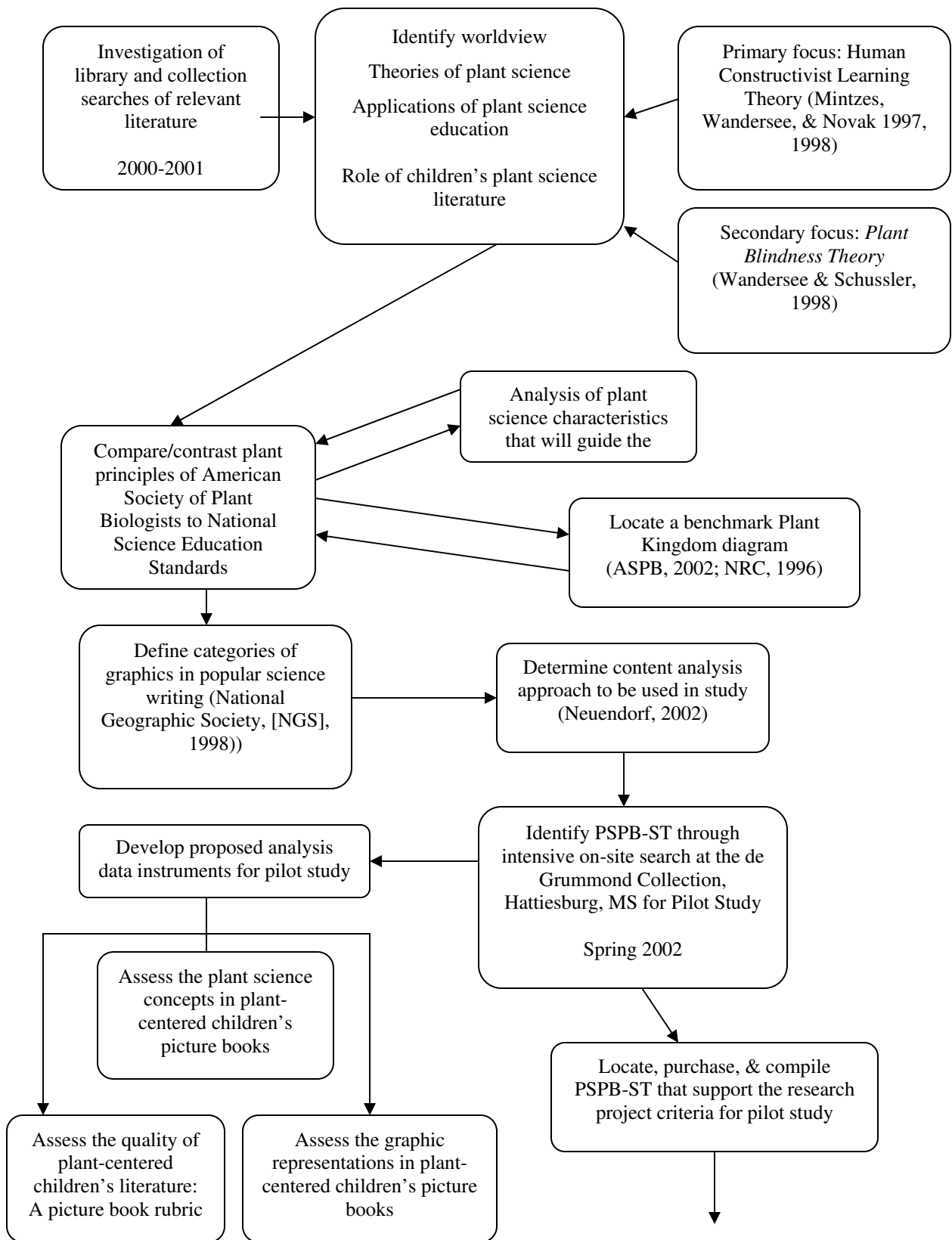
#### How Picture Books Influence Science Literacy

**Picture books can bring life to science.** Reading plant science children's books may be one of the best ways to first encounter science when we are young. If you think about it, what is science? Through science we endeavor to understand the universe. An effective science story promotes three important things: "It brings facts to life; it makes abstract concepts concrete; and through the virtual reality of storytelling, it walks listeners through the process of scientific inquiry" (Ellis, 2001, p. 43).

Picture books can also bring science to life visually, because they can stimulate the child's imagination and sustain interest. The story structure helps children to see relationships between the material world and their own personal world (Butzow & Butzow, 2000).

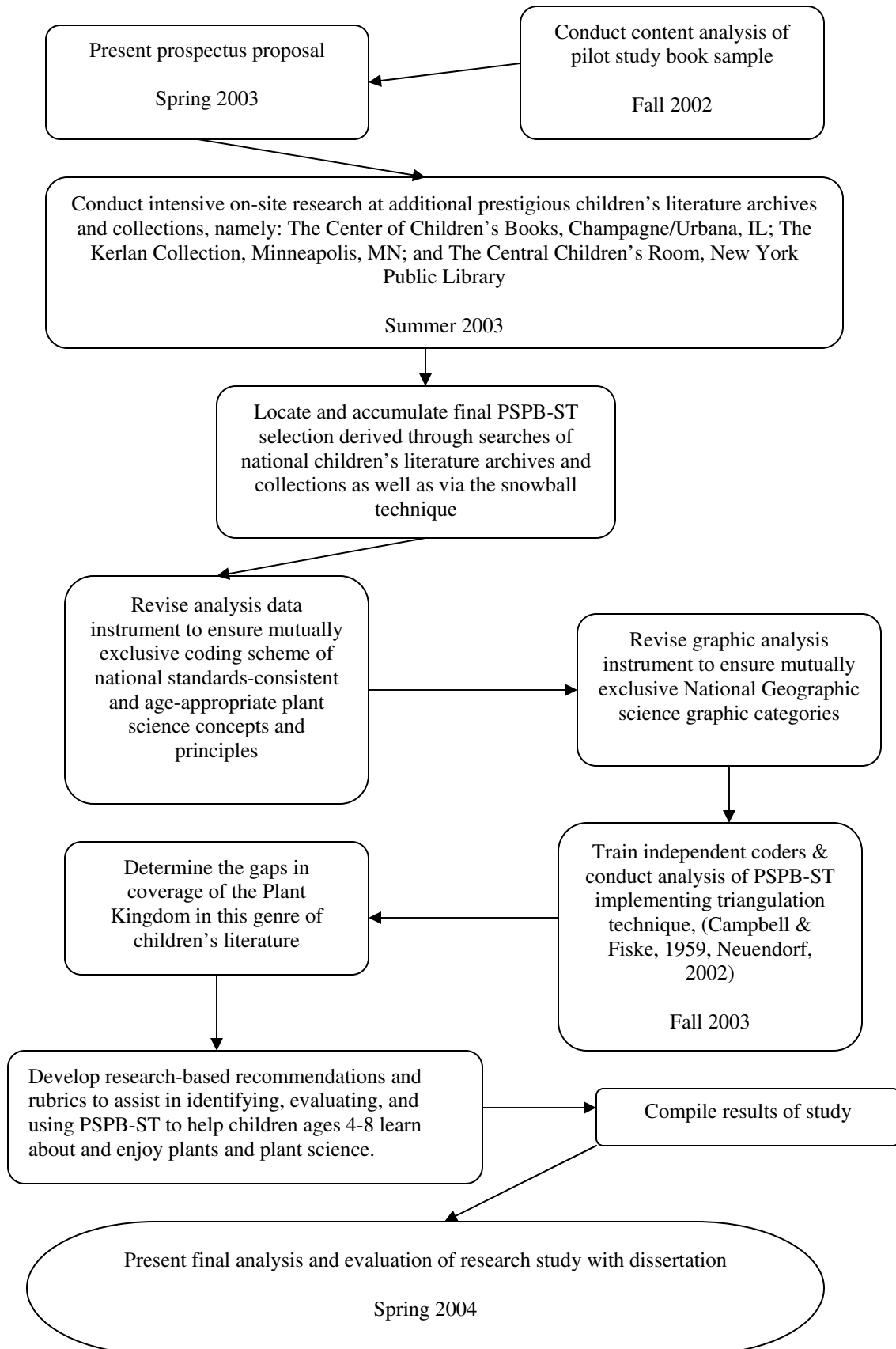
Butzow and Butzow (2000) illustrate a pertinent example of this in the book





**Figure 1.1. Stylized flow chart depicting the major benchmarks in this research investigation.**

Figure 1.1. continued



*Science Through Children's Literature*. Trees, even though they are a common sight for most children, often have little, if any, significance to their personal lives. Because of the benefits of picture books such as *A Tree Is Nice* by Janice Urdy (1988) or *The Giving Tree* by Shel Silverstein (1986) a child may be primed to assimilate the concept of "tree" and the nature of "treeness"--the range of attributes such as size, color, shape, and habitat that characterize trees within the Plant Kingdom.

**Picture books can promote scientific reasoning.** Picture books can be used as a springboard for hands-on science inquiry, exploration, and learning some of the science process skills that are crucial for attaining science literacy. Science process skills are some of the strategies that scientists employ to discover and understand the story of the universe. "A story puts facts and concepts into a form that encourages children to build hypotheses, predict events, gather data, and test the validity of the events" (Butzow & Butzow, 2000).

A good book involves the listener or reader in many of the strategies of gathering the facts of the story, making predictions about the outcome, and checking one's hypotheses against the unfolding details of the story. Picture books may promote scientific reasoning and critical thinking by providing information that a child can compare to her or his own observations and experiences (Martin, 1997). Also, picture books are written to match the child's intellect, which allows the child to make otherwise abstract concepts become personal and tangible.

**Picture books can broaden individual understanding.** Important concepts in picture books can be conveyed within a dynamic context so that the facts become part of a child's cognizance. Interesting, well-written literature for children can help meet the

needs of individual children and broaden their understanding of plant life, provided it aims to do the following:

1. To afford many opportunities for a child to explore her or his world in an infinite number of ways--such as thinking, seeing, and of feeling.
2. To nourish the mind and emotions...to invite the child to savor life in a different world, to feel the emotions of someone else, and to view the familiar in a ...new way.
3. To transmit sound moral values and attitudes communicated through characters in children's books.
4. To provide experiences that sharpen a child's insight into "self" as he/she searches and encounters that self in stories that allow for identification.
5. To serve as a vital line in preserving and communicating the humanistic tradition from one generation to the next.
6. To broaden aesthetic perception and give an understanding of form and order through language, ideas, and the visual art of picture books.
7. To explore varied contributions, values, ways of life in different cultures-- past and present--to give a sense of universal life.
8. To provide for children experiences outside their limited environment-- experiences that can be enjoyed vicariously in gaining some of the enchantment of life and a measure of personal fulfillment.
9. To stress themes of natural interest to childhood--dependent, however, upon the extent to which they have been developed through structure and style, with beauty and vitality, and with the essential ingredient: a genius for storytelling. (Georgiou, 1969, p. 10)

## Why Picture Books Appeal to Children Ages 4-8

**Reading the pictures.** A picture book is generally illustrated from cover to cover. This genre of children's books supplies a stock of images for the child's mental museum (Spitz, 1999). Kiefer (1982) defines a picture book as an art object that "is dependent upon succession of pages to convey a message. This message may be presented solely in pictures or through a combination of pictures and written text" (p. 14). Therefore, the images or pictures are integral to the total content of the book, in that they are "read" just as the text is read (Jacobs, 1965). As the old adage goes, a picture is worth a thousand words.

When the words have long since faded, an image can still be recalled vividly in the mind. An example of this is the timeless children's classic *Jack & the Bean-Stalk* (Denslow, 1903). Anyone who has read, or been read, the book can envision Jack as he climbs the enormous beanstalk through the white fluffy clouds, experiencing a sense of excitement of what lies beyond or the exhilarating sensation of climbing so high into the sky.

Children are offered recurring opportunities with images in picture books because they can explore them again and again. Through this exploration, they can learn to think more creatively and to be more reflective in their speaking and writing (Galda & Short, 1993; Lacy, 1986). As Protheroe (1992) wisely suggests, "There is one fact about imagery and children's learning which is indisputably true: Imposed pictures are almost always learned better than words" (p. 153).

**Pictures can help define the character(s).** Children often gaze at the pictures to identify distinctiveness of the characters. Through the pictures, children are enabled to "see something more" through a "magical book experience" (Kiefer, 1982, p. 711).

David Lewis (2001) describes just such an episode--when six-year-old Jane reads to him from *Time to Get out of the Bath, Shirley* by John Burningham (1978). As she reads, her eyes sweep back and forth between the text and the pictures (the words in capital letters represent the book text she reads aloud).

Jane: HAVE YOU BEEN USING THIS TOWEL SHIRLEY OR WAS IT YOUR FATHER? ... (looking at the picture below) probably her father 'cos it's got big hands

DL: Hmm

Jane: (examining the picture to the right of the gutter) She's gone on the back of the horse ... is that an owl or a bat? ... Bat!

DL: Don't know ... could be

Jane: On look, there's a witch. (p. 32)

In fact, it appears that the characters are defined foremost by what is illustrated, second, through the text--as the two media merge with the child's personal background knowledge and experience. Pressley (1977) found that: "If pictures depict information contradictory to that presented in the text ... memories for the text [are] dropped" (p. 613). This demonstrates that the pictures are providing the primary character information because children disregard the text and follow the pictures when the two are at odds (Protheroe, 1992).

### Picture Books Can Provide a Means of Playfulness

Lewis (2001) suggests that the pictures and words of picture books satisfy a child's need for amusement; these books are often particularly playful in ways that the text and images "adopt game-like disguise, break rules and subvert conventions" (p. 81). Examples of "child's play" picture books include such works as *Peepo* by Janet and

Allan Ahlberg (1999), *June 29, 1999* by David Wiesner (1999), and *Plantzilla* by Jerdine Nolen (2002).

In *Peepo*, the early childhood game of covering one's eyes and then peeping out is unfolded in texts that both literally and metaphorically offer glimpses into the life of a young family. *June 29, 1999* presents the experiments of a budding scientist, Holly Evans, in a joking manner. Holly plants vegetable seeds in planters that are held aloft in the sky by helium balloons. There is alliteration (consonantal play on words) as Wiesner (1999) writes phrases such as, "cucumbers circle Kalamazoo, lima beans loom over Levittown, [and] artichokes advance on Anchorage" (pp. 13, 14). *Plantzilla* tells a story about Mortimer Henryson's obsessive desire to take the classroom plant, Plantzilla, home for the summer break. The story unfolds in a humorous and somewhat bizarre manner. Mortimer sees Plantzilla as a playmate and companion. As children will sometimes cry for what they want, Mortimer also frets, "I want Plantzilla. Only Plantzilla" (Nolen, 2002, p. 11).

How do picture books have such a strong effect? Lewis (2001) thinks picture books have such an intense yet playful appeal because:

Young children are permanently on the borderline between ignorance and understanding and this very inexperience appears to liberate picture book makers from pre-existent notions of what a book should look like and what it should contain, and offers them the freedom to create new kinds of text (p. 79).

### Importance of Fictional Stories

**Picture books can improve a child's ability to understand.** Children often find it easier to follow ideas that are presented in the form of a story line than to understand factual information (Butzow & Butzow, 2000). Through fictional stories, children

engage in learning experiences they can relate to in a meaningful and enjoyable way (McGowan, 1987). The scientific concepts presented through characters and places often enable children to understand and to recall them more readily than the traditional textbook method (Butzow & Butzow, 2000).

**Picture books can foster positive attitudes.** Fictional stories have the power to promote positive scientific attitudes because children see scientists as ordinary people interacting with science as a part of their everyday lives. *A Weed is a Flower: The Life of George Washington Carver* by Aliko Brandenburg (1988) is an example of this promotional capability. George Washington Carver is first depicted as a little baby, very sick and weak. As the story unfolds, as he overcomes one adversity after another, attends college, and becomes a professor who discovers many amazing facts about, and uses for, peanuts.

Fictional picture books often model positive attributes such as appropriate behaviors, emerging values, lessons about people from various times and places, and diverse cultural backgrounds--in a style that reaches children (Lamme & Beckett, 1992; McGowan, 1987). Children's fiction also presents global issues from threatened environments and species to natural disasters, habitat loss, and global warming.

#### Criteria for Fictional Science Picture Books

Many authors (Janke & Norton, 1983; McGowan, 1987; Rice, Dudley, & Williams, 2001) have examined the issue of quality in children's science picture books. The consensus seems to be that first, the book should be developmentally appropriate. The book's settings and/or plot and themes should be relatively familiar and understood by an audience of children. Second, the book should have potential literary value being both meaningful and enjoyable to read. The author and illustrator should carefully



consider the book's character development, dialogue, imagery, and message. Third, the information (especially the science) be presented in carefully sequenced order, and be accurate and valid. The way of life or culture of other persons should be depicted in "true-to-life" fashion. The author should also distinguish between fact and supposition. Fourth, there should be an avoidance of all stereotypes or bias. Finally, the message should be of lasting value, merit the attention of the audience, and promote positive attitudes that society thinks children should eventually display as a citizen.

### Human Constructivist Learning Theory

This proposal was guided and driven by the human constructivist learning theory (Mintzes, Wandersee, & Novak, 1997; Mintzes, Wandersee, & Novak, 1999). This theory seeks to unite both a theory of learning (Ausubel, Novak, & Hanesian, 1968) and an epistemology of knowledge building, and seeks to find harmony among the "processes of meaningful learning, knowledge restructuring, and conceptual change" (1997, p. 48). Human constructivism asserts that no two human beings will construct precisely the same understanding and meaning when they are presented with the same event or object. It assumes that each person is unique in her or his capacity to make meaning and build knowledge.

### The Importance of Prior Knowledge

"If I had to reduce all of educational psychology to just one principle, I would say this: The most important single factor influencing learning is what the learner already knows. Ascertain this and teach him [sic] accordingly" (Ausubel 1968 as cited in Novak & Gowin, 1984, p. 40): This is to the epigraph in *Educational Psychology: A Cognitive View* by David Ausubel (1968).

## Definition of Terms

Botany--the scientific study of the Plant Kingdom.

Characteristics of plant centered instruction--a special quality or feature that distinguishes one plant from other plants or from other living organisms.

Concept--a pattern or regularity in objects or events designated by a word label.

Concept map--a type of graphic representation, invented by Novak, and characterized by a set of linked concepts arranged hierarchically to form a network of propositions.

Ethnobotany--the study of the relationships between plants and people.

Genre--a unique category or style of literature.

Graphic representations of scientific knowledge--scientific maps, charts, graphs, tables, diagrams, illustrations and images. Also includes, ways of showing details and interrelationships between parts--such as cutaway views and exploded views.

Human constructivism--Joseph Novak's theory of learning and understanding that proposes there is an external and knowable world, and that humans actively construct their knowledge of the world.

Picture book--a coherent literary work that conveys its message through illustrations containing characters, along with sparse prose or poetry; generally 32 pages in length, and aimed at an audience aged 4 to 8 years old.

Plant blindness--Wandersee & Schussler's theory that many people are virtually blind to presence of plants in their lives, see them only as mass entities, pay attention to

plants only at times when they bear flowers or fruit, and otherwise ignore and devalue them.

Plant Kingdom--includes all photosynthesizing, multicellular organisms such as mosses, ferns, conifers, monocot and dicot flowering plants, and so on--in an amazing range of diverse forms. This taxonomy contains more than 250,000 species.

Principle--a proposition or generalization formed by stating an important relationship between two or more concepts, such as "molecules are composed of atoms."

Scientific literacy--the goal of being a scientifically informed and functioning citizen; it exists as a continuum of the public's scientific understanding about the natural and the designed world--ranging from nominal understanding to functional, conceptual, procedural, and multidimensional understanding (Biological Science Curriculum Study [BSCS], 1999).

Story line--a sequenced series of events from a story with a problem or conflict of the story identified.

Story elements--the settings, characters, plot, resolution, sequence, dialogue, formal openings and closings, and verb tenses used in a story.

Subsumption--the incorporation of new concepts into our existing conceptual knowledge structures.

Superordinate learning--the acquisition of new general or overarching concepts, which requires significant knowledge restructuring.

Vee diagram--a graphic designed by Gowin, that depicts all the components of an investigation starting with the driving questions and its resulting knowledge claims.

Whole-plant-centered-instruction--instruction that integrates knowledge of plant parts and plant systems with related environmental factors, and that teaches about a single plant species in depth, rather than about many plants at once.

### Innovative Graphics Terms

Cutaway graphic--a graphic depicting an object that appears to be sliced apart or exposed to show what is underneath; the features exposed are generally presented from one point of view.

Exploded-view--a graphic depicting component parts of an object as separated, but still in proper orientation.

Flap-tab graphic--a two-stage graphic that is further revealed by lifting a flap to expose an unseen view of an object or event.

Gatefold graphic--a continuous, “2-page-spread” illustration that is folded into a book’s pages so that, when the book is closed, all pages appear to be the same size.

Pop-up graphic--a paper engineering mechanism-based, graphic that emerges from the page of a book -- rising to form a three-dimensional structure when a page is opened.

Photo-realism--a graphic illustration technique depicting highly detailed, “true-to-life” objects within non-photographed images to give the artwork a photograph-like appearance.

Sequence diagrams--a set of sequential diagrams that depict and reveal changes in an object(s) over time.

Zoom--an inset graphic, often circular, that provides the viewer with the illusion of magnifying a specific area of a larger graphic to see more detail.

CHAPTER 2:  
LITERATURE REVIEW

No Child Left Behind

On January 8, 2002, President George W. Bush signed into law the No Child Left Behind Act of 2001. This new law changes the role of the federal government in public education from levels K-12. This law is founded on the President's four basic education reform principles: stronger accountability results, increased flexibility and local control, expanded options for parents, and an emphasis on teaching methods that have been proven to work (U. S. Department of Education, 2002).

States will have more freedom to direct their federal education money, but they will also be required to maintain a greater accountability for students' learning through testing. Each state must create its own standards of what a child should learn and know in all grades. This accountability begins immediately with learning standards in math and reading; standards for science must be in place by the 2005-06 school year, and testing for science will begin during the 2007-08 school year.

This law, as no prior law, has the power, and carries with it the mandatory requirements, to improve academic learning. This law is historic and, although its success is still uncertain, it begins a new era in education.

Improving Scientific Literacy

The *National Science Education Standards* (Nations Research Council [NRC], 1996) the *Benchmarks for Scientific Literacy* (American Association for the Advancement of Science [AAAS], 1993) and *Science for all Americans* (Rutherford & Ahlgren, 1990) stress that American students deserve the opportunity to become scientifically literate. Our students should be able to use scientific principles and

processes in making personal decisions, and to participate in discussions of scientific issues that affect society.

This is more likely to happen if students experience science through an active learning process. Science that is presented primarily through an inquiry-based approach allows students to describe objects and events, ask questions, construct explanations, test their explanations against current scientific knowledge, and communicate their ideas to others (NRC, 1996). “Learning science is something students do, not something that is done to them” (NRC, 1996, p. 20).

The Life Science Strand of the *National Science Education Standards* (NRC, 1996) contends that students in grades K-4 should have an understanding of the characteristics of plants, the life cycles of plants, and how plants interact with their environment. They should realize that plants, just as animals, have basic needs and can only survive in environments where their needs are met. As we are warned by the Botanical Society of America, *Botany for the Next Millennium* (Botanical Society of America, [BSA], 1995), “Botanical knowledge is crucial to minimizing the global loss of biological diversity ... [because] relatively fewer and fewer people have any practical or intellectual knowledge of plants” (pp. 21, 22).

#### American Society of Plant Biologists

The American Society of Plant Biologists (ASPB, 2002) has also identified central principles of plant biology to aid students in developing a better understanding of plant biology. These 12 principles provide basic plant biology concepts for science education in grades K-12. These principles are more specific to plant biology than the National Research Council’s Life Science Strand Standards (NRC, 1996) and advocate teaching about our dependency on plant life and on plant products.

The *National Science Education Standards* (NRC, 1996) for plant science, and the *Principles of Plant Biology* (ASPB, 2002) were used as referents in developing the assessment tools of this study. They were closely compared and contrasted so that all of their recommended, age-appropriate concepts and principles were targeted during the content analysis of the science picture books.

### Human Constructivism

The human constructivist learning theory (Mintzes et al., 1997; Mintzes et al., 1999), which guided this study, seeks to unite both a theory of learning (Ausubel et al., 1968), and an epistemology of knowledge building, and seeks to find harmony among the “... processes of meaningful learning, knowledge restructuring, and conceptual change” (1997, p. 48)

Human constructivists assert that no two human beings will construct precisely the same conclusion or inference even when they are presented with the same event or object. Each person is unique in the capacity to make meaning and build knowledge.

In that no two individuals are alike in their construction of knowledge during meaningful learning, a “cookie-cutter” method of teaching is impossible. Knowledge is not a pre-packaged product that an independent agent (i.e., parent, teacher, peer) can place into the mind of a child.

Meaningful learning transpires only when the child constructs knowledge conceptually. This does not mean that the independent agent cannot influence or foster learning. It merely means that the process of structuring new concepts meaningfully requires the requisite prior knowledge be present, and not some general reasoning ability. As Deboer (1991) wisely states, “Learning *always* involves present understanding as the starting point” (p. 223).



Meaningful learning is knowledge that is personal, hierarchically organized, and situated in a framework of interrelated concepts that a child builds with the help of independent agents. This is an active process that requires the child to consciously connect new knowledge to existing knowledge. Children do this as they relate new knowledge to their perceptions of real world objects and events, as well as, to the knowledge constructed by others (Mintzes et al., 1997).

### Ausubel's Cognitive Assimilation Theory

#### Meaningful Learning Versus Rote Learning

**Cognitive Assimilation Theory.** The cognitive assimilation theory provides a concise framework for explaining different types of learning and how this learning develops (Ausubel et al., 1968). It describes the distinction between meaningful and rote learning and the criteria needed for meaningful learning to transpire. Three processes by which meaningful learning can be explained are: subsumption, obliterative subsumption, and superordinate learning. These tell how new concepts are either absorbed into existing categories, cause category modification, or cause the creation of entirely new meta-categories. This theory also helps explain the continuum from reception learning to discovery learning.

The cognitive assimilation theory describes three criteria for distinguishing the differences between meaningful learning and rote learning. Meaningful learning is nonarbitrary, nonverbatim, and is incorporated into the learner's existing framework of knowledge; rote learning is the act of retaining, for purposes of retrieving verbatim, disconnected knowledge (Ausubel et al., 1968; Mintzes et al., 1997).

First, for meaningful learning to occur, the learning must have value in and of itself. The value must come from the meaning it confers, not through an extrinsic

stimulus such as grades, peer pressure, or arbitrary rewards. What is to be learned must have value for the learner.

For botanical children's literature to significantly impact a child's personal understanding, the story must offer potential meaning for the child. The plot, structure, theme, and illustrations must be relevant to the current knowledge, maturity, and reasoning ability of the child.

Second, the child must already possess the relevant knowledge to which the new ideas are to be anchored. Children, no matter what age, have some knowledge to which they can connect new ideas. Jerome Bruner (1966) referred to this as a "personalization of knowledge" (p. 160) where children's feelings, fantasies, and values affect how they cognitively connect the new ideas to prior knowledge. As Bruner aptly phrased it, "... any subject can be taught effectively in some intellectually honest form to any child at any stage of development" (Bruner, 1960, p. 33).

Few children may have an understanding of photosynthesis, for example, but they do have ideas about plants. Their ideas and understandings, valid or invalid, are a starting point for learning about plants and for becoming aware of the plants that are present in their own environment.

Finally, the child must voluntarily choose to incorporate the new knowledge into their existing schemes in a nonarbitrary, nonverbatim fashion. Children are generally more than willing to explore ideas on their own if the content of the book is appealing. For this reason, science is best presented in an engaging and meaningful manner (NRC, 1996).

Children who gain knowledge by rote learning tend to store it as isolated bodies of knowledge. This knowledge has no connection or association to past or future

learning experiences. When knowledge has no connection or association, the learner generally has difficulty in retention and recall of this knowledge.

**Subsumption.** The learning process of subsumption involves the addition of more specific, less inclusive concepts, to general and more inclusive concepts and propositions (Ausubel et al., 1968). An example of this is when a child learns the parts of a flower and understands that through the seeds of a flower new plants will grow. This style of learning generally results in improved domain-specific knowledge.

**Obliterative subsumption.** Over time, when learning occurs repeatedly through the process of subsumption, there may be a significant modification of the general concept, as originally learned. Learning becomes more and more inclusive. This may result in the learner having a difficult time retrieving some of the specific, less inclusive concepts and propositions. Ausubel (1968) defines the process of repeated subsumption as obliterative subsumption.

**Superordinate learning.** The third learning process, superordinate learning, often results not only in modification of concepts, but also in a complete reorganization of the learner's cognitive structure. In superordinate learning, the learner links more general, highly inclusive concepts and propositions to an already existing pool of powerful relevant ideas (Ausubel et al., 1968; Mintzes et al., 1997). This integrative learning process has the greatest ability to significantly impact a child's framework of knowledge.

### Reception Learning Versus Discovery Learning

Meaningful and rote learning can come about by either reception learning or discovery learning. Reception learning occurs through the presentation of concepts and propositions by the teacher. The child is rather passive, for the most part, and simply the listener or receiver. Discovery learning is when the learner infers the proposition and

concepts first hand. Discovery learning requires that the child independently construct his/her own understanding--and although powerful, is not very efficient.

### An Epistemology of Knowledge Building

#### Knowledge Construction

Learners approach the “table of learning,” not as empty vessels waiting to be filled, but as vessels partially full of ideas and experiences. Learners also have an opinion of what constitutes learning and how they learn best.

Some favor rote learning approaches while others favor a more constructivist approach. What constitutes learning to the learner is generally a result of years of experience. Various educators influence the learner each year. The younger the learner, the more pliable they are towards understanding objects and events in the natural world. The older they are, the more it becomes a challenge. Either way “It is an ongoing struggle to construct robust, heuristically powerful [scientific] explanations” (Mintzes et al., 1997, p. 50).

The process of constructing knowledge can occur at any location, even on field trips, but the emphasis it receives and the way it is accomplished, depends on the reason for the visit and also the social composition of the group (Johnson & Tunnicliffe, 2000). Out-of-school learning, learning without formal structure, is called informal learning. Family learning is a kind of informal learning (Bitgood, 1989).

Whether or not we will remember an event, according to Rugg (1994) depends on two critical factors: the degree of attention we confer to it, and the meaning or importance we give it. Palmer and Suggate (1996) suggest that the important influences on people’s appreciation of the environment, for example, are the results of one’s childhood experiences of being taken to sites, and from influential adults who are enthused about

the environment. The role of the adult in this situation is vital if the child is to construct meaning from a confused and conflicting array of stimuli (Hart, 1997).

Vygotsky (1967; 1986) argued that social and cultural interaction is essential for cognitive development. It is through social interactions that a child internalizes language. The learning process is not a solitary exploration by the child in the environment; rather, it is a process of appropriation by the child. This deliberate act of acquisition can come about by observational learning, trial and error, conditioning, and so forth. In any case, the child interacts with sociocultural stimuli directly.

Strang (1997) suggests that beliefs and values are received, inculcated, and passed on through a process of socialization that creates a culturally specific relationships with the environment. This process consists of several fundamentals: the creation of categories, the learning of language, and the acquisition and dissemination of cultural knowledge. Each involves an interaction with the physical, social, and cultural environment, and contributes to the formation of individual and cultural identity.

Dewey (1916) described it adeptly when he wrote, “When we experience something we act upon it, we do something with it; then we suffer or undergo the consequences. We do something to the thing and then it does something to us in return: such is the peculiar combination” (p. 139).

### Knowledge Restructuring

Meaningful learning thrives with well-organized knowledge structures. Well-organized knowledge structures can allow the learner to grasp the totality of the whole, rather than isolated parts of the whole. Well-organized knowledge structures go beyond rote learning or simply memorizing; they help the learner understand how concepts compare, contrast, overlap, or merge with other thoughts. Meaningful learning

frequently happens by using tools to help learners organize their thoughts; these metacognitive tools may be concept maps, Vee diagrams, or roundhouse diagrams (Mintzes et al., 1999).

Metacognitive (self-monitoring) learning tools allow learners to identify and address their misconceptions or alternative conceptions. These learning tools empower the learner because they have the ability to help the learner “learn how to learn” (Novak & Gowin 1984, as cited in Mintzes et al., 1997, p. 88).

Knowledge restructuring may come through hands-on experience. However, not all hands-on experience aids knowledge restructuring. Without personalized student inquiry or discovery, the learning can be nothing more than following hands-on behavioral objectives. The learner “goes through the motions” physically, but little, if any, knowledge restructuring occurs.

### Conceptual Change

If students are exposed to plants in both nature and literature, they will often be compelled to re-think what they know about plants. The term conceptual change, as defined by Fensham, Gunstone, & White (1994), is commonly used to describe contexts in which learners hold existing ideas and beliefs which are in conflict with what is to be learned. Hence, learners are involved in changing ideas and beliefs if they are to embrace what is to be learned. This learning takes place through conceptual replacement or addition to his/her present ideas and beliefs. As the learner experiences new knowledge, he/she may reconstruct previous explanations and replace them with more meaningful explanations. There may also be an addition to the learner’s present existing ideas by simply making the current ideas more complex.

## The Colossal Role of Children's Literature

### Picture Books

Picture books may have originated with the ancient Paleolithic cave paintings (Kiefer, 1989). Paleolithic drawings usually are classified as either figurative, depicting animals or humans, or nonfigurative, taking the form of signs and symbols. The artist of these prehistoric illustrations, much like artists of today, were creating and communicating images that were responsive to, and a product of, their culture. This primitive form of communication later evolved into abstract signs, which eventually advanced into words (Cromer, 1987). Therefore, historically speaking, visual images and written words are part of the same graphic symbol structure.

### The Power of Words

It's been said that a single word is a picture. If so, then words or pictures within a sentence form a story. This has puzzled philosophers for millennia: how can words make meaning? Just saying a word links us to what the word refers. It is as though words have power all of their own. Words can carry us all over the world and allow us to experience realities or fantasies--past, present, and future. "Abracadabra" is not needed; "once upon a time" will do because words have extreme power! As so adeptly expressed by Norrentranders (1991), "Stories read aloud are a matter not of words, but of what words do to people" (p. 148). Biologist E.O. Wilson (1994) writes of such power, "I discovered fairy tales in the school library, and I took to reading every one I could find. I was transfixed by the magical choices..." (pp. 52, 53).

### The Meaning of Words

We read a series of arbitrary printed shapes and suddenly we understand. So how does this come about? Almost two millennia ago Saint Augustine (1995) implied that

children learn the meaning of words by association; they see the object and hear the word simultaneously. But then this raised questions, such as, how do children associate meaning to objects that do not exist like fairies or unicorns (Russell, 1905)? How do words form sentences? How can they hear a sentence for the first time and have no difficulty understanding the context? How do they learn verbs, adjectives, and propositions? For that matter, how do they understand not only what the words refer to but also what the speaker wants them to do with the words?

Noam Chomsky (1965) presented a whole new set of questions regarding meaning making. He argued that language involves knowing a set of unconscious rules, not socially imposed ones, directing what to do when we take in sensory information and translate it into representations of objects. His linguistic theory accounts for the universal similarities between all languages and for the fact that children are able to learn language fluently at an early age, in spite of limited data that have no systematic logic (Chomsky, 1980).

#### Potential of Plant Science Picture Books

Children's literature can be an effective medium that impacts both the cognitive and affective domains of learning (Krathwohl, 1964). Within the levels of intellectual activity in the cognitive domain, children's literature can provide the factual basis to encourage greater comprehension of plants in their environment, as well as the potential for application, analysis, synthesis, and evaluation through its use as a part of a larger instructional theme or unit (Bloom, 1956).

Children's literature also has definite potential in the affective domain, which consists of interest, attitudes, and/or personal involvement (Krathwohl, 1964). As Alexander Isayevish Solzhenitsyn said in his Nobel lecture in 1972, "The sole substitute



for an experience which we have not ourselves lived through is art and literature”  
(Martin, 2001, p. 324).

Through interactive exposure to these books, children may become more botanically literate. These books have the potential to foster an understanding of the Principles of Plant Biology of the American Society of Plant Biologists and the National Science Education Life Science Standards, because they provide a means for children to analyze the role of plants in their environment. Through botanical children’s literature, not only may children advance in their conceptual understanding, they may also grow to appreciate literature and understand stories more fully (Krough & Lamme, 1985).

Via their cognitive and affective appeal, picture books can translate objectively defined circumstances into subjectively realized knowledge, creating characters with whom the reader can identify, whose emotions they can share individually, whose behavior they can mimic, and whose viewpoint they can accept or reject (Spitz, 1999). Picture books with plant science stories may provide a means whereby children can be both participant and spectator, where they can move from character to character but still draw upon their own perspectives, predispositions, and life experiences.

Through such books, children can also experience nonverbal communication--the expressions, sights, sounds, and body language of the reader. In relation to the story plot, the ideas presented may compel children to reevaluate their own experiences and thereby become more aware of plant life on their lives.

Plant science picture books are a means by which meaningful learning can ensue. Children, for the most part, love to be read to and will often voluntarily incorporate the concepts and propositions of the book into their existing schemes of knowledge (Ausubel et al., 1968).

At the same time, this diversified genre of books has the ability to challenge children beyond their current level, offering them a “zone of proximal development” (Vygotsky, 1967).

Children seem to have a natural desire to learn, and as a result, a natural desire to be read to or to read. There is pleasure derived not only from the interaction with others but also from the literature-fueled experience of new knowledge. Physicist Steven Weinberg proposes “Nature seems to act on us as a teaching machine” (Gopnik, Meltzoff, & Kuhl, 1999, p. 163).

### Qualities of Outstanding Children’s Literature

What defines a good book for children? According to Temple, Martinez, Yokota, and Naylor (1998), quality books are those that expand awareness in children and provide an enjoyable experience, but do not overtly teach or moralize, and that tell the truth, embody quality, have integrity, and show originality. These books broaden children’s understanding, not only of themselves, but also of the world at large. Children may often learn a lesson from a book, even though the text does not contrive to instill morals. Such books may deal with significant truths about life, and are often poetic in their sound; the plot is convincing and the characters believable. The genre, plot, characters, language, style, theme, and illustrations come together to make a fulfilling story. Excellent children’s books portray unique characters or situations from a unique viewpoint; they stretch the minds of children, supplying them with new ways to think about the world or offering them alternative views.

### Literature Defines a “Sense of Place”

The editors of *Bookbird* describe a “sense of place” as it “reflects the importance of setting, style, themes, characters, events and perspectives for conveying to readers an

understanding and appreciation for the innumerable places are around the globe portrayed in children's books" (Freeman, Lehman, Ratcheva-Stratieva & Scharer, 2001, p. 3).

A hundred years ago, place was not really that important because people were often born, reared, and died in one place. However, in our industrialized society, we move. Some of us move many times. Because of these migratory influences, we often lack a sense of place. Creating a sense of place is what some books do very well.

Jella Lempan, the founder of *Bookbird: A Journal of International Children's Literature* believed that children's literature could be a vehicle for transcultural literacy-- a bridge that connects understanding and enlightenment (Freeman et al., 2001).

Literature may provide the vessel for children to travel to places to which they would have otherwise never been able to voyage.

We bring to the story what we know and what we have experienced. As we read the book, we place ourselves into the story as we make the place our own. We create our own "sense of place."

### Literature Influences Life

Richard Evans Schultes, a world renowned ethnobotanist, ascribes his fascination with the Amazon rain forest to sylvan fantasies created when he was read to as a bedridden child (Kandell, 2001). When he was about five years old, he was confined to his bed many months by a severe stomach disorder. During this time, his parents read excerpts from "Notes of a Botanist on the Amazon and The Andes" to him. This was a diary kept by British naturalist Richard Spruce during his 19th-century travels. These first-hand indigenous experiences, retold even a second, third, and fourth time, made such an impression upon five-year-old Richard Schultes that his life's direction was decided there and then.

## Plant Awareness

### Theory of Plant Blindness

Several studies have revealed that children prefer to study animals rather than plants (Baird, Lazarowitz & Allman, 1984; Wandersee, 1986). If plants are the very basis of our existence, why do adults and also children, tend to be less interested in plants than in animals? Why do we often fail to notice plants in our surroundings?

Many an object is not seen, though it falls within our range of visual ray, because it does not come within the range of our intellectual ray, i.e., we are looking for it [sic]. So, in the largest sense, we find only the world we look for. (Thoreau as cited in Zakia, 1997, p. 1)

Through extensive research, Wandersee and Schussler (1999) have termed the human condition of not seeing plants as '*plant blindness*'. They define *plant blindness* as:

1. The inability to see or notice the plants in one's environment;
2. The inability to recognize the importance of plants in the biosphere and in human affairs;
3. The inability to appreciate the aesthetic and unique biological features of the life forms that belong to the Plant Kingdom; and
4. The misguided anthropocentric ranking of plants as inferior to animals and thus, as unworthy of consideration (Wandersee & Schussler 1999, p. 84).

"Plant" is a term in everyday science that generally refers to a small herbaceous angiosperm also referred to as a flower (Ryman, 1994). "Blind" usually suggests missing visual information as in snow blindness or blind date (Wandersee & Schussler, 2000).

Plant and blind are common words that we can easily identify with and, thereby, relate to the term *plant blindness*.

The symptoms of *plant blindness* are explicitly described on the reverse side of a colorful 16-inch by 20-inch poster entitled *Prevent Plant Blindness* (Wandersee & Schussler, 1998). The poster, at first a little puzzling, shows a pair of black-rimmed glasses with red lenses that are hovering in the sky over a tree-lined, riverine environment. The implications are that someone wearing these red-lens glasses will be unable to see the green plants in the scenery. Underneath the spectacles in large, bold, black, diagonal letters are the words *Prevent Plant Blindness*. The symptoms of *plant blindness* are described as:

1. Thinking that plants are merely the backdrop for animal life;
2. Failing to see, notice, or focus attention on the plants in one's daily life;
3. Misunderstanding what plants need to stay alive;
4. Overlooking the importance of plants to human affairs;
5. Failing to distinguish the differing time scales of plant and animal activity;
6. Lacking hands-on experiences in growing, observing, and identifying plants in one's geographic region;
7. Failing to explain the basic plant science underlying nearby plant communities—including keystone plant growth, nutrition, reproduction and relevant ecological relations;
8. Lacking of awareness that plants are central to a key biogeochemical cycle—the carbon cycle; and

9. Being insensitive to the aesthetic qualities of plants and their structures—especially with respect to adaptation, coevolution, color, dispersal, growth, pattern, scent, size, sound, spacing, symmetry state, tactility, taste, and texture (Wandersee & Schussler, 1998).

In an attempt to explain this condition of *plant blindness*, several relevant principles of human visual cognition and perception are addressed.

First, people tend to see only what has meaning to them or what they already know. Not everyone sees the same thing even though they are looking at the same thing at the same time. Former athletes “see” so much more when watching a sport than do people who are watching it for the first time. These athletes see more because they have more expertise and cognitive understanding of the sport. Only by developing our knowledge that something exists will we be able to see, appreciate, and to understand the value of what lies within our field of view (Bandura, 1986; Kosslyn & Chabris, 1993).

Secondly, plants are often not seen because they fail to attract our attention because we feel no need to be conscious of them. To see something, our consciousness of seeing that something must exist prior to the activation of our attention (Mack & Rock, 1998). When we fail to see objects even though we are looking at them, it is because our attention is focused on something else.

### Inattentional Blindness

This phenomenon is defined as inattentional blindness (Mack & Rock, 1998). Many psychologists agree that attention is inherently intentional (Neisser, 1967; Treisman, 1982). “Perceptions are guided by preconceptions” (Bandura, 1986, p. 53) therefore an observer’s perceptual cognizance and cognitive behavior causes the observer to see some objects but not others.

Different measures of attention are instilled in us at an early age. When crossing a busy intersection we are cautiously advised to look both ways before crossing. Most children learn at an early age, through senses in addition to sight, what the meanings of "Hot stove!" or "Don't touch, it bites!" are.

If critical stimuli, such as these described, are perceived, it is because they have captured or attracted our attention. Generally, we do not perceive plants as critical stimuli--we do not feel threatened or endangered by them. However, if you have ever experienced the discomfort of the blistering, itchy rash associated with poison ivy, poison sumac, or poison oak, this scenario completely changes. Your attention becomes focused on staying clear of a climbing vine or shrub with a three-leaf formation or a seven-to-thirteen leaf formation with fruit growing between the leaf and the branch. These particular plants seem to “pop-out” at us and capture our attention. Solso (1994) says we see with our mind-brain system.

### A Dual Concept of Vision

Visual impressions are not limited to sensory experiences because seeing also involves the peripheral nervous system and the observer’s cognitive background. Solso (1994) refers to this a dual concept of seeing. Visual stimulation of the eye, plus the interpretation of sensory systems by the brain, allows us to “see” (1994, p. 4).

### Proximity

**“Back-drop” static proximity.** The static proximity of plants is also another explanation contributing to plant blindness. Plants become the background rather than the focal point of the picture. The proximity of objects influences the way we see visual elements. The closer together two or more visual elements are, the greater is the probability that they will be seen as a group rather than as individual objects (Zakia,

1997). An example of this is the leaves of trees. Do we “see” a leaf or just large areas of green? Plants for the most part are grouped by static proximity. We see them as a blended background rather than the separate parts. This occurrence has been referred to as the “plants as backdrop” phenomenon (Wandersee & Schussler, 1999, p. 86)

**Displaced proximity.** The visual area from which we can rapidly process information is defined as the useful field of view (Ware, 2000). This area is generally influenced by the information being displayed. A study conducted by Peterson and Dugas (1972) suggests that the useful field is far larger when watching moving targets than for watching static targets. They found people perceived moving targets at a faster response rate than static targets. If this is the case, then any movement, animate or inanimate, will cause us to focus on it rather than the static proximity of the plants. Because plants are sessile and typically move involuntarily, if at all, our brain does not detect differences in the plants (Wandersee & Schussler, 2000).

**Attention attraction by appearance or disappearance.** Other studies suggest it is not necessarily the movement that attracts our attention but rather the appearance or disappearance of an object in the field of view (Hillstrom & Yantis, 1994). The swaying of leaves on trees does not constantly distract us, but we will notice a flock of birds landing or flying away. Be they static or moving, plants are still more likely to be ignored. They do not grasp our attention because we all know they will not “run” away. We see them merely as the “backdrop”.

#### Visual Perception: Gestalt Laws

Gestalt psychology, a movement in experimental psychology around the 1920’s, has made important contributions to the study of visual perceptions. The gestalt theory states that we perceive items as well-organized patterns rather than as separate



components (Ware, 2000). According to this theory, when we “see” with our eyes, we do not see fractional particles in disorder. Instead, we notice larger areas with well-defined boundaries and shapes. We tend to see a ‘whole’ of something that is more structured and cohesive, rather than individual items within the whole.

Proximity and similarity are two of the four grouping concepts in the classic gestalt theory; the other two are closure and simplicity. Proximity refers to where items are and how they affect grouping. Similarity refers to the appearance of items and how they affect grouping. Both of these concepts could, in fact, contribute to plant blindness or help us understand why we fail to see or notice plants in our environments.

The law of proximity asserts that objects close together are perceptually grouped together. There are four specific types of proximity relationships: close edge, touch, overlap, and combining. The underlying principle of grouping proximity is close edge. The closer items are to one another the more likely they are seen as a group. When items get close enough to touch, they are even more likely to be considered attached. When items overlap, this effect is even stronger. When two items overlap, they seem to form a new more complex shape. The strongest of all grouping concepts is combining. When items superimpose or appear to lie on top of other items, they are often seen as one, rather than separate items.

The principle of proximity suggests why we tend to see leaves at the top of a tree as one mass rather than separate items. The leaves of plants are usually close together, often touching or overlapping, therefore at a glance, they appear to combine with other leaves.

The law of similarity refers to what items look like, not what they are like. The more the items are alike, the more likely we will see them as one group. The three elements of similarity are size, value or color, and shape.

Relative to plants, the size or shape of plants, is often more noticeable than differences in color. Plants such as Azaleas, Indian Hawthorns, or Gardenias, which have similar size, color, and shape, each tend to be seen as a group of shrubs rather than individual plant of that species.

In the book *Inattentional Blindness*, Mack & Rock (1998) found that people perceived individual items in groups of static proximity or similarity only when they were explicitly asked to be consciously attentive to the items. Apply this study to plants and ask the subjects to draw a picture of a leaf after being shown several different trees. It would be interesting to see how many people could actually draw one of the individual leaves.

#### The Imbalance of Biology, Botany, and Zoology

There is little doubt that science educators have played a role in fostering plant blindness in our children. Failure to teach about plants was noted as early as 1919 when Professor George Nichols stated that biology courses were “responsible for the popular delusion that biology is the study of animals” and that biology is “botany taught by a zoologist” (Nichols, 1919, as cited in Hershey, 1993, p. 418). Many students sense the inadequacy of their plant content knowledge. This is due to the way in which zoocentric examples have been used to teach basic biological concepts or due to the neglect of instruction to offer botanical field experiences (Bernhardt, 1999; Botanical Society of America [BSA], 1995; Hershey, 1993; Uno, 1994).

### Primary Children Talk about Plants in the Garden

Johnson and Tunnicliffe (2000) conducted a study in the Gardens of the Royal Horticultural Society at Wisley, Surrey, England. They observed and recorded the conversations of primary age school children, 5-11 years, without an official guide, but with teachers and parent chaperons.

Two analytical methods were utilized for this study. First, a systemic network analysis was used as a means of grouping or categorizing the children's conversations. These conversations were grouped into exclusive categories in such a way that comparison of conversations could be made between the groups. The plant-focused conversation category was subdivided into four subordinate groups:

1. Other interpretative comments, which included knowledge source comments such as questions and references to a source of the information offered;
2. Affective comments which included emotive responses such as "Ah!" or "Ugh";
3. Environmental comments referring to the natural habitat or endangered status of the species;
4. Comments about the actual plant species names, structure, or physiology that formed three subsections.

The other method of analysis used was a read/re-read technique to establish the broad categories and their subdivision based on the children's everyday understanding. The following categories were listed at the head of a spreadsheet and the comments categorized and inserted as they appeared in the children's conversations: color, size, shape, scent, feel, sound, taste, plant name, parts of plant, life cycle, affinity, gardening

practice, knowledge about gardening, animals in the garden, specific affinity, similes, and family connections (Johnson & Tunnicliffe, 2000).

The results of this study found that much depends on what children bring to the experience of visiting the garden and how they share this with others. Also, the presence of an adult increased the plant content of the conversations. The data showed that, overall, 95% of the conversations were focused on the exhibits (the gardens and the plants) and 79% contained a comment about a specific plant. The groups commented mostly about anatomical features of plants, of which 13% of all conversations mentioned leaves, 20% flowers or fruits, while only 4% mentioned the stem (Johnson & Tunnicliffe, 2000).

The second method of analysis, read/re-read, yielded the following findings. The majority of the comments made by the children in the garden were about obvious features that they could see, feel, or smell, and the plants were referred to by everyday names. The children's knowledge came mainly from their own experience of plants and gardening, and that of their families (Johnson & Tunnicliffe, 2000). Comments and frequencies of the children's comments are found in Table 2.1.

### Ethnobotany

#### A Bridge for Learning

In 1895, American botanist John W. Harshberger coined the term "ethnobotany" to describe the scientific investigation of plant usage by indigenous cultures (Balick & Cox, 1996). Today, ethnobotanists study a large range of interests related to indigenous populations, including the use of plants--food, medicines, dyes, transportation, clothing, shelter, and ritual. Indigenous cultures such as the Australian Aborigines and the American Indians have followed traditional, nonindustrial lifestyles for centuries,

**Table 2.1.**

**Comments and Frequency of Topics Discussed**

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Category	Topic	Frequency
Sensory	Sight	30
	Smell	2
	Touch	5
	Hearing	<1
	Taste	<1
	Sight	30
Pertaining to Garden	Plant Names	20
	Plant Parts	8
	Life Cycles	2
	Gardening	2
	Knowledge about Gardening	7
	Animals in the Garden	7
Affinity	Specific Affinity	3
	Similes	9
	Family Connections	4

---

and plants have a greater importance to them as a result.

One may ask, “How does ethnobotany bridge learning?” Foremost, the study of the relationship between plants and people of indigenous cultures are often clearer than in industrialized societies. The link between plant production and utilization is more direct. An ethnobotanist can study the people in these societies and learn how their everyday lives are impacted by plants, and vice versa--taking a close look at how they use plants for food, clothing, shelter, medicine, or rituals in their culture.

In our society, the economic patterns of production and consumption are so complex and disconnected that some people have very little understanding of the process of making plant-based products--from cultivation to finished product. For example: How is the harvested timber for a pencil changed into the actual finished product? Philosopher Leonard Read could not find a single person in America who could correctly describe how a pencil is made. He also discovered that companies which produced one component of the pencil, such as the eraser, had no idea how the other components of the pencil were created (Balick & Cox, 1996).

Within these societies, there are certain individuals who represent living analogs of prehistorical stages of Western civilization. Many of their practices have been passed down since the Stone Age. Archaeologists can often learn more about the prehistoric hunter-gatherer phase by conversing with an ethnobotanist who studies the lifestyles of modern hunter-gatherers.

With a plethora of global environmental issues confronting our world today, elucidation of the knowledge of the practice of stewardship by indigenous people may increase our understanding of how best to address them. Even without conscious

knowledge of these global issues, indigenous tribes often attempt to maintain a sensitive balance within environment.

### Ethnobotany and Literature

Norrentranders, emphasizing the benefits of ethnobotany in literature, writes “An important source of information is the intuitive folklore... but until now no one had bothered to make this practical wisdom explicit” (Norrentranders, 1991, p. 307). Today, it seems, more and more writers reflect this view (Bang, 1997; Cherry, 1990; Cherry & Plotkin, 1998).

Mark Plotkin and Lynne Cherry (1998) describe the wonderful world of folklore in the book *The Shaman's Apprentice: A Tale of the Amazon Rain Forest*. Through the eyes of a young man, who desires to one day become a shaman, the life and vitality of the indigenous Amazon people are artfully described. Even though the young man sees the elder shaman face uncertainty as malaria strikes many villagers--due to the interaction with white missionaries--he still maintains his desire to follow in the respected tradition of being a shaman's apprentice.

When Plotkin, being interviewed by his daughter, was asked why he wrote a book for children, his reply was “Kids are the best environmentalists! They are energetic, curious; and they're dreamers!” (Plotkin, 1999, ¶6).

Other works of children's literature which apply ethnobotany to learning are *The Great Kapok Tree: A Tale of the Amazon Rain Forest* by Lynne Cherry (1990) and *Common Ground: The Water, Earth, and Air We Share* by Molly Bang (1997). Cherry's kapok tree (1990) vividly reveals the beauty of a preserved Amazonian rain forest and the marvelous creatures that inhabit it. At the end of the story, one can only imagine what would have been the repercussions if the woodsman had destroyed the kapok tree as he

had originally intended. To promote stewardship, Bang (1997) utilizes a simple parable about sheep, and the commons they graze on, to point out a disturbing paradox about our relationship with the environment that sustains us.

### Summary

In conclusion, this literature review has demonstrated that there is an imminent need for our children to appreciate and assimilate botanical concepts and principles. The No Child Left Behind Act of 2001 (U.S. Department of Education, 2002) requires that, beginning with the school year 2007-08, children in grades 4-6 must be evaluated on their understanding of the characteristics of plants, the life cycles of plants, and how plants interact with their lives. Ironically, even though plants are the very basis of our existence, several studies have revealed that children prefer to study animals rather than plants (Baird, Lazarowitz, & Allman, 1984; Wandersee, 1986). Through extensive research, Wandersee and Schussler (1999) have termed this human condition of not seeing plants, and therefore not appreciating plants, as plant blindness. Johnson and Tunnicliffe (2000), in their studies of children's conceptions of plants, found that their knowledge of plants come mainly from their own experiences and depends on the quality of their interactions with plants. The studies of Johnson and Tunnicliffe (2000); Baird, Lazarowitz, & Allman, (1984); and Wandersee (1986) support the human constructivist learning theory (Mintzes et al., 1997; Mintzes et al., 1999), because they all show that no two children will construct exactly the same conclusion or inference even when they are presented with the same experiences or objects. Therefore, for children to understand botanical concepts and principles, it appears that they must be presented with the opportunity to construct new knowledge conceptually, connecting this knowledge to their existing knowledge through an active inquiry process. Plant science picture books with a



plot and characters offer an avenue whereby children may come to appreciate and assimilate botanical concepts and principles. It seems reasonable to assume that the combined power of words and images can be an effective tool that impacts both the cognitive and affective domains of learning (Krathwohl, 1964; Norrentranders, 1991; Wilson, 1994) and can promote scientific literacy. It seems obvious that research which characterizes this new children's literature genre is needed--given its emergence, its potential impact on science education, and its current paucity of research.

CHAPTER 3:  
RESEARCH METHODS

Research Design

The research study was a content analysis of children science picture books about plants, specifically those having a plot and characters. After the books were located and examined, the next step was to look for recurring regularities, in the context of this study's research questions. These regularities formed the basis for an initial unitizing, "or breaking the text into units of information that [would] will serve as the basis for defining categories" (Tashakkori & Teddlie, 1998, p. 123) of similar content. This typology development (or set of substantive categories) was then used to form categories that were internally consistent and mutually exclusive. This subjective evaluation was used to synthesize instruments to assess the quality of the visuals and the text in this genre of children's literature. The research flow chart (see pages 9, 10) and Gowin's Vee Diagram (see page 7) provides details for the various phases of this research.

The meaning of "content analysis" is emergent. It has been variously defined in terms of an ongoing narrative, the immediate semantic environment, the literary tropes operating, and connections between the text and experience or knowledge. Berelson (1952, as cited in Guba & Lincoln, 1981) defines content analysis as "a research technique for the objective, systematic, and quantitative description of the manifest content of communication" (p. 240). Neuendorf (2002) defines content analysis as "a summarizing, quantitative analysis of messages that relies on the scientific method (including attention to objectivity-intersubjectivity, a priori design, reliability, validity, generalizability, replicability, and hypothesis testing) and is not limited as to the types of variables that may be measured or the context in which the messages are created or

presented (p. 10). Neuendorf's writings and methodology have had the greatest influence on this study.

After World War II, sociologists and students of mass communication refined content analysis. Content analysis is a quantitatively oriented qualitative technique by which standardized measurements are applied to metrically defined units and these are used to characterize and compare documents (Denzin & Lincoln, 1998).

Content analysis has been advanced by the electronic computer and computer-based programs. It has been used to characterize the content of everything from societal issues in popular magazines to violence on television programs to the musical styles of "Barney and Friends" songs (McGuire, 1985). Recently its use has been especially popular in cultural studies and mass communications research.

### Research Methodology

Over the past several decades, there has been a metaphorical war of paradigms within the field of educational research. Some researchers advocate a purely quantitative approach while others argue for qualitative methods (Eisner, 1981; Smith & Heshusius, 1986). The positivist sees the monomethod of quantitative research as the superior research paradigm; whereas, the constructivists feel qualitative research is superior. Several researchers, however, advocate the stance of the pragmatist, arguing that the researcher should use what works and reject the "either – or" point of view. Tashakkori and Teddlie (1998), Patton (1990), and Howe and Eisenhart (1990) all agree that the research question should guide the study, rather than the research method.

Tashakkori & Teddlie (1998) recommend the use of mixed methods--where there is a combination of quantitative and qualitative approaches in different phases of the research process. They state:

We encourage researchers to use appropriate methods from both approaches to answer their research question. For most applications in the social and behavioral sciences, these research questions are best answered with mixed methods or mixed model research designs, rather than a sole reliance on either the quantitative or the qualitative approach. (p. x)

The current study utilized a mixed methods design, in that both qualitative and quantitative data collection methods were used to make descriptive statistical comparisons that helped to answer the stated research question. The text and content of the books were analyzed through qualitative methods. Quantitative methods were used to statistically compare the range and the frequency of occurrence of plant science concepts and principles, the number and type of graphic representations, artistic innovations, and story plots of the books.

### Data Collection

#### Sample Characteristics

Children's science picture books about plants, with a story and plot, constitute an emerging children's literature genre with a target audience of children ages 4-8 and have a typical length of approximately 32 pages. Many books that initially appear to fit this category have no coherent story or characters, and resemble science school textbooks. The sample analyzed was that of plant-centered children's science picture books (which is a subset of children's science books) that has both a plot and characters. This small but influential, emerging genre of picture books contains the kinds of storybooks parents and librarians buy, that children like to hear and see, and which they eventually want to read by themselves. In these books, the pictures and words are equally important to the

popularity of the book. The sample used in this study was distilled from books with the following characteristics:

1. Children's science picture books published in the English language by major publishers, worldwide, from 1950 – present;
2. Children's science picture books with a target audience of ages four to eight;
3. Children's science picture books with an approximate length of 32 to 40 pages;
4. Children's science picture books with fiction or nonfiction structure that tell about an event or series of events involving a plant or plants and have a plot and characters; and
5. Children science picture books that have pictures and/or text on at least every other page.

#### Sampling Procedure

The study used a purposeful sample that matched the aforementioned targeted book characteristics. The books in the sample were drawn primarily from the renowned collections and archives of four nationally prominent libraries: the de Grummond Children's Literature Collection at the University of Southern Mississippi, Hattiesburg, MS; the Kerlan Collection at the University of Minnesota, Minneapolis, MN; the Center for Children's Books at the University of Illinois at Urbana-Champaign, IL; and the Central Children's Room at the Donnell Library Center, New York Public Library. Appendix A contains descriptive writings of the researcher's reflections at each of the children's literature collections. The snowball technique was used until saturation, to locate other suitable books--by moving outward from these four eminent institutions--based on expert advice obtained at those sites and library references about the books already located.

The de Grummond Children's Collection, located at the University of Southern Mississippi, in Hattiesburg, Mississippi, is housed at one of North America's leading research centers in the field of children's literature. Although the collection has many strengths, the main focus is on American and British children's literature, both historical and contemporary. Founded in 1966 by Dr. Lena Y. de Grummond, the collection holds the original manuscripts and illustrations of more than 1,200 authors and illustrators, as well as over 70,000 published books. The library is the main repository for the works of Ezra Jack Keats, and contains numerous galleys, illustrations, and author information files. Other special strengths of the collection are its extensive holdings related to *Aesop's Fables*, Kate Greenaway, H. A. and Margaret Rey, and George Alfred Henty.

The Kerlan Collection located at the University of Minnesota, in Minneapolis, Minnesota, is another one of the world's great children's literature research collections. The Kerlan Collection contains original materials, including manuscripts, artwork, galleys and color proofs, for over 7,000 children's books. Presently, the collection also includes more than 90,000 children's books, primarily by twentieth-century American writers. Also included are over 300 periodical titles and more than 1,200 reference titles, as well as other items including letters, posters, toys, photographs, audiovisuals, publisher's catalogs, and even a children's literature figurine collection! Teachers, librarians, students, authors, illustrators, translators, and critics from the United States, as well as those from many foreign countries, come here to study the materials in this unparalleled collection

The Center for Children's Books is a special research collection of recent and historical books for youth and children located at the Graduate School for Library and Information Science at the University of Illinois in Champaign, Illinois. This center

houses a non-circulating collection of more than 14,000 recent and historically significant trade books for youth, birth through high school, plus review copies of nearly every trade book published in the United States in the current year. There are over 1,000 professional and reference books on the history and criticism of literature for youth, literature-based library and classroom programming, and book-based storytelling. Although the collection is non-circulating, the resources are available for examination by scholars, teachers, librarians, students, and other educators.

The Center for Children's Books is also the home of *The Bulletin of the Center for Children's Books* (University of Illinois Graduate School of Library and Information Science, 1997). The Bulletin, founded in 1945, is devoted entirely to the review of current books for children. It provides concise summaries and critical evaluations to help readers find certain types of books. Each review gives information on the book's content, reading level, strengths and weaknesses, and quality of format, as well as suggestions for curricular uses. *The Bulletin of the Center for Children's Books* is published monthly, except for August, by the Publication Office of the Graduate School of Library and Information Science at the University of Illinois at Urbana-Champaign and is distributed by the University of Illinois Press.

The Central Children's Room at the Donnell Library Center, New York Public Library features non-fiction and reference books for children on all topics, as well as, a literature collection rich in current and retrospective works. This collection is a national leader in children's services and resources with over 100,000 volumes of material for children of all ages, and for adults.

A noncirculating collection of 18<sup>th</sup> and 19<sup>th</sup> century children's books is available by appointment. The Central Children's Room also features a range of materials for

adults about children's literature. In addition, the Central Children's Room regularly holds such programs as films, story hours, and guest appearances by authors and illustrators.

The original Winnie-the-Pooh toys, Mary Poppins's umbrella, and other unique items are on permanent display, and special exhibitions, often featuring original art by children's book illustrators are scheduled regularly. Other collection highlights include: 5,000 musical and spoken-word audiocassettes; backfiles of periodicals for and about children; 9,000 books in languages other than English; literary reviews, history, and criticism of children's literature; and biographies of children's book authors and illustrators.

### Sample Size

The researcher found no evidence that others have studied this targeted genre, nor that other researchers have traveled to four major national children's literature collections and immersed themselves so deeply in them. With more than 120,000 children's books in print today (Lyncy-Brown & Tomlison, 1999), serious thought and hundreds of hours of time were devoted by the researcher to identify and filter the target books from such a huge source set. Computer-based catalogs, archives, many hours of shelf combing, and reference librarian queries were used in this study. A concentrated effort was made to find as many books as possible that fit the target book characteristics to answer the aforementioned research questions. At each children's literature collection the researcher compiled a concise list of titles that she felt would meet the criteria of the study. Over a period of 18 months, more than 300 children's books relating to plant(s) were read and reviewed for this study. Some were quickly eliminated because they did not meet the *easily* identifiable criteria such as exceeding the page limit or publication date span.



Others were excluded for insufficient plant science, inaccurate plant science, or having no factual story plot (see Appendix B). There were three additional books that the researcher felt would meet the criteria of the study, but these were unable to be purchased outside of the initial children's collection where they were identified. Thus they were excluded from the study to their probable low influence level.

Due to the nature of this content analysis, it was required that these books be in-hand. Fifty-four books were purchased, but upon closer criteria-based review, the researcher omitted 18 of these books, yielding a total of 36 books to be analyzed in this study (see Appendix C). Appendix D presents the books used in this study, by year of publication, title, and author.

This sample size in this study is approximately the same as samples used in previous content analysis research studies conducted by such researchers as: (a) GERALYN Anderson Arango (1995), *A Content Analysis of the Portrayal of Homeless Persons in Children's Books* (sample size 38); (b) Emiliano Ayala (1999), "*Poor Little Things*" and *Brave Little Souls*" *The Portrayal of Individuals with Disabilities in Children's Literature* (sample size 59); (c) Carlos Ray Ziegler (1971), *The Image of the Physically Handicapped in Children's Literature* (sample size 47); and (d) Richard Abrahamson (1979), *Children's Favorite Picture Storybooks: An Analysis of Structure and Reading Preferences* (sample size 50).

### Data Analysis

#### Measurement Procedures

There was one independent variable in the study and that was the plant science picture books. The dependent variables were those found within the text and visual content of the plant science picture books:

1. The quality of the plant science plant science learning opportunities within the overall book;
2. The book's integration of plant science concepts/principles;
3. The motivational power of the story to teach important ideas about plants and the Plant Kingdom;
4. Identifiable trends within this emergent children's literature genre; and
5. The innovations in the graphic representation of plants that these books contain.

Patton (1990) contends that the challenge of qualitative analysis is “to make sense of massive amounts of data, reduce the volume of information, identify significant patterns, and construct a framework for communicating the essence of what the data reveal” (pp. 371-372). Identifying the important patterns and trends in the data being analyzed was facilitated by employing a “simple valence analysis” procedure described by Tashakkori and Teddlie (1998).

At the onset of the study the researcher conducted a pilot study (see Appendix E), which served as a practicum by familiarizing the researcher with the methods, techniques, and applications of a content analysis. The pilot study also allowed the researcher to develop ideas and strategies that were later used in the overall data analysis procedures. During the pilot study, the researcher developed a relatively small number of +/- criterion-based coding schemes to aid in the search for patterns in the books.

There was no relevant codebook identified from previous studies that could be used to analyze plant-science concepts and principles in the 36 plant-science children’s literature selected for this study. Thus, a codebook was created (see Appendix F) using

the National Science Education Standards (NRC, 1996) and the Principles of Plant Biology (ASPB, 2002) .

The researcher also created a data sheet to code the types of plant science graphics, artistic innovative illustrations, and the story plots of the books (see Appendix G). The types of graphics coded were predominately those defined by the National Geographic Society (1998) as being the best National Geographic diagrams of the past 30 years. The goal of these newly created instruments was to create a set of coding units so complete and unambiguous that they would virtually eliminate individual differences among trained coders.

The researcher initially created the codebook and data sheet, and then four additional coders, along with the researcher, modified the instruments during the practice coding process. The coders were highly experienced individuals with master's degrees or beyond and with 15 years or more experience in their field of study. The coders consisted of a biologist, a botanist, assistant director librarian of a public library, and an elementary school teacher (see Appendix H).

Extensive time was required for the modifications of the codebook and training of the coders. The coder training extended over a period of two months. This consisted of nine hours of consensus-building group discussions, as well as numerous e-mail messages and telephone conversations.

The coding process, for the most part, was blind coding (Neuendorf, 2002), in that only one coder was aware of the research questions guiding the investigation. Blind coding was used as an effort to deter what is termed demand characteristic (Orne, 1975) or the tendency of coders to give the researcher what he or she desires. During the

process of coder training, the codebook was revised seven times and the data sheet was revised eight times, until all the coders felt comfortable with the coding scheme.

During the practice coding, the coders coded one book cooperatively and then two additional books individually, with consultation and guidance. The coders were cautioned to read and reread, as well as to study the illustrations during the coding process. During the practice coding training, reliability was monitored and assessed informally.

After a consensus was reached on the procedures and revisions of the codebook, the coders independently coded five additional books. The books coded were selected through random cluster sampling. The entire set of books was divided into subsets according to publication date, by decade. From each decade beginning with 1950-1960 one book was selected. The sample size of five books was selected because five books constituted more than 10% of the full sample (Lombard, 2002).

### Validity and Reliability

Intercoder reliability or “the extent to which the different judges tend to assign exactly the same rating to each object” (Tinsley, 1975, p. 78) was calculated using Cohen’s kappa. The reliability correlation coefficient was .76 and, according to Banerjee, Capozzoli, McSweeney, & Sinha (1999), this level indicates exceptional agreement beyond chance. Ellis (1994, p. 91) indicates a “widely accepted rule of thumb” is that a correlation coefficient beyond .75 to .80 is indicative of high reliability. Frey, Botan, and Kreps (2000) judge a coefficient of 70% or higher to be reliable.

Cohen’s kappa was used to compute the agreement of nominal data in which two or more raters classified categories into nominal scale categories. This measurement of inter-observer agreement compensates and corrects for the proportion of agreement that

might occur by chance. Chance agreement is defined as the proportion of times that the coders would be expected to agree if their ratings were independent of each other. It defines the proportion of shared responses in which there is agreement, after chance agreement is excluded (Cohen, 1960).

Content and construct validity was obtained by asking the expert coders to evaluate the degree to which the categories represented the content intended. Even though experts do not always agree on a particular instance, overall agreement for categorizing a subsample was reached before proceeding. Judgmental validity was appropriate in this case because the categories were clearly defined to a specific attribute and objectively evaluated to clearly defined principles (Tashakkori & Teddlie, 1998). For the experts to make judgments regarding the validity of the instrument, the constructs were defined in an observable “operational” manner, for example:

1. Characteristics of plant centered instruction--a special quality or feature that distinguishes one plant from other plants or from other living organisms.
2. Concept--a pattern or regularity in objects or events designated by a word label.
3. Graphic representations of scientific knowledge--scientific maps, charts, graphs, tables, diagrams, illustrations and images. Also includes, ways of showing details and interrelationships between parts--such as cutaway views and exploded views.
4. Principle--a proposition of generalization formed by stating an important relationship between two or more concepts, such as "molecules are composed of atoms."

### Defining Trustworthiness

With respect to credibility and trustworthiness, a triangulation technique was implemented. Lincoln and Guba (1985) define triangulation as “pitting a variety of data sources, investigators, perspectives (theories), and methods against one another in order to cross-check data and interpretations” ( p. 210). Triangulation was accomplished in this study by using national standards-based benchmarking (ASPB, 2002; NRC, 1996), expert advice from the coders, and the researcher's investigative results, as tested by the coders. The former three were used to inform the cross-check of the results by the coders and encouraged the coders to challenge one another's perspectives during the coding process.

### Data Analysis Plan

Measures of central tendency were computed on the defined categories of plant science concepts/principles principles and the types of science graphics found in this genre across books, to provide a numerical picture of “averageness.”

The range and percentages were calculated and tabulated to address the frequency of grade-appropriate, standards-based plant science concepts and principles found in this genre of children's literature. These percentages were used to highlight areas in which gaps in coverage were evident.

### Summary

This content analysis study examined children science picture books that have a plot and characters. This small, but influential emerging genre of picture books contains the kinds of storybooks parents and librarians buy; the books that children like to hear and see, and which they may eventually want to read by themselves. Over a period of 18 months, more than 300 children books relating to plant(s) were read and reviewed. Of these books, 36 met the prior established characteristics:

1. Children's science picture books published in the English language by major publishers, worldwide, from 1950 – present;
2. Children's science picture books with a target audience of ages four to eight;
3. Children's science picture books with an approximate length of 32 to 40 pages;
4. Children's science picture books with fiction or nonfiction structure that tell about an event or series of events involving a plant or plants and have a plot and characters; and
5. Children science picture books that have pictures and/or text on at least every other page.

This sample of books was drawn primarily from the renowned collections and archives of four nationally prominent libraries: the de Grummond Children's Literature Collection at the University of Southern Mississippi, Hattiesburg, MS; the Kerlan Collection at the University of Minnesota, Minneapolis, MN; the Center for Children's Books at the University of Illinois at Urbana-Champaign, IL; and the Central Children's Room at the Donnell Library Center, New York Public Library.

The independent variable analyzed in this study was the plant science picture books. The dependent variables were those found within the text and visual content of the plant science picture books, which included:

1. The quality of the plant science learning opportunities within the overall book;
2. The book's integration of plant science concepts/principles;
3. The motivational power of the story to teach important ideas about plants and the Plant Kingdom;
4. Identifiable trends within this emergent children's literature genre; and

5. The innovations in the graphic representation of plants that these books contain.

The goal of the study was to travel to, and spend a significant amount of time searching within the four previously identified children's literature collections in order to locate, examine, categorize, describe, and pinpoint the plant science learning potential and pitfalls (both verbal and visual) of children's science picture books that have a plot and characters.

This emerging genre of children's literature is unique in that it has the ability to capture children's attention, contains high-quality age-appropriate plant science, and unites both visual and verbal ways of learning. This study has sought to reiterate the importance of children's literature that teaches its young readers scientific principles while in harmony with the artwork, illustrations, photographs, or graphics--eminent characteristics of children's literature that the Giverny Award has recognized for the past six years.



CHAPTER 4:  
RESEARCH FINDINGS

Content Analysis

This content analysis study was divided into two parts. The first was a content analysis of the text of plant-centered science picture books that met the requirements of the following characteristics:

1. Children's science picture books published in the English language by major publishers, worldwide, from 1950 – present;
2. Children's science picture books with a target audience of ages four to eight;
3. Children's science picture books with an approximate length of 32 to 40 pages;
4. Children's science picture books with fiction or nonfiction structure that tell about an event or series of events involving a plant or plants and have a plot and characters;  
and
5. Children's science picture books that have pictures and/or text on at least every other page.

The second part was a content analysis of the graphics and artistic innovations within these identified books. The graphics analyzed were comprised mostly of the types identified by the National Geographic Society (2001), *Inside/Out: The Best of National Geographic Diagrams and Cutaways* as being the best examples from the last 30 years.

Analysis Techniques

Each of the four coders were given the same six books out of the entire set of 36 books, extensive training, instructions and two forms of coding, the “Botanical Science Analysis Codebook”, and “Identifying Innovative Graphics of Plant Science”, along with

answer sheets. The author coded the entire set of books, providing an additional set of responses to the two forms of coding.

After all the coders completed and returned the answer sheets, their responses for each of the titles were entered on a data spread sheet. These data were then analyzed using Cohen's kappa, yielding an intercoder reliability correlation coefficient of .76. According to many quantitative experts this value indicates an acceptable reliability rating (Banerjee, Capozzoli, McSweeney, & Sinha, 1999; Frey, Botan, & Kreps, 2000; Ellis, 1994).

Using a tally sheet, equivalent responses that were entered by at least 3 out of the 5 coders for each coding unit were considered the consensus answer. These data were then combined with responses from the other books coded by the author. The data were sorted and analyzed by each variable of the coded unit. The results were then used to find and tabulate the range and frequency of plant science concepts and principles found in these books.

In finding and tabulating range and frequency of plant concept and principles for the "Botanical Science Analysis Codebook", 19 of the 20 units coded met the necessary 3 out of 5 coder agreement standard for the study, in an average of 95 % of the coded units. Coding units that did not meet this requirement are noted on the tables as "Non-consensus responses."

Unitizing and categorizing were carried out in order to report the responses to "Identifying Innovative Graphics of Plant Science", which asked the expert coders to identify the science graphics, innovative or skillfully creative forms of illustrations, the story plot, and key botanical aspects of the books.

## Findings on Research Questions

### Primary Question

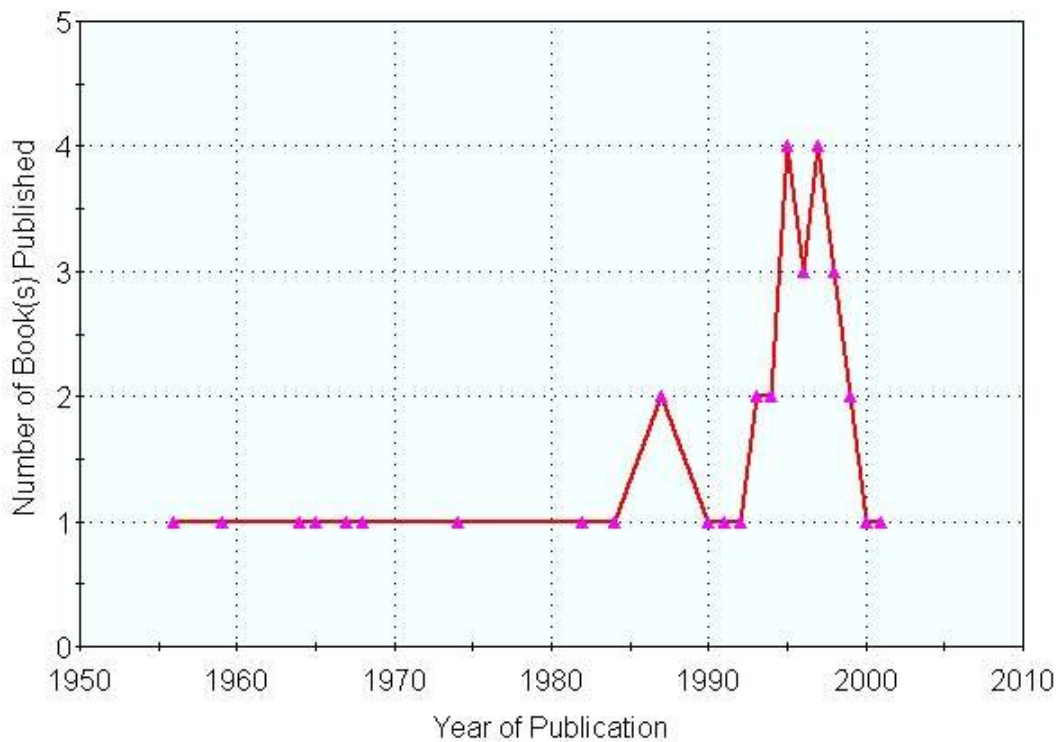
What will an exhaustive search for, and a focused content analysis of plant-centered children's science picture books that have a plot and characters reveal about this emergent genre of children's literature?

Identifying this emergent genre of plant-centered children's literature was a challenging task. Firstly, a book was often disguised as a plant book even with a title specifically related to plants, and was sometimes primarily about animals and their characteristics, rather than about plants. This applied to the illustrations as well as to the content of the story. Secondly, the plant(s) were sometimes described with rather un-plant-like characteristics or a mixture of fantasy and reality, making it difficult for a reader to differentiate between factual and non-factual plant science. Thirdly, even though a book initially appeared acceptable, the book might be written more like a child's science textbook than a child's picture book. And finally, some of the books met the criteria for plant science but had virtually no story plot. Some stories did not contain the necessary sequential elements to make an engaging or interesting story.

The number of books identified for the study varied greatly by year of publication. The majority of the books, 64%, were published in the 1990s, with the fewest books being published in 1970s. Figure 4.1 presents the frequency of plant-centered children's picture books identified according to decade of publication.

Eight of the 36 plant-centered children's picture books had won previous awards or honors. The Caldecott Medal Award, which is awarded annually by the Association for Library Service to Children, a division of the American Library Association, to the artist of the most distinguished American picture book for children was awarded to one

book. Two other books were designated as Honor Book Awards for the Caldecott Medal. The Parents' Choice Silver Honor, given by the Parents' Choice Foundation to excellent books designed to entertain and help children develop universally ethical attitudes, and rigorous standards and skills was awarded to one book. One book won the Christopher



**Figure 4.1. Publication of Plant-Centered Books Identified According to Decade**

Award for Young People, presented each February by [The Christophers](#) (2003) to books that affirm the highest values of the human spirit. The Christopher Awards began in 1949; the Books for Young People category was added in 1970. Three books won the Giverny Award: Best Children's Science Picture Book, which teaches its young reader at least one important scientific principle, or encourages the reader toward specific science-related pursuits or inquiry. This award also requires that the book's artwork, illustrations,

photographs, or graphics work in harmony with the text to tell an important story well.

Table 4.1 presents the honored books according to publication date, title, author, and year and type of Award received.

**Table 4.1.**

**Honored Book Award According to Publication Date, Title, Author, and Year and Type of Award**

Publication Date	Title	Author	Year and Type of Award Received
1956	A Tree is Nice	Urdu, Janice May	1957 Caldecott Medal Winner
1995	Tops & Bottoms	Stevens, Janet	1996 Caldecott Honor Book
1997	A Log's Life	Pfeffer, Wendy	2000 Giverny Book Award
1997	The Gardener	Stewart, Sarah	1998 Caldecott Honor Book
1997	Sam Plants a Sunflower	Petty, Kate	1999 Giverny Book Award
1998	The Summer My Father Was Ten	Brisson, Pat	1999 Christopher Award
1999	Weslandia	Fleischman, Paul	1999 Parents' Choice Award
2000	The Hidden Forest	Baker, Jeannie	2003 Giverny Book Award

The majority of the children's plant science picture books had stories with three or more types of plants rather than one specific kind of plant. Twenty of the books were of this nature; the plants described were species or varieties of plants grown in flower or

vegetable gardens or plants that grow wild. Sixteen of the stories specifically centered around one type of plant. All together, there were 44 different plant types discussed in the text of 30 books. This number does not include the many more types of plants that appeared in the illustrations, because these type(s) of plants that were featured in the story could not always be identified. Six of the books did not identify the type of plant(s) within the story. Of the diversity of plant types discussed, only one story included aquatic plants. The mean for the types of plants presented was 1.57 and the mode was 1. Table 4.2 presents each plant type and the number of occurrences for each specific plant type.

**Table 4.2.**

**Types of Plants Discussed in the Stories**

Type of Plant	Number of Occurrences	Percentage of Occurrences
African violet	1	1.4%
Apple tree	1	1.4%
Ash tree	1	1.4%
Bean	3	4.3%
Beet	1	1.4%
Broccoli	1	1.4%
Brussels sprouts	1	1.4%
Carrot	2	3.0%
Cassava root	1	1.4%

**Table 4.2. continued**

Type of Plant	Number of Occurrences	Percentage of Occurrences
Celery	1	1.4%
Chilies	1	1.4%
Cinchona tree	1	1.4%
Corn	4	6.0%
Cotton	1	1.4%
Daisy	1	1.4%
Eggplant	1	1.4%
Evergreen “Christmas” tree	1	1.4%
Flax	1	1.4%
Hollyhock	1	1.4%
Kapok tree	1	1.4%
Kelp	1	1.4%
Lettuce	3	4.3%
Lupine	1	1.4%
Maple tree	1	1.4%
Marigold	2	3.0%
Melon	1	1.4%
Oak tree	4	6.0%
Onion	2	3.0%
Pepper	2	3.0%
Petunia	1	1.4%

**Table 4.2. continued**

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Type of Plant	Number of Occurrences	Percentage of Occurrences
Polk	1	1.4%
Potato	2	3.0%
Pumpkin	2	3.0%
Radishes	2	3.0%
Rosy dock	1	1.4%
Squash	1	1.4%
Sugar maple	1	1.4%
Sunflower	3	3.0%
Sweet Potato	1	1.4%
“Swist” fantasy plant	1	1.4%
Tomato	6	9.0%
Walnut tree	1	1.4%
Weedee tree	1	1.4%
Zinnias	2	3.0%
TOTAL: 44		99.9%

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Research Subquestion 1

What types of botanical subject matter knowledge and plant science learning opportunities are offered by these books?

During the coding process of “Identifying Innovative Graphics of Plant Science” botanical aspect(s) were identified. These specific aspects were divided into units of



botanical subject matter. The units of relevant subject matter were then grouped into categories of learning opportunities. The identified learning opportunities posed by these books included: (a) biodiversity of plants, (b) characteristics of plants, (c) life cycles of plants, (d) economic botany, (e) ethnobotany, (f) ecology, (g) agriculture, and (h) horticulture. Both the text and illustrations were considered in identifying the learning opportunities offered by these books. The coders also agreed that many of the books were applicable to more than one category of learning opportunity.

The first learning opportunity offered was biodiversity of plants. Biodiversity of plants in the environment was seldom presented exclusively as biodiversity of plants; it often included biodiversity of animals. Threats to biodiversity and conserving biodiversity were also identified in some books. Table 4.3 presents subject-matter knowledge relevant to biodiversity of plants and the titles of books that presented this learning opportunity.

**Table 4.3.**

**Botanical Subject-Matter Knowledge and Book Titles Relevant to Biodiversity of Plants**

Subject-Matter Knowledge: Biodiversity	Book Title
Plant/animal biodiversity of an Amazon rainforest	The Great Kapok Tree: A Tale of the Amazon Rain Forest
Plant/animal biodiversity of an Amazon rainforest	The Shaman' Apprentice: A Tale of the Amazon Rain Forest
Aquatic plant biodiversity	The Hidden Forest
Plant biodiversity	The Plant Sitter
Plant biodiversity of edible plants	Tops & Bottoms

**Table 4.3. continued**

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Subject-Matter Knowledge: Biodiversity	Book Title
Conserving biodiversity	When the Monkeys Came Back
Conserving biodiversity	Where the Forest Meets the Sea

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Characteristics of plants, the second plant science learning opportunity identified, included various distinguishing traits, qualities, and properties of plants. Growth form and appearance, growth rate, and reproduction propagation were the plant characteristics identified in this study. Growth form and appearance were identified through flower color, foliage color, fruit/seed color, and foliage texture as well as by size and shape. Seed reproduction propagation was coded as shown by seeds, cuttings, or bulbs. Table 4.4 presents botanical subject-matter knowledge relevant to the plant science characteristics of plants and the book titles that presented this learning opportunity.

The third plant science learning opportunity identified was the life cycle of plants. This plant science learning opportunity was identified in books that discussed how long a plant lived or the time frame required for a plant to grow, flower, or set seed. The life cycle of plants also included germination, growth, and development. Table 4.5 presents botanical subject-matter knowledge relevant to the life cycle of plants and the book titles that presented this learning opportunity.

Economic botany, or the practical value of plants, was the fourth plant science learning opportunity identified. Economic botany examples included plant fibers used for clothing; plant berries used for products such as sunscreens and insect repellants; trees used to build houses or boats; plants used to make medicine; and evergreen trees

**Table 4.4.**

**Botanical Subject-Matter Knowledge Relevant to Plant Science Learning Opportunity: Characteristics of Plants**

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Subject-Matter Knowledge: Characteristics of Plants	Book Title
Growth form/appearance and propagation by seed	A Handful of Seeds
Growth form/appearance and growth rate	A Tree's Tale
Growth form/appearance	Home Lovely
Growth form/appearance, growth requirements, growth rate, propagation by seed	How a Shirt Grew in the Field
Growth form/appearance (flower color and foliage texture), growth requirements, growth rate,	Lost Plant
Growth form/appearance, growth requirements, growth rate, and propagation by seed	Sam Plants a Sunflower
Growth form/appearance, growth rate, and propagation by cuttings	Sunflower House
Growth form/appearance, growth requirements, growth rate, and propagation by seed	The Big Tree
Growth form/appearance and propagation by seed	The Gardener
Growth form/appearance, growth requirements, growth rate, and propagation by cuttings	The Plant Sitter
Growth form/appearance and propagation by seeds	Tops & Bottoms

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**Table 4.5.**

**Botanical Subject-Matter Knowledge and Book Titles Relevant to the Life Cycle of Plants**

Subject-Matter Knowledge: Life Cycle of Plants	Book Title
Longevity	A Tree's Tale
Germination, growth, and development	How a Shirt Grew in the Field
Germination, growth, and development	Sam Plants a Sunflower
Germination, growth, and development	Sunflower House
Germination, growth, development, and longevity	The Big Tree

harvested for commercial Christmas trees sales. Table 4.6 presents botanical subject-matter knowledge relevant to economy botany and the book titles that presented this learning opportunity.

**Table 4.6.**

**Botanical Subject-Matter Knowledge and Book Titles Relevant to Economic Botany**

Subject-Matter Knowledge: Economic Botany	Book Title
Peanuts used to produce paper, ink, shaving cream, sauces, linoleum, and shampoo	A Weed is a Flower
Commercial harvest of evergreen trees	Christmas Tree Farm
Flax fibers used to produce clothing	How a Shirt Grew in the Field
Plants used to produce medicines, clothing, and dye	The Shaman's Apprentice: A Tale of the Amazon Rain Forest
Plant berries used to produce sunscreen and insect repellent	Weslandia

The fifth plant science learning opportunity identified was ethnobotany. Ethnobotany, an allied discipline to economic botany, involves the study of the relationship between plants and people. This also included the interaction of indigenous people with plants, as well as their uses of the plants. Table 4.7 presents botanical subject-matter knowledge relevant to ethnobotany and the book titles that presented this learning opportunity.

**Table 4.7.**

**Botanical Subject-Matter Knowledge and Book Titles Relevant to Ethnobotany**

Subject-Matter Knowledge: Ethnobotany	Book Title
Interaction of Amazonia native peoples with plants	The Shaman’s Apprentice: A Tale of the Amazon Rain Forest
Interaction of Amazonia native peoples with plants	The Great Kapok Tree: A Tale of the Amazon Rain Forest
Interaction of a child to plant uses in his fantasy civilization	Weslandia

Ecology was the sixth science learning opportunity identified. Ecology, the study of the relationships between living organisms and their environment, was identified in various forms. The ecological issues identified were deforestation, invasive plants, and destruction or alteration of plant or animal habitats. Table 4.8 presents botanical subject-matter knowledge relevant to ecology and the book titles that presented this learning opportunity.

The seventh plant science learning opportunity identified was agriculture. Agriculture encompasses the business of cultivating soil, producing crops, and farming on a large scale of land. The subject-matter knowledge analyzed in this study was either coded as commercial agriculture purposes, as a business of raising crops for resale; or as

**Table 4.8.**

**Botanical Subject-Matter Knowledge and Book Titles Relevant to Ecology**

Subject-Matter Knowledge: Ecology	Book Title
Ecological appreciation through community gardening	City Green
Ecological appreciation through environmental exposure	The Hidden Forest
Effects of non-native plant introductions	The Story of Rosy Dock
Effects of deforestation/effects of reforestation	When the Monkeys Came Back
Results of possible deforestation	The Great Kapok Tree: A Tale of the Amazon Rain Forest
Results of possible deforestation	Where The Forest Meets the Sea

private/individual agriculture purposes where crops were produced, but not for resale.

Table 4.9 presents the 5 books out of the 36 books analyzed in the study that focused on botanical subject-matter knowledge relevant to agriculture and the book titles that presented this learning opportunity.

The eighth plant science learning opportunity identified was horticulture. Very closely related to agriculture, but more of a novice form of farming, in that horticulture involves the cultivating fruits, vegetables, flowers, or ornamental plants

using a smaller plot of land than agriculture. Simply expressed, horticulture is the cultivation of a garden. Fifteen of the 36 books presented knowledge about gardening.

**Table 4.9.**

**Botanical Subject-Matter Knowledge and Book Titles Relevant to Agriculture**

Subject-Matter Knowledge: Agriculture	Book Title
Experimental agricultural methods of crop rotation; experimental uses of plant products	A Weed is a Flower: The Life of George Washington Carver
Commercial farming of evergreen “Christmas” trees for resale	Christmas Tree Farm
Private agriculture endeavors; methods of crop rotation; complimentary plants	The Harvest Birds
Private agriculture endeavors; crops used for production of clothing	How a Shirt Grew in the Field
Private agriculture endeavors; importance of soil preparation; importance of basic plant needs	Pumpkin Fiesta

Table 4.10 presents botanical subject-matter knowledge relevant to horticulture and the book titles that presented this learning opportunity.

Research Subquestion 2

What is the range and the frequency of occurrence of national standards-consistent and age-appropriate plant science concepts and principles found in these books?

The “Botanical Science Analysis Codebook”, created through the use of the American Society of Plant Biologists Plant Principles (ASPB, 2002) and the National Science Education Standards (NRC, 1996), was used to compute the range and frequency

**Table 4.10.**

**Botanical Subject-Matter Knowledge and Book Titles Relevant to Horticulture**

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Subject-Matter Knowledge: Horticulture	Book Title
Introducing a non-native plant species into a foreign environment; consequential negative impact	The Story of Rosy Dock
Plant growth and longevity trees relative to human growth and longevity	Franklin Plants a Tree
Cultivation of sunflowers	Sunflower House
Cultivation of lupines; seed dispersal by wind; seed propagation	Miss Rumphius
Community gardening	City Green
Fantasy gardening; ethnobotany fantasies of a young boy	Weslandia
Cultivation/planting a garden; seed multiplication	A Handful of Seeds
Cultivating unknown plants; comparing and contrasting their differences/similarities	Home Lovely
Detailed sequential plant growth of sunflowers, both textual and visual	Sam Plants a Sunflower
Family gardening	This Year's Garden
Cultivating, planting, and harvesting a vegetable garden; also compares/contrasts the edible parts of plants	Tops & Bottoms
Gardening in limited and unusual places; the flat roof top of a city building	The Gardener
Simple principle of seed multiplication	Too Many Pumpkins
Cultivating a garden; being exposed to a garden for the first time	The Tomato Patch

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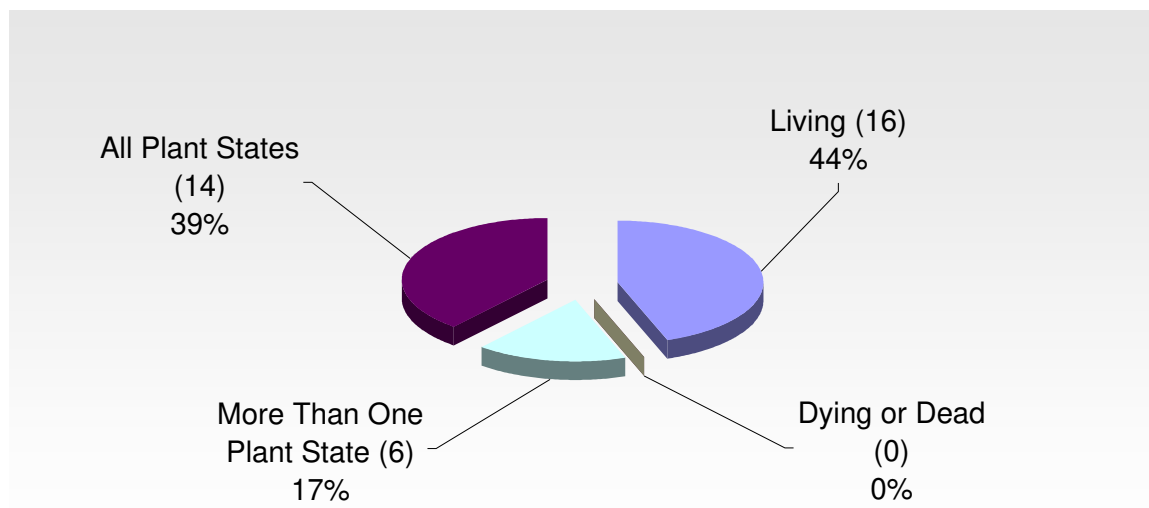
of age-appropriate plant science concepts and principles. The concepts and principles coded were plant state; producer/consumer; the process of photosynthesis; basic plant needs of water, air, space, nutrients, and temperature; plant structures which included roots, leaves, flowers and seeds; reproductive structures; plant form diversity; plant size diversity; external signals; environmental stresses; plant habitats; and plant uses. The text and/or illustrations were used to identify instances of the concepts and principles in the coding units.

The first concept, plant state, was coded according to six possible variables: living, dying, dead, more than one of the above, all of the above, or unable to determine. A living plant was a plant normal in color that appeared to be conducting photosynthesis. A dying plant was a plant or plant part that was removed from its original placement, but still had the ability to continue living if this part, such as a leaf, rhizome, or plant cutting was once again given the necessary elements for survival. A dying plant was also a plant that appeared “sick” or was turning brown, and it appeared as if it would die. A dead plant was a plant that lacked the ability to conduct photosynthesis; the plant therefore had the appearance of being dead. Figure 4.2 lists the range and frequency of the plant state concept that were identified by the text and/or illustrations.

The concept of producer or consumer was coded in all of the 36 plant science picture books in some form. Five books made reference only to plants as producers with no reference to consumers. The other 31 books suggested both producers and consumers. An example of how producers and consumers were presented is, “Long summer days made the seedling grow strong enough to survive the crushing moccasins of people gathering food. Autumn winds blanketed the seedling with colorful leaves, hiding it from hungry deer that pawed the ground in winter’s cold” (Carrier, 1996, p. 2).

The degree to which the process of photosynthesis was presented in the text and/or illustrations was identified in three forms. It was coded as either clearly presented, made reference to, or not addressed.

In one story the process of photosynthesis was clearly presented as the plant's ability to use energy from sunlight along with other chemicals (carbon dioxide and water) to make its own food. "During photosynthesis the leaves combine water, supplied by the roots, with carbon dioxide gas from the air. Sugar is formed, and oxygen, the gas that we and all other animals breathe, is given off" (Hiscock, 1991, p. 17).



**Figure 4.2. Plant States as Presented in Text and/or Illustrations**

Three stories made reference to the plant's ability to make its own food. Such as "The tree, like all other green plants, uses its leaves to make its food. If too many leaves are eaten by caterpillars, the tree will not be able to make the food it needs in order to live so it will starve" (Busch, 1968, p. 10) or "The sunlight on the leaves helps the plant to

make food for itself to grow” (Petty, 1997, p. 8). Schussler and Wandersee (1999) clearly presented the process of photosynthesis through children’s dialogue.

Sometimes they would talk about how Petal [an African Violet] WAS like them and how she WASN’T like them. “Do you think we need to buy Petal some plant food?” worried Abby. “Abby! Plants MAKE their own food! I’ve been reading about plants at the library. All they need is water, light, fresh air, and tiny amounts of nutrients from the soil,” said Tate. (Schussler & Wandersee, 1999, p. 19)

The other 32 stories did not address photosynthesis or the ability of a plant to make its own food.

The plant concepts and principles about plants’ basic needs: water, air, space, sunlight, nutrients, and temperature were coded as clearly identified, vaguely implied or not addressed. A clearly identified basic need was coded when the need was explicitly stated or illustrated. An explicitly stated or illustrated example was water being poured from a watering can onto a plant. A vaguely implied need was coded when the need was not explicitly stated or illustrated but rather implied. An example of a vaguely implied need was a watering can shown, but no illustration of water.

Water was coded 22 instances as clearly identified, 2 instances as vaguely implied, and 12 instances as not addressed. Petty (1997) portrays an example of a clearly identified instance in the book *Sam Plants a Sunflower* as she writes, “He made some little holes and put a seed in each hole. He covered them with soil and watered them” (p. 4). Zion (1959) also describes the basic need of water in varying amounts as he writes, “He watered them carefully – some a lot – and others just a little” (p. 11).

The basic need of air was coded 5 times as clearly identified and 31 times as not addressed. The basic need of air was clearly presented by Carle (1987) as he states, “Then their little stems and leaves begin to grow toward the sun and air” (p.15). The basic need of air was also coded when the illustrations depicted wind movement.

Space was clearly identified in 11 of the stories, vaguely implied in 9 stories, and not addressed in 16 stories. As with the illustrations of the basic need of air, space was also coded when the illustrations depicted evenly spaced plants or planting. An example of space in a book is “Sam has left lots of space between them [sunflowers] because they’re going to grow so big” (Petty, 1997, p. 4).

Sunlight, as a basic plant need, was clearly identified in 11 stories, vaguely implied in 3 stories, and not addressed in 19 stories. Examples of text that present the basic need of sunlight include “the other, the future stalk, stretches up toward the sun” (Petit, 1991, p. 24); “The sun shines. Rain falls. The seeds grow so round and full they start to burst open a little” (Carle, 1987, p. 16); “Prince Kurwin found a sunny spot right beside the moat . . . Then he dug a hole and planted his tomato vine” (Wondriska, 1964, p. 26); and “the sun shines down” (Stewart, 1997, p. 13).

The basic need of plant nutrients was coded 7 times in stories as clearly identified, 5 times as vaguely implied, and 14 times as not addressed. Examples of text that included the basic need of plant nutrients are: “In time the land produced less as the soil tired . . . When the 1800’s ended, the cows and farmers moved on to the rich valleys of the west” (Carrier, 1996, pp. 22, 25); “When the planting is done . . . They walk up and down the rows, giving each tree a handful of fertilizer. The fertilizer will feed the trees, helping them grow bushy and green” (Budbill, 1974, p. 8); and “The log is becoming part of the soil . . . Whatever nourishment is left in the log enriches the earth around it. A tree seed

[acorns illustrated] might land on this rich soil and begin to grow” (Busch, 1968, pp. 34, 35).

Eleven times the basic need of a temperature requirement was coded as clearly identified, 4 times as vaguely implied, and not addressed 21 times. Examples of text that presented the basic need of temperature include: “The spring sun warms the earth” (Petit, 1991, p. 24); “Slowly it [an acorn] pushed up a sliver of green that swayed in the warm breeze rising from the sea below” (Carrier, 1996, p. 1); and “It was a good day for planting seeds. The sun was warm” (Petty, 1997, p. 4). Hiscock (1991) skillfully describes how certain seeds need cold temperature in order to germinate as he writes,

The seeds whirled and spun as they fell. Some landed on the rocks and some in the brook. One seed, no different from the others, came down on a patch of good soil and was covered by falling leaves. The seed did not sprout, though, for sugar maple seeds must be chilled by the winter before they are ready to grow. (Hiscock, 1991, p. 12)

Table 4.11 lists the range and frequency of basic plant needs that were identified by text and/or illustrations.

The plant structure of roots, leaves, flowers, and seeds, as with the basic needs of plants were coded by varying degrees. In 16 books roots were shown or mentioned. Eighteen books made no reference to roots. One book presented roots as the source of entry for water, oxygen, and/or other nutrients into the plant and another book added that roots serve as the support system for the plant. Petty (1997) presents a vivid example of the structure of roots as she writes, “When the water mixed with the soil, the roots drink the good things from the soil that will

help the plant grow” (p. 7). Petit (1991) also describes how the roots move and give support to the plant.

The walnut’s shell splits open and two white sprouts appear in the crack. The one that will become the root buries itself in the earth; the other, the future stalk, stretches up toward the sun. The root spreads and strengthens, and the stalk rises and turns green. (p. 24)

Table 4.12 presents the range and frequency in which the structure of roots was identified by text and/or the illustrations.

The structure of plant leaves was coded in all of the plant science stories. Leaves were shown or mentioned in 33 of the stories and leaves were presented as the location where the process of photosynthesis or food making begins in 3 stories. Petty (1997) presents the structure of leaves in a simplistic manner as she writes, “The sunlight on the leaves helps the plant to make food for itself to grow” (p. 8).

Where as Bruce Hiscock, (1991) in *The Big Tree*, describes it in a more mature style.

The sugar is produced in the leaves, which gather sunlight. During photosynthesis the leaves combine with water, supplied by the roots, with carbon dioxide gas from the air. Sugar is formed, and oxygen, the gas that we and all other animals breathe, is given off. This wonderfully complex process is carried out by chlorophyll, the substance that makes leaves green. (p.17)

**Table 4.11.**

**Basic Needs as Presented in Text and/or Illustrations**

<b>Basic Need</b>	<b>Clearly Identified</b>	<b>Percentage Of Occurrences</b>	<b>Vaguely Implied</b>	<b>Percentage Of Occurrences</b>	<b>Not Addressed</b>	<b>Percentage Of Occurrences</b>
Water	22	61%	2	6%	12	33%
Air	5	14%	0	0%	31	86%
Space	11	31%	9	25%	16	44%
Sunlight	14	39%	3	8%	19	58%
Nutrients	7	19%	5	14%	24	67%
Temperature	11	31%	4	11%	21	58%

**Table 4.12.**

**Plant Structure of Roots as Presented in Text and/or Illustrations**

Degree Presented	Number of Occurrences	Percentage of Occurrences
Shown or mentioned	16	44%
Source of entry for water, oxygen, or nutrients	1	3%
Source of entry for water, oxygen, or nutrients and the support system	1	3%
Not addressed	18	50%
TOTAL: 36		100%

Table 4.13 presents the range and frequency of the plant structure of leaves that were identified by text and/or illustrations.

**Table 4.13.**

**Structure of Plant Leaves as Presented in Text and/or Illustrations**

Degree Presented	Number of Occurrences	Percentage of Occurrences
Leaves shown or mentioned	33	92%
Leaves presented as the location of photosynthesis	3	8%
TOTAL: 36		100%

The structure of flowers was coded 18 instances as being shown or mentioned. Nine stories did not address the structure of plant flowers. In 8 instances one or more part(s) of the flower were identified. Petty (1997) illustrates the flower, as well as the



flower parts beautifully, as she writes “The petals are kept safe inside the bud until the flower is ready to open” (p.9). Flowers were presented as a site of reproduction typically requiring pollination in one story. “All summer long the birds and bees and butterflies come visiting. They have never seen such a big and beautiful flower” (Carle, 1987, p. 26). Table 4.14 presents the range and frequency of the structure of flowers that were identified by text and/or illustrations.

**Table 4.14.**

**Plant Structure of Flowers as Presented in Text and/or Illustrations**

Degree Presented	Number of Occurrences	Percentage of Occurrences
Flower shown or mentioned	18	50%
One or more flower part(s) identified	8	22%
Flower presented as site of reproduction and typically requiring pollination	1	3%
Not Addressed	9	25%
TOTAL:		36
		100%

The structure of seeds was coded as being simply shown or mentioned in 2 stories. Seeds were presented as agents of plant reproduction in 17 stories. In 6 stories not only were plants represented as agents of plant reproduction, they were also presented as being dispersed by multiple agents such as wind, rain, or animals. Cooney (1982) writes, “ ‘It was the wind,’ she [Miss Rumphius] said as she knelt in delight. ‘It was the wind that brought the seeds from my garden here! And the birds must have helped!’ ” (p. 19).

Fleischman (1999) also describes seed dispersal. “Each Afternoon his mother asked him what he’d learned in school that day. ‘That seeds are carried great distances by the wind,’ he answered on Wednesday” (p. 7). Eleven stories did not address seeds in any manner. Table 4.15 presents the range and frequency of the plant seed structure that were identified by text and/or illustrations.

**Table 4.15.**

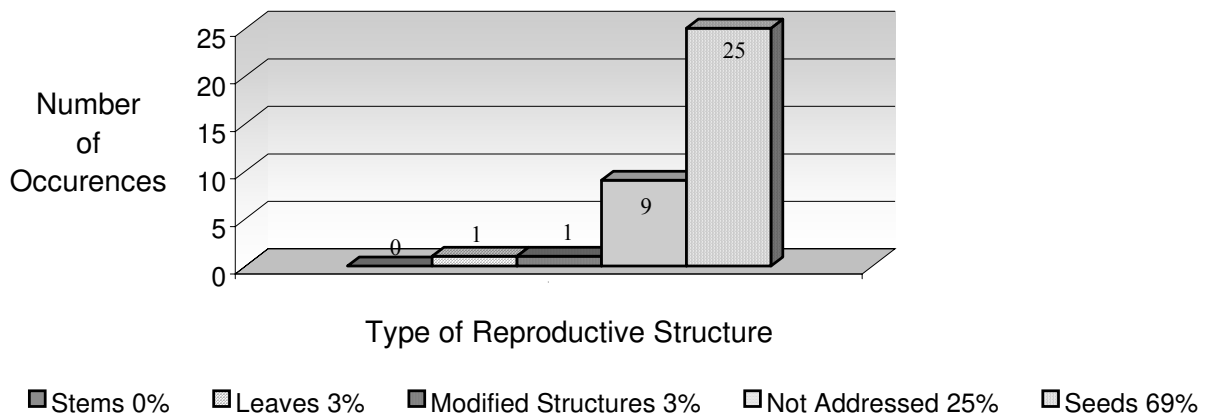
**Plant Seed Structure as Presented in Text and/or Illustrations**

Degree Presented	Number of Occurrences	Percentage of Occurrences
Seeds shown or mentioned	2	6%
Seeds presented as agents of plant reproduction	17	47%
Seeds presented as agents of plant reproduction by multiple means	6	17%
Not Addressed	11	30%
TOTAL:		36
		100%

Plant reproductive structures were coded as seeds, stems, leaves, or other modified structures. Twenty-five books made reference to seeds as a reproductive structure. Leaves were described as a reproductive structure in one book (cuttings). Zion (1959) writes about the activities of a little boy named Tommy who has a job as a *plant sitter*. He writes,

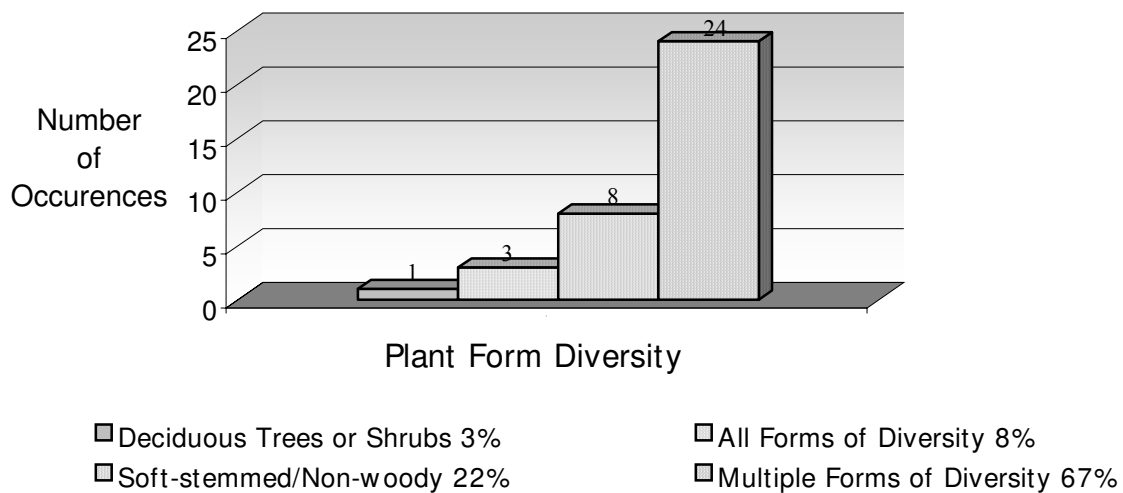
When he [Tommy] got home, he did what the book said to do. He cut and trimmed all the plants. . . . Then he planted the cuttings in the little flower pots he'd bought. The book said they would grow. (pp. 28, 29)

One book made reference to a bulb as a modified underground stem, structure used for reproduction: “And, Grandma, thank you for all the bulbs” (Stewart, 1997, p. 14). Stems were not identified as a reproductive structure. Nine of the books did not address any type of reproductive structure. Figure 4.3 presents the range and frequency of the reproductive structures that were identified by text and/or illustrations.



**Figure 4.3. Plant Reproductive Structures as Presented in Text and/or Illustrations**

Plant form diversity was coded as deciduous tree and shrubs, non-deciduous (evergreen) land plants, soft-stemmed/non-woody plants, and aquatic plants. Twenty-four books were coded as having one or more plant forms in the story or illustrations. Three books were coded as having all of the above plant forms. Eight books were coded as addressing only soft-stemmed/non-wood plants and one book was coded as deciduous trees or shrubs. Figure 4.4 presents the range and frequency of the plant form diversity that were identified by text and/or illustrations.



**Figure 4.4. Plant Form Diversity as Presented in Text and/or Illustrations**

Plant size diversity was coded as plants under 1 foot tall; plants equal to or over 1 foot tall but less than 5 feet tall; and plants equal to 5 feet and taller. The most often coded response, 28 occurrences, was a culmination of all plant sizes or more than one of the above. One book discussed plants less than 1 foot tall and another book addressed plants greater than 1 foot tall but less than 5 feet tall.

Table 4.16 presents the range and frequency of the plant size diversity that were identified by text and/or illustrations.

**Table 4.16. Plant Size Diversity as Presented in Text and/or Illustrations**

Plant Size Diversity	Number of Occurrences	Percentage of Occurrences
Plants < 1' tall	1	3%
Plants $\geq$ 1' to < 5' tall	1	3%
Plants $\geq$ 5' tall	3	8%
More than one of the above	28	78%
All of the above	3	8%
TOTAL: 36		100%

With regard to external signals, three types of signals were addressed: a plant growing toward a light source; a plant responding to a touch source, such as vines or tendrils; and a plant's roots growing downward or toward gravity.

One book made reference to plants growing toward a light source but did not address the other two external signals. *The Big Tree*, by Bruce Hiscock (1991) presents an explicable example of light as an external signal as he writes, “. . . a violent storm swept over the hill. It knocked down an old white pine, and for the first time, bright sunshine reached the little maple. The tree began to straighten and lift its leaves toward the light” (p. 15). Baker (2000), also writes about this external signal; “Gigantic golden trees of kelp reach toward the sun. Shafts of sunlight shimmer in their branches” (p. 14).

Two books made reference to plants responding to a touch source as in a vine or tendrils, but not the external signals of light and gravity. White (1996), uses beautiful

illustrations as well as a humorous description about a plants ability to respond to touch as she writes, “ ‘Pumpkins!’ Rebecca Estelle shrieked. Pumpkin vines had twined under the bushes, over the birdbath, through the porch rails, and onto the rocking chair” (p. 16).

Four books addressed roots growing downward or toward gravity. Petit (1991) describes this external signal as she writes, “The walnut’s shell splits open and two white sprouts appear in the crack. The one that will become the root buries itself in the earth” (p. 24).

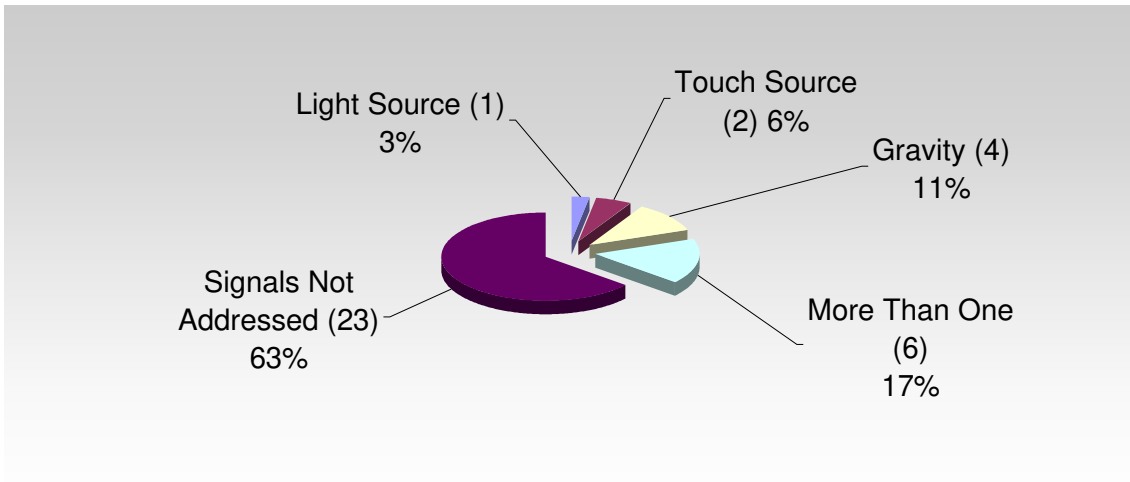
Six books included one or more external signals of plant growth. Carle (1987) in *The Tiny Seed* describes the external signals of sunlight and gravity as he writes, “They are plants. First they send roots down into the earth. Then their little stems and leaves begin to grow up toward the sun and air” (p. 15).

External signals were not addressed in 23 out of the 36 books. Figure 4.5 presents the range and frequency of the external signals that were identified by text and/or illustrations.

Environmental stress was coded according to 4 types of stress: drought, flooding, biotic stress, and/or fire. Drought or flooding individually was not coded in any of the books, however they were coded 3 times along with the other types of environmental stresses.

Biotic stress or stress caused to a plant by insects, animals or humans, diseases from bacteria or fungi was coded 14 times. More than one environmental stress type was coded in 3 books.

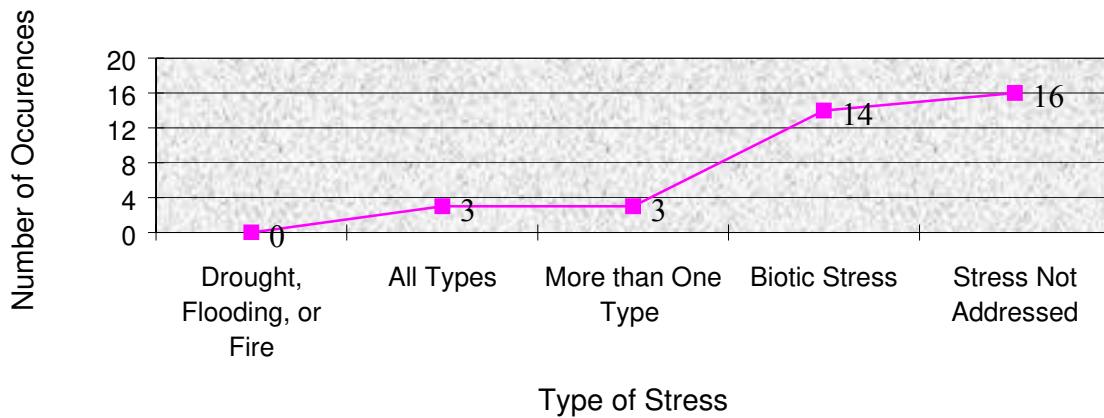
Bunting (1993) describes an example of biotic stress to plants as she writes, “Four days later we find that our tree had been poisoned. . . .Dad’s face is grim. ‘Maybe someone dumped chemicals they weren’t supposed to dump’ ” (p.14).



**Figure 4.5. External Signals as Presented in Text and/or Illustrations**

Brandenburg (1965) in *A Weed is a Flower* presents the external stress of flooding and the biotic stress of insects. “Most of the farmers raised cotton. But sometimes the crops were destroyed by rain or insects, and the farmers couldn’t earn enough to eat” (p. 20).

Sixteen books did not address any type of environmental stress. Figure 4.6 presents the range and frequency of the environmental stress that were identified by text and/or illustrations.



**Figure 4.6. Environmental Stress as Presented in Text and/or Illustrations**

The categories that addressed plants as animal habitats were bird habitats, insect habitats, wildlife habitats, and/or aquatic life habitats. Ten books were coded as having all of the above habitat categories. Five books were coded as having more than one habitat category. Habitats for birds and wildlife habitats and/or aquatic life were coded in one book each. Habitats for insects were coded in four books. Thirteen books did not address any form of animal habitat. Busch, (1968) depicts a tree as being a variety of animal niches as she writes,

No matter how lonely a tree looks, it is never alone. A tree has company all the time . . . . You might notice the bird cradle of an oriole hanging in the treetops . . . . Perhaps you see what looks like a big untidy basketball make of leaves. This was a gray squirrel's summer house. . . . Down in the lower leaves of a tree you might see tiny green insects, called aphids, which suck plant juices from the leaves. On the trunk of a tree you will probably see unusual kinds of plants growing, called lichens, which cover the bark. (pp. 1,3,4,6)

Table 4.17 presents the range and frequency of plants as habitats that were identified by text and/or illustrations.

The final plant concept and principle coded was plant uses. In this coded unit the plants were a primary source of materials in products of everyday use by humans or characters personified; the plant use was also part of the story plot. Plant use coding variables included food, medicine, clothing, shelter and furniture, fuel, more than one plant use, or all of the above plant uses. In 12 instances food was identified as a primary plant source use and in 2 instances clothing was coded as a primary plant source use. More than one plant use was identified in 6 books. Plants were not depicted as being used



**Table 4.17.**

**Plant as Habitats as Presented in Text and/or Illustrations**

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Habitat	Number of Occurrences	Percentage of Occurrences
Birds	1	3%
Insects	4	12%
Wildlife/aquatic life	1	3%
More than one of the above	5	15%
All of the above	10	29%
Not addressed	13	38%
<hr/>		
N=36	TOTAL: 34	100%
<hr/>		
n=34		
Non-consensus responses = 2		

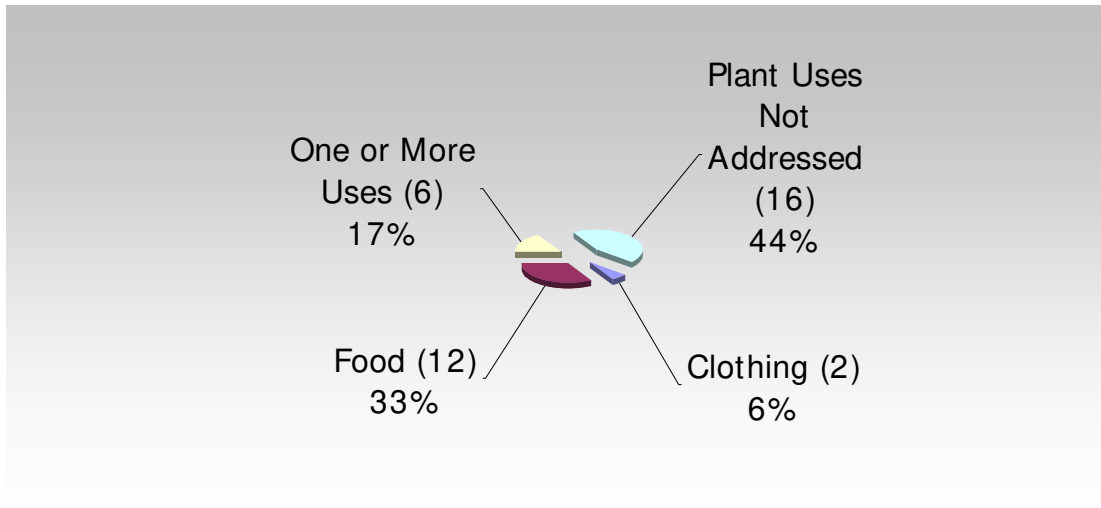
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as a primary source of materials for everyday products in 16 of the 36 books. *The Shaman's Apprentice* by Cherry and Plotkin (1998) and *A Weed is a Flower* by Brandenberg (1963) present many examples of plant uses. The following are excerpts from each of the stories.

“Every day Gabriela followed the shaman through the forest and learned about the hundreds of plants he used for medicines; plants to cure earaches and stomachaches, snake and insect bites” (Cherry & Plotkin, 1998, p. 26).

And even though people in those days called peanuts “monkey food,” Professor Carver said they were good for people, too. Besides, he found that still more things could be made from peanut. Paper, ink, shaving cream, sauces,

linoleum, shampoo, and even milk! In fact, he made three hundred different products from the peanut. (Brandenberg, 1965, p. 24) Figure 4.7 presents the range and frequency of the plant uses that were identified by text and/or illustrations.



**Figure 4.7. Plant Uses as Presented in Text and/or Illustrations**

### Research Subquestion 3

What types of science graphics and artistic innovations are found in these books?

In order to simplify answering the questions, the original subquestion question 3: “What types of science graphics, artistic innovations, and story plots are found in these books?” was divided into two questions; one relating to the books’ graphics, the other relating to the text.

The science graphics analyzed were comprised mostly of the graphics identified by the National Geographic Society, *Inside/Out: The Best of National Geographic Diagrams and Cutaways* (2001) as being the best examples from the last 30 years.

Definitions of each type of science graphic are found in Chapter 1. The type of science graphic that was coded the most frequently was a cutaway diagram with 21 examples in 7 different books. The second most frequently occurring science graphic was sequence diagrams with 19 examples in 5 books. One book had three examples of flap-tab graphics. This book also contained one pop-up graphic. Another book presented an example of a photo-realism graphic. There were no books coded as having an exploded view or a gatefold diagram. Twenty-three books were coded as having none of the targeted science graphics. Table 4.18 presents the types of science graphics, the number of science graphics, and the mean of the occurrences.

**Table 4.18.**  
**Type of Science Graphics Identified in the Books**

Graphic Type	Number of Books With Science Graphic	Number of Science Graphics	Mean
Cutaway	7	21	3.0
Exploded-view	0	0	0
Flap-tab	1	3	3.0
Gatefold	0	0	0
Photo-realism	1	1	1.0
Pop-up	1	1	1.0
Sequence Diagrams	5	19	3.8
Zoom	3	4	1.3
TOTAL:	18	49	2.5

The illustrations for the most part were in complete color, and that included 31 of the 36 books. Two books were illustrated using black and white and 1 book alternated with two pages of black and white illustrations followed by two pages of colored illustrations. Two other books also were illustrated in black and white, with an occasional repeat of an added spot color. One book was illustrated with green, yellow, blue, and black.

“Identifying Innovation Graphics of Plant Science” data sheet question 1 sought information on the artistic innovations in the books. An artistic innovation is a new or skillfully creative form of illustrating. Thirteen books were coded as having an artistic innovation. Several books presented unusual point of views or visual perceptions such as birds eye view, a ground level view, or view through an unusual setting such as from an airplane or inside a hollow tree. Another book presented a panoramic view where the entire city block appeared almost circular. Three books used “dream” or “thought” clouds to visual what the characters were thinking. In all cases their thoughts were about plants. Another book presented artistic innovations through the use of natural materials such as pressed “seaweeds,” sponges, and sands along with molded translucent clay objects and plastic resin to represent seawater so realistically that the books pages almost look wet. Glimpses of the past were also presented in 2 books; one as footprints in the sand revealing that someone or something had passed this way before and the other as in faint, almost invisible forms of creatures from days long gone. Sunflowers, tracking the movement of the sun, were also an example of an artistic innovation coded in one of the books. The sunflowers with their faces to the sun were presented in three sequential diagrams; as the sun moved so did the sunflowers.

#### Research Subquestion 4

What types of story plots are found in these books?

In order to answer Research Question 6, “Identifying Innovative Graphics of Plant Science” questions 3 and 4 sought information on the story plot and botanical aspects of the books. This information was unitized and then used to create categories pertaining to story plot, characters, and setting.

The story plot was categorized as either a plot where a problem occurs followed by a solution to the problem or as a main event and/or a series of events occurring. In 24 (67%) of the stories there was a problem presented, followed by a resolution to this problem. Examples of these problems included the guilt and resolutions of a young boy after destroying of a neighbor’s garden; two children attempting to discover what had happened to their lost plants; disputes settled between neighboring villages through the use of plants as “peace offerings”; and the eagerness or apprehensive emotions of a novice gardener.

The plot of 12 stories involved a series of events or one main event. Some events were simple; some were complex. One plot described the life of a log as it falls to the ground where it slowly decomposes over time. In this same spot a fallen acorn sprouts and begins the cycle of a log’s life again. Other plots revealed the plant-science happenings that occurred in famous people lives such as George Washington Carver or Johnny Appleseed. Several plots focused on the lives of plants or seeds from germination to full growth.

In all of the books, the plot of the stories focused on plant-centered conclusions, regardless of whether or not the character(s) of the stories were plants or people. Some of the stories with conflict/resolution scenarios also depicted characters that experience

dynamic character changes. In 10 of the stories, the character's disposition toward plants changed due to the botanical events of the story.

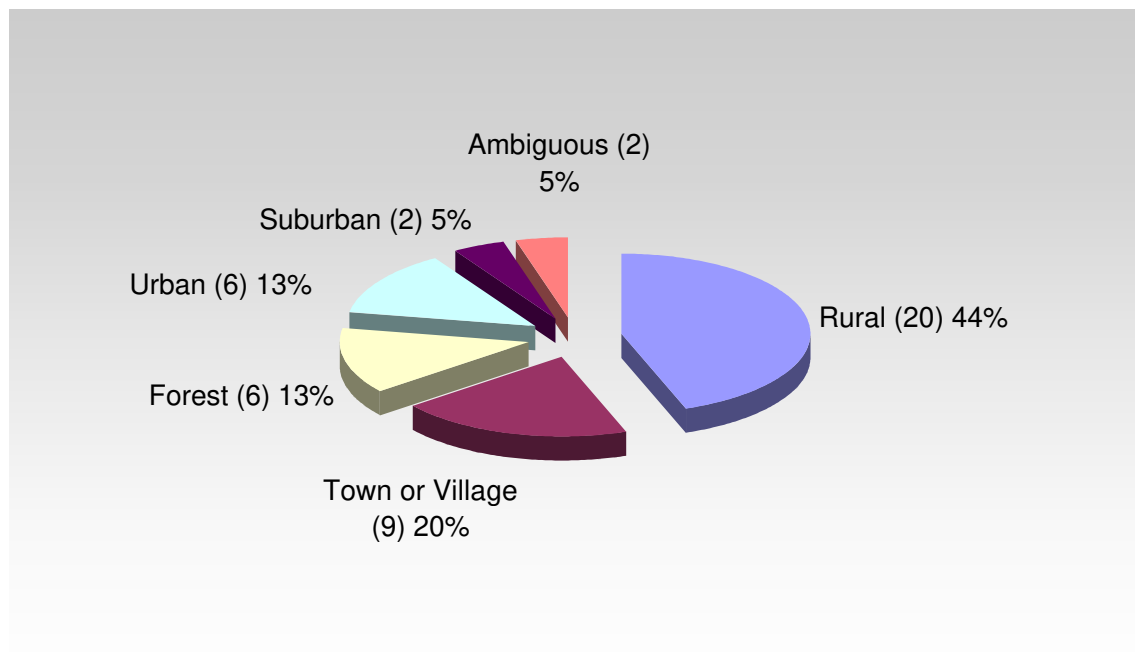
The characters of the stories were divided into four main categories: people, animals (personified), plants, or plants with people. The majority, 56% of the plots, depicted people as the main characters. These characters were coded according to ethnicity as "Caucasian", "African American", "Hispanic", or as indigenous people. In each of these stories there may have been other races of people, but the main characters were the coded race. The story plots included "Hispanic" characters in 4 stories, "African American" characters in 2 stories, indigenous people in 1 story and 16 stories with "Caucasian" characters. Animals personified were the characters in 3 of the stories. These personified animals included a diversity of animals such as cats, worms, birds, rabbits, bears, turtles, and beavers. There was one story plot that had only plants as the main characters in the story. Nine other story plots included people illustrated in the books, but the main character(s) were plants. Table 4.19 presents information about the characters in the stories.

The settings of the stories were categorized as urban, suburban, rural, town or village, forest, and/or ambiguous. Stories were found most frequently to occur in rural areas with 20 occurrences, followed by towns or villages with 9 occurrences. There were an equal number of urban settings and forest settings with 6 each. Two settings occurred in suburban settings and 2 settings were ambiguous. One of the forest settings included an aquatic forest. Some stories were coded as having more than one setting. Figure 4.8 presents the type of settings, the number of settings, and the percentage of occurrences where the stories took place.

**Table 4.19.**

**Character(s) in Stories of Plant-centered Children’s Picture Books**

Character	Number of Occurrences	Percentage of Occurrences	
People	Caucasian	16	44%
	African American	2	6%
	Hispanic	4	11%
	Indigenous	1	3%
Animal(s) personified	3	8%	
Plants with people illustrated	9	25%	
Plants only	1	3%	
<b>TOTAL:</b>	<b>36</b>	<b>100%</b>	



**Figure 4.8. Settings of Stories in Plant-centered Children's Picture Books**

### Research Subquestion 5

What resulting research-based recommendations and rubrics can be offered to assist parents, teachers, and librarians in identifying, evaluating, and using such books to help children ages 4-8 learn about and enjoy plants and plant science?

There are hundreds of new children's science picture books on the market today, such that discerning a book that both entertains and educates is a challenging task. Many books burden the child with a plethora of science facts or the illustrations are so overpowering to the text that the child cannot *hear the words* for the *noise of the pictures*. Such books often have disjointed storylines, so that any page could be the beginning or ending of the story, and the artwork is "artwork" just for the sake of itself. Thus, how does one go about selecting quality plant-centered books to help children ages 4-8 learn about and enjoy plants and plant science? The researcher offers five recommendations and has created two rubrics to facilitate in the selection process.

**Recommendations.** First, the book should be developmentally appropriate. The setting, plot, and theme should be relatively familiar and understood by an audience of children. It is important that story elements be relevant to the current knowledge, maturity, and reasoning ability of the children. No two children will construct precisely the same understanding and meaning when they are presented with the same book, thus assessing the prior knowledge of the children is fundamental before prior to book selection.

Second, the book should have potential literary value by being both meaningful and enjoyable to read. The book should involve the children, either as listeners or readers, in many strategies, from gathering the facts of the story, to making predictions about the outcome, to checking one's hypotheses against the unfolding details of the



story. Important concepts should be conveyed within a dynamic context so that the facts become part of the children's cognizance.

Third, the information (especially the science) should be presented in carefully sequenced order, and be accurate and valid. There should be a harmonious balance between the text and the plant illustrations. The way of life or culture of other persons should be depicted in "true-to-life" fashion. The book should distinguish between plant fact and supposition. The plant science must contain plant science principles and standards that will serve to educate, as well as entertain the children.

Fourth, there should be an avoidance of all stereotypes or bias. Children's literature has definite potential in the affective domain to influence the children's attitudes and interest (Krathwohl, 1964).

Finally, the message should be of lasting value, merit the attention of the audience, and promote positive attitudes that society thinks children should eventually assimilate as a citizen. It should instill in children an appreciation and awareness of our dependency on plant life. The book may also allow the children to gain an understanding of ecological issues, the benefits of other cultures knowledge through the study of ethnobotany, and the economic connection between plants and people.

**Rubrics.** For most educators, a rubric is a set of scoring guidelines to evaluate the overall quality of work performance or a product. The evaluation is based on the sum of a full range of criteria, rather than a single numerical score (Family Education Network, 2000). In this study, the rubrics are tools to evaluate the overall story, and to evaluate the botanical science in children's picture books for ages 4-8.

The first rubric (see Appendix J) evaluates the overall quality of a plant-centered children's book. This rubric addresses the major components of a story, such as the

introduction, organization, setting, and characters. The components are labeled as categories on the rubric and each one has a unique set of criteria to with which that component is evaluated. Each level of criterion quality, ranging from 4 being the highest to 1 the lowest, is mutually exclusive.

The second rubric (see Appendix J) evaluates the degree to which the book addresses plant science concepts and principles identified by the American Society of Plant Biologists (ASPB, 2002) and the National Science Education Standards (NRC, 1996). The plant science concepts and principles evaluated are basic plant needs; root, leaf, flower, and seed plant structures; external signals; plant diversity; environmental stress to plants; the value of plants in our society; and plant awareness. As with the storybook rubric, these levels of criteria are also mutually exclusive.

These rubrics do not yield dichotomous ratings as being either good or bad, because all books do not lend themselves to each category addressed on the rubrics, especially the botanical science rubric. These rubrics merely serve as a guide for evaluating the plant science concepts and principles for children ages 4-8.

As with any book evaluation tool, the researcher suggests that the evaluator read the rubric and book completely at least once before beginning the evaluation. The evaluator may also want to have other persons to evaluate the story and then compare the evaluations.

CHAPTER 5:  
SUMMARY AND CONCLUSIONS

Statement of the Problem

Children are influenced by their environment, by the information they receive about plants in their lives, as well as by media, such as children's science picture books. Thus, a content analytic investigation of the plant science children's literature can serve as a tool for increasing plant awareness by making good use of this popular body of literature. Because no such study had been conducted previously, the current study was concerned with identification from 1950 to 2003, the time span of this emergent genre.

Purpose of the Study

The purpose of this study was to locate, examine, categorize, describe, and pinpoint the plant science learning potential and pitfalls (both verbal and visual) of children's science picture books that have a plot and characters.

Delimitation of the Study

The delimitations of this study consist of the examination of children's fiction wherein plant science is the underlying theme of the story. The picture books included in this study were written and published in the English language between 1950 and present, and were written for an audience of children, ages 4 through 8. Rhyming books were not included in this study. The target books were located through extensive on site searches at four major, nationally recognized centers of excellence, as described previously, and secondary identification of targeted books radiated from a snowball search strategy originating at the four major centers and their associated experts.

## Methods

This study employed Neuendorf's (2002) method of content analysis and Tashakkori and Teddlie's (1998) mixed methods research design. The sample analyzed in the present study encompassed 36 children's fiction picture books published between 1959-2002. These 36 titles were identified by the author after spending a significant amount of time searching within four selected nationally recognized children's literature collections, as well as, through secondary searches which included, local public libraries, computer databases, and inquiries using children's book guides including *A to Zoo: Subject Access to Children's Picture Books* (Lima & Lima, 1998), *Best Books for Children: Preschool Through Grade 6* (Gillespie, 1998), and *From Cover to Cover: Evaluating and Reviewing Children's Book* (Horning, 1997), among others.

The instrument used in the analysis of books for this study was created by the author using the National Science Education Standards (NRC, 1996) and the Principles of Plant Biology (ASPB, 2002) as a guide . The researcher also created a data sheet to code the type of plant science graphics and artistic innovative illustrations of these books using *Inside/Out: The Best of National Geographic Diagrams and Cutaways* (NGS, 1998). Coders with expertise in children's literature and/or in plant science coded 17% of the target books, which allowed the author to establish intercoder reliability. The author coded the entire set of target books. The responses of the coders and the author were tabulated and the results were presented in Chapter 4.

## Summary of Findings on Research Questions

### Primary Question

What will an exhaustive search for, and a focused content analysis of, plant-centered children's science picture books that have a plot and characters reveal about this emergent genre of children's literature?

Some of the best storybooks that have ever been written were written about plants. This emergent genre of children's literature may be small in size (for now), but is certainly powerful in presentation. Books, such as *The Shaman's Apprentice* (Cherry & Plotkin, 1998), *Home Lovely*, (Perkins, 1995), or *The Hidden Forest* (Baker, 2000) do something for the reader (or listener); they invite one to become part of the story. The text and visuals are such that the book evokes a positive response; a response that may be unique to each individual. It is very likely that books such as these will be read over and over, and each time it is read something new will be gained from the reading.

The following are statements on the emergent genre of plant-centered children's picture books that have a plot and characters--as used in this study, along with the researcher's comments on these findings:

1. Plant-centered children's picture books that have a plot and characters are a small subset of children's plant science picture books. The 36-target-book set analyzed in this study was selected from over 300 plant science children's picture books. These 300 plant science children's picture books, and those, in turn, were selected from over 1,000 book summaries relevant to the subject of plant science. As an educator, librarian, or parent, one must be aware that just because a book has a plant on the cover or in the title, it may not be about plants or be a book that a child will relate to, or actually enjoy. The crucial test in selecting a plant-centered children's picture book is that it have a story

with characters. There must also be a sequence of events that either involves plants or people interacting with plants. The book must have a compelling story with a beginning and an ending not just pictures that pair isolated fact after fact.

2. Eighty-one percent of the books in this genre were published since 1980, and 64% were published between 1990-1999. Six percent were published in the 1950s, followed by 11% in the 1960s, 3% in the 1970s, 11% in the 1980s, and 6% between 2000-2003. There has been a gradual increase across the last 15 years. Hopefully, through studies such as these, authors will begin to rise to the challenge of writing and illustrating high quality plant-centered children picture books that have a plot and characters.

3. The majority of the books analyzed in this study presented three or more types of plants in the story or illustrations. Forty-four different types of plants were presented in these stories, with the tomato plant being the one most frequently presented. This number of plant species seems commendable for only 36 books. However, for children to truly appreciate and to understand the vastness of plant diversity, this number probably needs to increase quickly. With the world's approximately 270,000 known species of plants, and 12.5% of them considered endangered, 36 books with 44 different types of plants just does not seem adequate (Stevens, 1998).

4. Only two authors published more than one book within the time span of this study. It is a fact that plants provide the foundation of life on this planet. Authors and illustrators have an overwhelming responsibility to help children learn about them and appreciate them.

5. Eight of the 36 books in this study won book awards or honors. At the current time, there is only one award that specifically honors books in this genre-plant science picture books that teach scientific principles in harmony with their illustrations, and that

is the Giverny Award, which has been given for the past six years (See <http://www.15degreelab.com>).

### Research Subquestion 1

What types of botanical subject-matter knowledge and plant science learning opportunities are offered by these books?

The plant-centered picture books analyzed in this study offered various forms of plant science topics. Diverse ethnic cultures and how their society interacts with plants were presented. Multiple plant disciplines, such as agriculture, horticulture, ecology, and ethnobotany, among others were presented. The stories appeared to represent three plant biomes; desert biomes, forest biomes, and grassland biomes. Stories focusing on aquatic biomes were underrepresented and tundra biomes were not represented at all.

The following are statements on the types of botanical subject matter knowledge and plant science learning opportunities offered by these books, along with the researcher's comments on these findings:

1. There were eight types of botanical subject-matter knowledge and plant science learning opportunities offered by the plant-centered children's picture books analyzed in this study: biodiversity of plants; characteristics of plants; life cycles of plants; economic botany; ethnobotany; ecology; agriculture; and horticulture. The preceding categories may not be inclusive of the botanical aspects presented in the books analyzed in the study, but they were the most often occurring and the major types of botanical subject matter knowledge offered.

2. Biodiversity of plants, which include threats to biodiversity and conserving biodiversity, was offered by 6 books of the 36 books. Animal biodiversity, overshadowing plant diversity in some cases, was also presented randomly in the plant-

centered plant science picture books. Even though it seems only animal extinction makes the ‘news’, is not it due to lack of plant life that often causes animals to become extinct? *When the Monkeys Came Back* by Franklin (1994) presents an excellent story of plant-animal ecology. The trees were destroyed, which in turn forced the monkeys to leave also. Children need more books of this nature that may help them comprehend this delicate balance in nature.

3. The characteristics of plants, which include growth, form, and appearance; growth requirements; growth rate; and/or reproduction propagation, were offered in 11 books. Five books offered the life cycles of plants, which include germination, growth, and development, and 2 of these books also addressed plant longevity.

4. The monetary value of plants or economic botany was presented 12 times in the 36 books. In industrialized societies, such as ours, the botanical processes of production to consumption are so complex that many adults have little understanding of plant origins, thus neither do children. Building a house with lumber may have a different meaning to a child than building a house with trees. The only *cotton boll* that some children can relate to is a white fluffy *cotton ball* taken from a plastic bag. In the story *The Tomato Patch* (Wondriska, 1964), two young boys argue confidently with another child that tomatoes come pre-packaged in cans; because that is the only way they had ever seen them. Authors, parents, teachers, and librarians must help bridge their gap of understanding between the raw plant product and the finished plant product.

5. Three books offered the learning opportunity of ethnobotany or the study of the relationship between plants and people. Indigenous peoples have retained much knowledge concerning plants, that our society has abandoned. There is a 25% chance that the medicine bought at the local pharmacy today has an active ingredient derived from a



plant, and this plant-derived drug was discovered through the knowledge of indigenous peoples—the ethnobotanical approach (Balick & Cox, 1996).

6. The ecological learning opportunities offered in this study include deforestation, invasive plants, and destruction or alteration to plant or animal habitats. Ecological learning opportunities were identified in 6 out of the 36 books. This topic, though maybe rather advanced for children ages 4-8, is of utmost importance in our world today. Children have the means to contribute to the destruction of plant life, even if the destruction is localized. Brisson (1998) and Baker (2002) present stories where the characters, which are children, experienced the importance of ecology first-hand. The characters are positively transformed from careless, mindless, arrogant children, into characters who are sensitive and appreciative of plants. Plant-centered science picture books with characters and a plot have this power! When children read about negative learning experiences of other children, such as the guilt suffered by a young boy after destroying his neighbor's garden or seeing the ugliness of a littered landscape for the first time, the story may cause the children to become a better plant stewards.

7. The subject matter of agriculture was presented in 5 of the books analyzed in the study. The learning opportunities presented include commercial farming of Christmas trees; the business of cultivating soil and planting crops for experimental purposes; growing plants for clothing purposes; among others. The books also presented different means by which farming methods may occur, such as through the use of heavy equipment or machinery, animals used to pull farming implements, and of course, by the hands of people with and without tools. Past and present methods of agriculture were presented, however not one book made reference to innovative/future methods of farming such as the use of hydroponics.

8. Fifteen of the 36 plant-centered stories offered the learning opportunity of horticulture or the cultivation of fruits, vegetables, or flowers. In all of but of three of these stories, the characters were children or animals personified. Children, who are read or read a story where the characters are of their similar age, the children may be more inclined to take the role of the characters in the story, than if the characters were adults. Because of exposure to careers choices at an early age, children may quickly complete the phrase ‘when I grow up.’ Richard Evans Schultes describes his fantasies as being an ethnobotanist, when he was read stories about the Amazon forest as a child. Children who are read or read stories about growing beautiful fruits, plants, and vegetables may fantasy themselves as being horticulturists when they become adults (Kandell, 2001). As stated previously, plant-centered children’s picture books with a plot and characters, have influencing power! These books have the potential to influence children’s aspirations and dreams. Consequently, authors/illustrators need to produce more high quality plant-centered children’s picture books that focus on botanical science careers.

### Research Subquestion 2

What is the range and the frequency of occurrence of national standards-consistent and age-appropriate plant science concepts and principles found in these books?

The following are statements concerning the range and the frequency of occurrence of national standards-consistent and age-appropriate plant science concepts and principles found in these books, along with the researcher’s comments on these findings:

1. Plants were presented as *living* in 44% of the books, followed by *living, dying, or dead* in 39% of the books. The American Society of Plant Biologists principle number

nine reads, “Plants, like animals, are subject to injury and death due to infectious diseases caused by microorganisms” (ASPB, 2002). The 5<sup>th</sup> principle, which describes how plants are like people and animals in that they respire, and utilize energy to grow and reproduce, and die, may also be difficult for children to comprehend.

Forty-percent of the books presented biotic stress or stress caused to a plants by insects, animals or humans, diseases from bacteria or fungi as the most often occurring type of stress to plants. Eve Bunting (1993), in the story *Someday a Tree* presents a disturbing and sad story of how a tree dies from biotic causes (poisoning). Parents, teachers, and librarians, who present this plant concept to young children, may actually help prevent stress or premature death to plants (especially small plants).

2. The majority (89%) of the books did not address photosynthesis or the ability of a plant to make its own food. This is a major disparity concerning the plant science concept-photosynthesis in this emergent genre of plant-centered children’s picture books. Only concerned authors and illustrators can fill this gap. The concept of photosynthesis need not be presented as a complex idea, but presented simply as the plant’s ability to use energy from the sun, along with other elements, to make their own food.

3. The basic needs of plants coded in some identifiable form in the books were determined as follows water (61%); sunlight (39%); space (31%); temperature (31%); nutrients (19%); and air as (14%). The basic plant needs of nutrients and air were also identified as gaps in the range and frequency of occurrences of national standards-consistent and age-appropriate plant science concepts and principles found in the books analyzed in this study. Again, the only people who can fill this gap are the authors and illustrators of plant-centered children’s picture books.

4. The basic plant structures coded in some identifiable form in the books were roots (50%); leaves (100%); flowers (75%); and seeds (70%). It appears that the concept of basic plant structures is adequately presented in this emergent genre of children's literature. It would be amenable however, if the plant structure of roots was addressed more often in future plant-centered children's picture books.

5. Twenty-seven books were coded as presenting some form of plant reproductive structures. The reproductive structure, seeds, was coded the most often occurring in 25 of the books. The reproductive structures, stems and bulbs, were each coded in two additional books. Plant reproductive structures, one of the strengths of this genre of children's literature, was presented in 75% of the books analyzed in the study.

6. Sixty-seven percent of the books presented more than one form of plant diversity and 78% of the books presented this as varying from heights of less than one foot tall to over five feet tall. Plant diversity was also strength of this emergent genre of children's plant science literature.

7. Thirty-six percent of the books presented external signals. The external signal of light with plants growing toward the light source was identified in one book (3%) as the only external signal presented in that book. Plants responding to a touch source such as plant vines or tendrils was the only external signal presented in two books (5%). Plant roots growing downward or toward gravity was found in four books (11%) as the only external signal presented. In six books (17%) there was a combination of two or more examples of plants responding to the identified external signals. The concept of external plant signals affecting plant growth was a major gap in the books analyzed in this study. This gap, most likely, is not due to the difficulty of presenting this concept, but rather simply because authors and illustrators have not been made aware of the importance of

children learning about how external signals affect plant growth. Hopefully, books written, illustrated and published this year will begin to fill this gap.

8. Plants used as animal habitats were coded in 23 (62%) of the books analyzed in the study.

9. Plants were coded as a primary source of material used in products of everyday use by humans or characters personified in 20 or 56% of the books analyzed in the study.

### Research Subquestion 3

What types of science graphics and artistic innovations found in these books?

The following are statements on the types of science graphics and artistic innovations found in these books, along with the researcher's comments on these findings:

1. Six types of science graphics were found in 13 books used in this study. Cutaways, coded in 19% of the books, were found most often, followed by sequence diagrams in 14% of the books and zoom graphics in 8% of the books. There was 1 book (3%) coded with flap-taps and a pop-up graphic. There was one book (3%) coded with a photo-realism graphic. A few of the books had more than one type of science graphic. There were no examples of an exploded view or gatefold graphic in any of the plant-centered children's science picture books. Sixty-four percent of the books did not have any of the science graphics targeted. Certain science graphics, such as pop-up, flap-taps, or gatefold, may be a major cost factor for authors and illustrators when publishing a book. However, it seems there should be no additional cost for illustrations of the other innovative science graphs. As stated previously, maybe the reason that these types of graphics have not been used is simply because illustrators and authors are unfamiliar with them. Again, hopefully, concerned parents, teachers, librarians, authors, and illustrators

will share the findings of this study, and a change toward using innovative plant science graphics will be soon forthcoming.

2. Eighty-six percent of the books were illustrated in full color. All of the books published after 1970 were in full color. Three percent of the books were illustrated in black and white and 8% were illustrated mainly in black and white with an occasional repeated color. Green, yellow, blue, and black were used to illustrate one book or 3%.

3. Artistic innovations, new or skillfully creative forms of illustrating, were found in 13 books. These artistic innovations included an array of forms such as unusual point of views; “dream” or “thought” clouds used to visualize what the character(s) was thinking; use of natural materials to realistically illustrate scenes; glimpses of the past; and illustrated forms of plant characteristics.

#### Research Subquestion 4

What types of story plots are found in these books?

Plant-centered children’s picture books can improve a child’s ability to understand. Children often find it easier to follow ideas that are presented in the story plot than to understand factual information (Butzow & Butzow, 2000). Fictional stories also have the power to promote positive scientific attitudes because children see scientists as ordinary people interacting with science as part of their everyday lives.

The following are statements on the story plots and characters found in the 36 books analyzed in the study, along with the researcher’s comments on the findings:

1. The majority of the story plots (67%) presented a plot with a problem followed by a solution to the problem. Thirty-three percent of the story plots involved a series of events or one main event. Twenty-eight percent of the story plots revealed a dramatic change in the disposition of the character’s personality. The change in the character’s

disposition was most often directly influenced by the interaction of the character with plants in their environment.

2. Of the characters in the stories, the most frequently coded race was “Caucasian” with 44%. Eleven percent was reported as “Hispanic” and 2% as “African American”. Indigenous peoples were reported as the characters in 3% of the books. Animals personified were reported as the characters in 8% of the books. The category, plants with people illustrated, was reported in 25% of the stories and the category, plants only, was coded in 3% of the stories. It appears there is a gap in the ethnic composition of characters in this emergent of children’s literature. There is a need for more African American characters, as well as other minority characters. Plants support the entire human race; thus the entire human race should be represented in plant-centered children’s picture books. There is also a need for more characters represented by Indigenous peoples.

3. Events of a story will often occur in more than one place. The settings of the stories analyzed in this study most frequently occurred in a rural setting (44%), followed by a town or village area (20%), and in an urban or forest area each with 13%. Five percent of the settings were coded as suburban and 5% were ambiguous or unidentifiable. This finding was as expected given the larger diversity of plant life in rural areas as compared to the diversity of plant life in a suburban or city setting.

#### Research Subquestion 5

What resulting research-based recommendations and rubrics can be offered to assist parents, teachers, and librarians in identifying, evaluating, and using such books to help children of ages 4-8 learn about and enjoy plants and plant science?

The following are statements regarding research-based recommendations and the use of rubrics to assist parents, teachers, and librarians in identifying, evaluating, and using such books to help children ages 4-8 learn about and enjoy plants and plant science:

1. The book should be developmentally appropriate. Its story should be conveyed with a dynamic context so that the facts become part of the child's cognizance. Therefore it is important to assess the prior knowledge of a child before selecting the book because no two children will construct precisely the same understanding and meaning from the context of the same story. For botanical children's literature to significantly impact a child's personal understanding of the plot, structure, theme, and illustrations must have potential meaning for the child.

2. The book should have plausible literary value that is both enjoyable and meaningful to the child. The story should engage the child either as a listener or reader in strategies of gathering facts of the story, making predictions about the outcome, and checking their own hypothesis against the unfolding details of the story.

3. The plant science of the story should be sequentially ordered, accurate, valid, and as current as possible. There needs to be a harmonious balance between the text and the plant illustrations. Look for books that offer realistic plant science diagrams and cutaways that provide alternative visuals of science concepts and principles. The book needs to differentiate between plant fact and supposition.

4. The book should avoid all stereotypes or bias. Many books used in this study followed this recommendation through the use of animal characters personified. In this aspect there was no affiliation to race and in most cases neither to physical size or gender. Children's literature has definite potential to influence the child's attitudes and interest.



5. The message should have lasting value, merit the attention of the child, and promote a positive attitude that society feels the child should eventually assimilate as a citizen. It should instill in the child an appreciation for plant life and an awareness of our dependency on plant life. This may be done through books with character(s) who undergo dramatic character change due to personal interactions with plants. This type of story often offers a child the opportunity to experience adverse situations in non-threatening settings. And finally, choose books that have the potential for the child to gain an understanding of ecological issues; the value of learning about other cultures and their relationships with plants; and the economic importance of plants in our lives.

6. The use of rubrics to evaluate plant-centered children's picture books will assist parents, teachers, and librarians in identifying, evaluating, and using such books to help children ages 4-8 learn about and enjoy plants and plant science. These rubrics evaluate categories of story components and plant science concept and principle.

### Conclusions

Fiction, through the use of children's picture books, has a cognitive and affective appeal by creating characters with whom children can identify, with whom they can share vicariously, whose behavior they can imitate, and whose viewpoint they can accept or reject. Through written words and illustrations children are allowed experiences which they may be unprepared for in life in a focused, intensified form because fiction is able to provide the reader (or listener) both distance and intimacy. Through fiction, children become both participant and spectator, moving about in the symbolic, fictional world of the story, reflecting on their own perspectives, predispositions and life experiences. Depending on what the story presents, the story plot may compel the child or children to reevaluate their own experiences (Norrestrand, 1991).

The major conclusion of this study is that this small genre of plant-centered children's science picture book literature has the potential to reveal to children that plants are the material basis of our culture and that it is plants that provide the life-sustaining elements needed to survive on this planet. These books written between 1950 and present, the inclusive dates of the study, reflect plant science concepts and principles that are viable for children to gain an appreciation and understanding of plants in their lives. The books chosen through the efforts of this study can contribute to improving the nation's science literacy. It can also help children to appreciate what botanists study and imagine themselves doing science.

The 36 books analyzed in the study do this by presenting the basic plant needs of water, air, temperature, sunlight, and space; by describing plant structures and the reproductive structures of plants and the uses of these plant structures; by revealing the complex role of plant decomposition as a cycle of plant life back into the environment; and through the use of story plots where characters interact with plants. These 36 books also present various botanical aspects of plants that include biodiversity, economic botany, ecology, and Ethnobotany.

Children's exposure to plant biodiversity is often limited to exposure of plants in their own environment. These books present a vast array of illustrated biodiversity accompanied along with texts that describe the biodiversity relating to 64 plants. The biodiversity included topical rainforest biodiversity, deciduous and evergreen forest biodiversity, aquatic biodiversity, and desert biodiversity, among others.

The books describe and illustrate scenarios relating to the economic value of plants from the planting of seeds to harvest and the finished product. Understanding

economic value may be difficult for to children to conceptualize because often the finished product is drastically different from the initial plant.

The books also provide children with opportunities a glimpse into other cultures and the relationships of plants to indigenous people. Through the stories children have an opportunity to compare and contrast how they use plants in their lives to how indigenous people use plants.

Another complex issue offered by these books is the time necessary for plant growth and development and longevity often associated with plants. Time is often abstract for children. These books allow the children to visualize germination, plant growth, and development in a matter of a few minutes through the reading of 28 to 32 pages. In reality this period of growth occurs in a few days to hundreds of years.

Plant years are not always equal to human years. The books allow children to compare the growth rate and longevity of plants to people. The conceptual understanding of time relevant to plant life may enable children to realize that the actions taken today may have lasting repercussion for years to come.

The books analyzed revealed many artistic innovative graphics and plant science graphics. These types of well-organized graphics allow the children to grasp the totality of the whole rather than isolated parts of the whole. Flap-taps or cutaways may allow the children to understand the relationship of the roots to some of the basic needs of the plant. Sequence diagrams reveal how a plant changes over time. Zoom diagrams magnify the complexity of plants and show what otherwise might be unable to view with the naked eye.

## Implications

The author was pleased to have been able to research an area of children's literature, that of botany, which had not been explored in dissertation, journal, or article form to date, thus adding to the body of knowledge existing on children's literature. This dissertation presented research on this unexplored content area in children's literature in the form of a content analysis, a format that, according to the experts whose work are presented in Chapter 2, is lacking in children's books. The dissertation also includes an annotated bibliography of books with a focus of botany with a plot and characters which the author hopes will serve as an additional reference for teachers, librarians, parents, researchers, or any others who are interested in this particular topic.

This dissertation connects another dimension, that of plant-centered science picture books, to existing research on increasing children's awareness of plants. It reflects the investigations of Reiss and Tunnicliffe (1999) and Schussler and Wandersee (1998) as it takes its place among critical issues of botanical research. This dissertation also provides a source of information to those who read it which the author hopes will help them to enable children to appreciate plants through children's books.

This study presented a format for gathering botanical data, which the author believes, will be easily replicable in future studies of plant science in children's literature, as well as for future updates of the present study. This dissertation incorporated electronic media, in the form of electronic searches, contacts made through INTERNET, and first hand investigations to gather information used in various parts of the research. The access to and utilization of various forms of media provided the author with a more far-reaching and up-to-date scope of information and resources than that which was available solely through print sources of information.

The instruments developed through the efforts of this dissertation can help authors, parents, teachers, librarians, and other persons of interest select the best books in this genre of children's literature.

Using the *Botanical Science Analysis Codebook* and the *Plant Science Analysis Rubric* the evaluator will be able to evaluate how well the book corresponds to what experts (NCR, 1996; ASPB, 2002) say children ages 4-8 should know and understand about plants. The principles, concepts, and plant standards presented in the children's literature may be scored according to a varied range of each unit allowing the coder to give each book an overall performance score.

The *Data Sheet: Identifying Innovative Graphics of Plant Science* will allow persons of interest to judge the plant science graphics of the book according to well-defined graphics (NGS, 1998). Graphics and illustrations are vital to a child's cognizance understanding, therefore it is equally important that there is a tool to identify and evaluate these graphics and illustrations.

The over-all story plot and characters can be evaluated through the rubric, *Assessing the Over-All Quality of Plant-Centered Children's Literature: A Picture Book Rubric*. This tool will allow the rater to judge the plot of story according to plant science merit and value and to determine whether the botanical events of the story work to bring about personal changes in the character's attitude, opinion, and beliefs. This rubric will also allow the rater to evaluate how well the story promotes vital botanical aspects such as ecology or ethnobotany. Selecting books that foster plant awareness through stories and vicarious experiences may add both depth and breath to children's knowledge about plants.

### Recommendations for Further Research

1. Studies should be undertaken which develop insight into children's responses to plant-centered children's science picture books to answer the following questions: "What type of story evokes what type of response from children?" "What type of graphic evokes what type of response from children?"

2. This study examined plant-centered children's books applicable to ages 4-8. Books of similar structure should be analyzed for a more mature age group to compare and contrast the books and to discover if there are trends, patterns, or underlying themes throughout highly visual, plant-centered literature.

3. Studies should be performed on the graphics found in plant science picture books to see which types have the greatest impact on children's interest in plant science and on science learning.

4. Efforts should be made to study and then improve local children's literature collections at school libraries, by adding exemplary plant science picture books from this genre that were identified at the national centers of excellence. Then, the science learning impact of these books can be studied and used by children in actual classrooms served by those libraries.

5. The sociocultural aspects of these books appear to have the potential to enrich plant science teaching and learning (economic botany, horticulture, agriculture, ethnobotany, disturbance ecology). A well-designed study may be able to identify the benefits of such sociocultural knowledge integration that accrues to learners whose plant science lessons are supplemented by selected books from this genre.

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## APPENDIX A: REFLECTIONS ON CHILDREN'S LITERATURE COLLECTIONS

### DeGrummond Children's Literature Collection, University of Southern, Mississippi

The de Grummond Children's Literature Collection at the University of Southern Mississippi was selected as the children's collection for the pilot study. For one reason, it was the closest literature collection to my home and two, the Children's Book Festival, which always takes place in the spring of the year, was held during my research. The Children's Book Festival added a little lagniappe to the study even though it did not reveal any plant-centered children's science books as anticipated. Before the visit I contacted the staff at the collection through email. Dee Jones, the curator, was most accommodating and seemed eager for me to visit their facility. She let me know however, that they would be very busy during the days of the Festival and that it would be best for them if they could pull the books that I would be using before my arrival. This sounded great to me! I discussed with her the details of my study and suggested a search of keywords.

The staff made me feel very welcome once I arrived. I was given a tour of the collection, a large table in a quiet area to review books, and unlimited access to the copy machine. The library was relatively empty even though the festival was in progress. There were never more than four people reading books at one time and these were all adults. The library was brightly lit with windows covering one entire side of the room. Even though these were covered in blinds, the light filtered through giving the room a comfortable, relaxing atmosphere.

I got to work immediately. First, I read the books cover to cover. One of the requirements of my study was that the books be published in 1950 or later. This collection was in part a historical collection so there were several books that were



published before this cutoff date. The page length of the books had to be between 24-38 pages. This also culled a few of the books. The story or plot of the books was my next consideration. So many of the books I found were more like science text than storybooks. They were factual with little or no creativity. This requirement omitted more books than any other, here and also at the other collections.

Over the next several days I read 99 books. I had a stack of most definitely “no”, a stack of “maybe”, and a stack of “yes”. It was only later, as I reviewed more and more books that my “yes” stack became “most probably”. I made detailed notes from 39 of the books. This information included the publication details, story characters, plot, and illustration details. The nature of the study required that I have the books in-hand, therefore I later purchased 13 of these books. Eight were used for the pilot study and three were included in the final book set for the content analysis.



I found it rather unusual that two of the books had the same title and the same author wrote four of the others. There were two additional books also written by this author, but they were not selected for the research because they were more factual than a story.

During my time there, I did take a little time to explore the exhibits and book displays of the many authors presenting at the festival. I did not however, see any books that I felt would be considered plant science literature or acceptable for my study. It seemed animals dominated the subject topics.

The permanent exhibit of Ezra Jack Keats was most impressive. Seeing his original artwork, transcripts, and the various steps that he went through before the finished product, instilled in me a great appreciate for his work. Many of the artifacts were personal centering on his career in the military and his work as a beginning author.



The results of my research at the de Grummond Children's Literature Collection inspired me and made me eager to continue my research. The variety of plant science literature located, through my efforts and that of the supportive staff, offered me a glimpse of what awaited me at the other children's collections.

The de Grummond Children's Literature Collection  
University of Southern Mississippi  
Box 5148  
Hattiesburg, Mississippi 39406  
Contact Person: Dee Jones, Curator  
Phone number: (601) 266-4349  
Email: [dee.jones@usm.edu](mailto:dee.jones@usm.edu)  
Web site: <http://avatar.lib.usm.edu/~degrum/>

Center For Children's Books, University of Illinois

I arrived at the Center for Children's Books, University of Illinois, on Monday of the week of Thanksgiving. The library, located in a semi-basement room approximately



30 by 60 feet, was neatly organized. Windows, which surrounded the higher part of one wall, were at ground level. Stacks of books were at ground level to the left of

the door. Directly in front of the door were rectangular tables with chairs and to the right of the tables were ceiling to floor stacks of books. The room was quite illuminated with both natural and florescent lighting.

There were only a few people in the library. On my first day of research, I was the only patron. The following days there were never more than three scholars there at a time and no children. This was due in part to the fact the library is located on a university, but also because the books are non-circulating.

As with the other libraries where I had conducted research, I notified them in advance of my coming. Janice Del Negro, Director of the Center, was most welcoming and accommodating. She gave me a tour of the facility, shared with me some of the center's history, and introduced me to the staff. She also directed me to the various book reviews that the center had to offer, the use of an on-line computer database, and complete access to the copy machine and break room.

I was not familiar with the *Bulletin for Children's Books*, a monthly book review published by the University of Illinois. Janice briefly instructed me as to how to search

for books by subject, title, year, or author in the *Bulletin for Children's Books*, as well as, in other reference books; *A to Zoo: Subject Access to Children's Picture Books* (Lima, C. & Lima, J., 1998) and *Best Books for Children: Preschool Through Grade 6* (Gillespie, 1998). I secluded myself at one of the four tables after my brief learning session.

The year 1950 and the subject heading, plants, is where I began my research. The subject headings, from there, were expanded to include such words as gardening, farming, trees, flowers, harvest, and etcetera. I read book reviews for the entire day. These reviews described concise summaries of the books that would later be pulled from the shelves to read and review. These reviews also allowed me to eliminate the books that would not meet the criteria of my study because they included the appropriate age levels and the number of pages of the books. As I read the book reviews, I made notes and copied certain pages that I felt would be helpful for my final selection of books. I had a list of books to read and review, which I shared with Janice at the end of the day. She told me she would have a staff person pull these books from the shelves and they would be waiting for me on the table when I arrived the next morning.

The next day was spent reading and reviewing books. I found that not all of the books that I read about the in the book reviews were appropriate for my study even though they met parts of the criteria; some had no plot or characters and other were more of a textbook than a storybook. There were a few books the staff was unable to locate, but I later found them at other libraries.



On Wednesday, the third day of researching at the center, I alternated from the on-line database, to the book reviews, to actually pulling and reading books from the stacks. In all, I read approximately 400 book reviews, read and reviewed 63 books, and finally decided upon 7 books that I felt would meet all the criteria including the plant science and concepts established for my study.

I feel the time spent researching at the Center for Children's Books was both productive and educational. The time there was productive, in that I located seven plant-centered children's science books for my study, and educational because I learned the use of the *Bulletin for Children's Books* to conduct searches.

The Center for Children's Books  
University of Illinois  
501 E. Daniel Street  
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Contact Person: Janice M. Negro, Director  
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Email: [delnegro@uiuc.edu](mailto:delnegro@uiuc.edu)  
Web site: <http://www.lis.uiuc.edu/~ccb/about.html>

## Central Children's Room: Donnell Public Library, New York

The Donnell Public Library is located in downtown Manhattan. Being from a small town, I can still vividly recall the atmosphere as I walked from my hotel about 4 blocks away to the library. There were cars bumper-to-bumper, engines roaring, horns honking, and people shoulder to shoulder on the sidewalks briskly walking to their destinations.

I arrived at the Donnell Library on a Monday shortly after the library opened. I entered through a set of revolving doors, was directed through a roped area similar to that of airport security, and waited for my bags to be checked. It seemed the library was rather busy for a Monday morning, but then again, was this activity merely a reflection of the activity on the outside? I quickly located a library guide and took the elevator to the Central Children's Room on the second floor.

Stepping off the elevator the first thing I saw was an enclosed glass case display of the original Winnie-the-Pooh characters: Pooh, with all his friends, Eeyore, Roo, Kanga, and Piglet. It was amazing to see how they had evolved through the years. The Pooh bear purchased at a local store today looks very little like the original patchwork Pooh.

Glancing to the left I saw a picture of Mary Poppins and in a smaller glass case her original umbrella. Stacks of children's books were in large open areas to the left and right of the elevator. Enclosed areas, presumably offices, were directly in front of the elevator.



As with the other libraries, I went directly to the librarian on duty and introduced myself. I shared my research and purpose of visit even though I had emailed the curator, Janne Lambe, several weeks before of my arrival date and purpose. The librarian working made no reference of this email. She identified the different stacks in the collection and directed me to a computer to conduct searches. She also informed me there were books on reserve stacks that were not for circulation, but she would pull any of these I wanted to see.

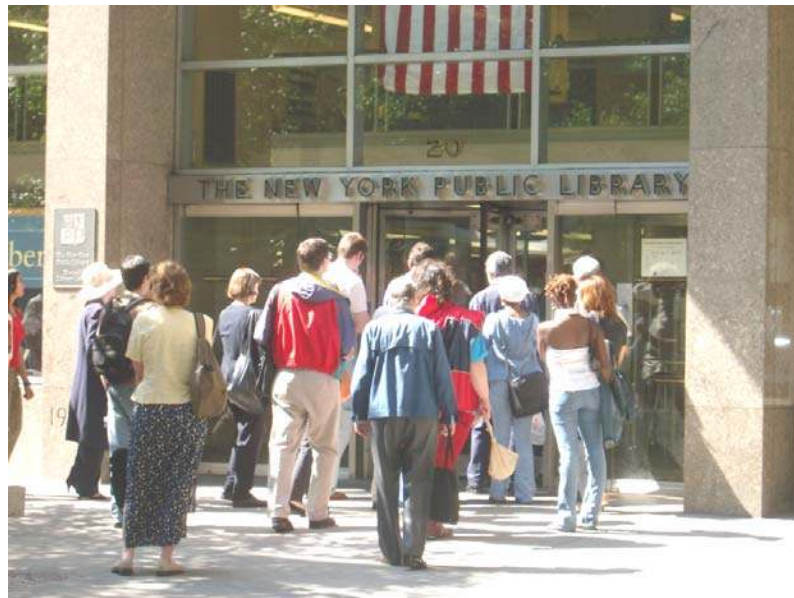
The computer she directed me to was the only computer available and it appeared quite old and to be running a DOS program. When I attempted to print a search, I discovered the printer did not work. The librarian then asked a young boy, who appeared to be playing a game, to allow me to use his computer.

This experience was repeated often throughout my stay at the library. I realized this was a children's library, so of course, children would be there, but what about children reading books. It seemed they were always at the computers. One instance involved 2 young girls, who looked to be between the ages of 8 and 12, and a man. They walked to a computer next to me, so I overheard their conversation. He said he would be gone for a few hours and if they needed anything they had his cell phone number and their mother's phone number. I suppose he was their father. He left them and they spent the remainder of their three hours at the computer.

The rest of the day was spent conducting computer searches and locating the books on the stacks. Various subject headings were used in the searches such as gardening, plant, tree, farming, botany, seed, and flowers. Finding the books was a bit confusing because the books were located in 4 different areas: children's room stacks, reading room stacks, children's room collection, and children's room reference.

On Tuesday, I along with approximately 50 other people, were waiting on the sidewalk for the library to open.

I quickly made my way to the second floor when the doors opened. All of the computers were available for searches so I took advantage of the moment. The search yielded four



pages of plant science books to review. I pulled several books from the stacks, found a quiet place to read and got busy. Today, it seemed, would be different. Time passed quickly and before I realized it the Central Children's Room was overflowing with children and adults.

There were children running all over the place some laughing, some crying, and some screaming. Glancing over at a computer I noticed a young child, around the age of 3 or 4, in a major confrontation with his mother. She was attempting to find him a suitable Internet site to explore and it appeared he was not happy with her choices. He hit her in the face while screaming and crying. Needless to say, she became very upset. She carried him into the restroom, then slapping and wailing screams were heard. And I thought yesterday was busy. The activities going on today were like a three-ringed circus. I soon discovered it was story time!



A few hours later the library was back to its semi-quiet state. Janne Lambe, the Curator of the library, and I had a lengthy conversation. I commented on the activity and the volume of people compared to the other libraries where I had conducted research. She was familiar with the other libraries, as well as their curators. “They have no idea how it is here, do they?” she replied exhaustedly. I couldn’t have agreed more.

We discussed my study in detail. I shared with her the principles of the American Society of Plant Biologists, the National Standards and Benchmarks, and the National Geographic book *Inside/Out: The Best of National Geographic Diagrams and Cutaways* (1998) that were guiding my study. She was most interested and offered to further assist me in my search. She located three books I had not previously discovered. It was rather unusual, but because of her assistance to me, she was exposed to a book that she had never read before. She later commented she might plan a story time to include plant literature to help increase awareness of plants in children.

At the conclusion of two full days of research I had read more than 300 on-line book summaries, read and reviewed 64 books, and compiled a list of 14 possible book titles for my content analysis. This list was only a “possible” list because many of these books were out of print and were not available to purchase. Even though it began as a rather exasperating and frustrating experience, I feel the Central Children’s Room was visit was quite successful.

The Donnell Library Center  
Central Children’s Room  
20 West 53<sup>rd</sup> Street  
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Email: [jlamb@nypl.org](mailto:jlamb@nypl.org)  
Web site: [http://www.nypl.org/branch/central\\_units/d/ch/kids.html](http://www.nypl.org/branch/central_units/d/ch/kids.html)

### The Kerlan Collection: Elmer L. Andersen Library

As with most of the other libraries, I arrived at the Elmer L. Andersen Library on an early Monday morning. I had emailed the curator in advance of my coming and she knew of my arrival date. When I arrived she and the staff graciously welcomed me and explained their research procedure.

The actual collection was kept in the basement. I was to request several books at once because it took a significant amount of time to retrieve the books. The room used for research was relatively small compared to the other library areas I had researched. It was approximately 25 by 30 feet with two rows of tables. Large padded rolling chairs were at the tables. Along the shorter walls, there were three computers for on-line searches. There was an extensive card catalog that covered the entire back wall. I was told most of the collection was on the computer database and would be, by far, easier to use. The wall opposite the card catalog held shelves of research journals and book reviews. The half top of this wall was glass and offices could be seen beyond. There were two doors directly opposite each other on the walls where the computers were.

Two other people were researching in the room when I arrived. I learned later that they were scholars who frequented the collection. One was conducting an in-depth study on the writings of Author Canon Doyle, the mastermind of Sherlock Holmes, and the other was researching the correspondence between a specific author, Eve Bunting, and her editor.

After our brief visit, I immediately got to work searching for plant-centered children's science picture books on the computer database. During the next three days, I also used some of the same types of book reviews to search for books as I had at the other libraries, such as *A to Zoo: Subject Access to Children's Picture Books* (Lima & Lima,

1998) and *From Cover to Cover: Evaluating and Reviewing Children's Book* (Horning, 1997). Many of the books revealed through my searches were the same books I had read at other libraries. When I read a summary about a book that I was unfamiliar with, I would fill out a request form for that book. When I had ten or more requests the staff would go to the basement, locate the books, and bring them back to me.

One fascinating experience was discovering that the original artwork of one of the books I had previously selected for the study was part of this collection's archives. It was an awesome to



hold in my gloved hands the original transcripts and illustrated drawings of *The Plant Sitter* (1959), by Gene Zion!

During the second day of researching Library Assistant, John Barneson, asked if I



would like a tour of the collection. I replied with an eager “yes.” One of the other frequent researchers asked if she could join us.

We took an elevator down through eight stories of solid limestone. Descending the temperature dropped rapidly to 58 degrees Fahrenheit. John told us this was the constant year around temperature with very little humidity. The collection was actually

kept in a cavern carved out of rock. We walked from the elevator through a wide corridor to a locked door. It is hard for me to describe the feeling that came over me when he unlocked the door and we walked through. The room was the length of two football fields and two stories high! Never had I seen such an enormous collection. There were rows and rows of stacks, from floor to ceiling, which held over 1.5 million volumes of books, manuscripts, illustrations and artifacts. About three fourths of the way down the room, the stacks became larger and more open with boxes and boxes. This was where much of the original artwork was stored. There was also a small vehicle with a lift, which was used to stack and retrieve materials. As we left the room, he took us down another hall and showed us an open glass window where the solid bed of limestone could be seen. Being asked to request several books at a time, now took on new meaning for me. I now realized what the staff went through to retrieve the books!

At the end of three days of research, I had read approximately 250 on-line book summaries, read and reviewed 57 books, viewed pages and pages of original manuscripts and artworks and had compiled a list of 21 books that I would later add to a list of books which I could possibly use for my content analysis.

The Kerlan Collection  
The Children's Literature Research Collections  
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Minneapolis, Minnesota 55455  
Contact Person: Professor Karen Nelson Hoyle, Curator  
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Phone number: (612) 624-4576  
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Web site: <http://special.lib.umn.edu/clrc/kerlan.html>

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- Horning, K. (1997). *From cover to cover: evaluating and reviewing children's books*.
- Lima, C. & Lima, J. (1998). *A to zoo: Subject access to children's picture books*. New Providence, NJ: R.R. Bowker Publisher.
- National Geographic Society. (1998). *Inside/out: The best of National Geographic diagrams and cutaways*. Washington, D. C.: National Geographic Publishing.
- Zion, G. (1959). *The plant sitter*. New York: Scholastic Book Services.

APPENDIX B: BOOKS CONSIDERED FOR SELECTION OF STUDY AND  
REASON FOR EXCLUSION

- Adler, D. (1995). *One yellow daffodil: A Hanukkah story*. Orlando, FL: Harcourt Brace & Co. Reason: Insufficient plant science.
- Alderson, B. (1999). *The tale of the turnip*. New York: Candlewick.  
Reason: Insufficient plant science.
- Aldridge, J. (1993). *A possible tree*. New York: Macmillan Publishing Co.  
Reason: Insufficient plant science.
- Allen, Laura. (1963). *A Fresh Look at Flowers*. Franklin Watts, Inc. New York. Reason: Factual, no story event occurs.
- Anderson, J. (1997). *Sunflower Sal*. New York: Whitman.  
Reason: Insufficient plant science.
- Anno, M. (1995). *Anno's magic seeds*. New York: Philomel Books.  
Reason: Insufficient plant science.
- Appelt, K. (1996). *Watermelon day*. New York: Holt.  
Reason: Insufficient plant science.
- Applebaum, D. (1993). *Giants in the land*. New York: Houghton, Mifflin.  
Reason: Unable to locate or purchase.
- Bash, B. (1989). *Desert giant: The world of the saguaro cactus*. San Francisco, CA: Sierra Club Books for Children. Reason: Factual, no story event occurs.
- Bash, B. (1989) *Tree of life: The world of the African Baobab*. San Francisco, CA: Sierra Club Books for Children. Reason: Factual, no story event occurs.
- Bash, B. (1994). *Ancient ones: The world of the old-growth Douglas fir*. San Francisco, CA: Sierra Club Books for Children. Reason: Factual, no story event occurs.
- Bash, B. (1996). *In the heart of the village: The world of the Indian Banyan tree*. San Francisco, CA: Sierra Club Books for Children. Reason: Factual, no story event occurs.
- Bishop, N. (1997). *Strange plants*. New York: Richard C. Owen Publishers.  
Reason: Does not meet inclusive page length of study (11p.).
- Blane, G. (1965). *Flower box mystery*. Chicago, IL: Melmont Publishers.  
Reason: Exceeds inclusive page length of study (62 p.).

- Bodecker, N. (1972). *Miss Jaster's garden*. New York: Golden Press.  
Reason: Insufficient plant science; reading level appears above the inclusive age range.
- Bogacki, T. (2000). *My first garden*. New York: Foster Farrar.  
Reason: Insufficient plant science.
- Brandenberg, A. (1976). *Corn is maize: The gift of the Indians*. Toronto, Canada: Fitzhenry & Whiteside Limited. Reason: Factual, no story event occurs.
- Brown, M. (1954). *The little fir tree*. New York: Thomas Y. Crowell Co.  
Reason: Insufficient plant science.
- Bruce, L. (2000). *Fran's flower*. New York: Harper Collins.  
Reason: Insufficient plant science.
- Bunting, E. (1994). *Flower garden*. Orlando, FL: Harcourt Brace & Co.  
Reason: Insufficient plant science.
- Busch, Phyllis. (1979). *Cactus in the desert*. New York: Harriett Barton.  
Reason: Factual, no story event occurs.
- Busch, Phyllis. (1968). *Lions in the grass*. New York: World Publishing Co.  
Reason: Factual, no story event occurs.
- Carlson, N. (1982). *Harriet and the garden*. Minneapolis, MN: Carolrhoda Books, Inc.  
Reason: Insufficient plant science.
- Carlstrom, N. (1987). *Wild wild sunflower child anna*. New York: Macmillan.  
Reason: Insufficient plant science.
- Caseley, J. (1990). *Grandpa's garden lunch*. New York: Greenwillow Books.  
Reason: Insufficient plant science.
- Chaffin, L. (1969). *I have a tree*. New York: D. White  
Reason: Insufficient plant science.
- Chevallier, Chiara. (1999). *The secret life of trees*. New York: Dorling Kindersley.  
Reason: Factual, no story event occurs.
- Cole, H. (1995). *Jack's garden*. New York: Greenwillow Books.  
Reason: Reason: Insufficient plant science; Does not meet inclusive page length of study (25 p.).
- Delaney, A. (1997). *Pearl's first prize plant*. New York: Harper Collins.  
Reason: Insufficient plant science.

- DePaola, T. (1983). *The legend of the bluebonnet*. Toronto, Canada: General Publishing Co. Limited. Reason: Insufficient plant science.
- DePaola, T. (1988). *The legend of the Indian paintbrush*. Hong Kong. South China Printing Co. Reason: Insufficient plant science.
- Dr. Seuss, (1971). *The lorax*. New York: Random House.  
Reason: Does not meet inclusive page length of study (61 p.).
- Eclare, M. (2000). *A handful of sunshine*. New York: Ragged Bears.  
Reason: Insufficient plant science.
- Ehlert, L. (1991). *Red leaf, yellow leaf*. New York: Harcourt.  
Reason: Factual, no story study.
- Evangelista, G. (2001). *In search of the perfect pumpkin*. New York: Fulcrum.  
Reason: Insufficient plant science.
- Fisher, A. (1977). *And a sunflower grew*. New York: Bowmar.  
Reason: Unable to locate or purchase.
- Fleming, C. (2002). *Muncha! Muncha! Muncha!* New York: Schwartz/Artheneum.  
Reason: Insufficient plant science.
- Florian, D. (1986). *Discovering trees*. New York: Macmillan Publishing Co.  
Reason: Factual, no story event occurs.
- Ford, M. (1999). *My day in the garden*. New York: Greenwillow Books.  
Reason: Insufficient plant science.
- Fowler, S. (1998). *Beautiful*. New York: Greenwillow Books.  
Reason: Insufficient plant science.
- Gerstein, M. (1995). *Daisy's garden*. New York: Hyperion Books for Children.  
Reason: Insufficient plant science.
- Greene, E. (1993). *The legend of the cranberry: A Paleo-Indian tale*. New York: Simon.  
Reason: Insufficient plant science.
- Greenstein, E. (1996). *Mrs. Rose's garden*. New York: Simon & Schuster Books For Young Readers. Reason: Insufficient plant science.
- Hafner, M. (2001). *Molly and Emmett's surprise garden*. Columbus, OH: McGraw-Hill Children's Publishing. Reason: Insufficient plant science.
- Hall, Z. (1996). *The apple pie tree*. New York: Blue Sky Press.  
Reason: Insufficient plant science.



- Hall, Z. (1998). *The surprise garden*. New York: Blue Sky Press.  
Reason: Insufficient plant science.
- Heller, R. (1984). *Plants that never ever bloom*. New York: Sandcastle Books.  
Reason: Factual, no story event occurs.
- Henderson, D. (1994). *Dinosaur tree*. New York: Bradbury Press.  
Reason: Reading level appears to be above inclusive age range of study.
- Henkes, K. (1991). *Chrysanthemum*. New York: Greenwillow Books.  
Reason: Insufficient plant science.
- Hines, A. (1997). *Miss Emma's wild garden*. New York: Greenwillow Books.  
Reason: Insufficient plant science.
- Hopkinson, D. (2001). *Bluebird summer*. Singapore: Tien Wah Press.  
Reason: Insufficient plant science.
- Ikeda, D. (1992). *The cherry tree*. New York: Knopf.  
Reason: Insufficient plant science.
- Jenkins, M. (1996). *Fly traps! Plants that bite back*. Cambridge, MA: Candlewick Press. Reason: Factual, no story event occurs; does not meet inclusive page length of study (24 p.).
- Jones, C. (1995). *The tree in the ancient forest*. Nevada City, NV: Dawn Publications.  
Reason: Reading level appears to be above inclusive age range of study; does not meet inclusive page length of study (25p.).
- Kallen, S. (1993). *If the trees could talk ...* Edina, MN: Abdo & Daughter. Edina,  
Reason: Does not meet inclusive page length of study (21p.).
- Keller, H. (2002). *Cecil's garden*. New York: Greenwillow Books.  
Reason: Insufficient plant science.
- Kimmel, E. (1996). *Onions and garlic: An old tale*. New York: Holiday House.  
Reason: Insufficient plant science.
- Lauber, P. (1994). *Be a friend to trees*. New York: HarperCollins.  
Reason: Factual, no story event occurs.
- Locker, T. (1995). *Sky tree: Seeing science through art*. New York: HarperCollins.  
Reason: Insufficient plant science; does not meet inclusive page length of study (28p.).

- Mabey, . (1983). *Oak & company*. New York: William Morrow & Co.  
Reason: Factual, no story event occurs.
- MacDonald, M. (1998). *Pickin' peas*. New York: HarperCollins.  
Reason: Insufficient plant science.
- Mallett, D. (1995). *Inch by inch: The garden song*. New York: HarperCollins.  
Reason: Inaccurate plant science.
- Moss, M. (2000). *This is the tree*. New York: Kane/Miller Book Publishers.  
Reason: Factual, no story event occurs.
- Muller, G. (1988). *The garden in the city*. New York: Dutton Children's Books.  
Reason: Reading level appears to be above inclusive age range of study.
- Muntean, M. & Rubel, N. (1984). *Alligator's garden*. New York: Dial Books for Young Readers. Reason: Insufficient plant science.
- Nolen, J. (2002). *Plantzilla*. New York: Harcourt, Inc.  
Reason: Inaccurate plant science.
- O'Malley, K. (2000). *Bud*. New York: Walker.  
Reason: Insufficient plant science.
- Oppenheim, J. (1995). *Have you seen trees?* New York: Scholastic Inc.  
Reason: Factual, no story event occurs.
- Oram, H. (2000). *Princess Chamomile's garden*. New York: Dutton Children's Books.  
Reason: Insufficient plant science.
- Osborne, M. (2001). *Kate and the beanstalk*. New York: Schwartz/Artheneum.  
Reason: Inaccurate plant science.
- Parnall, P. (1988). *Apple tree*. New York: Macmillian.  
Reason: Does not meet inclusive page length of study (26 p.).
- Pattou, E. (2001). *Mrs. Spitzer's garden*. New York: Harcourt.  
Reason: Insufficient plant science.
- Peck, J. (1998). *The giant carrot*. New York: Dial Books for Young Readers.  
Reason: Inaccurate plant science.
- Pittman, H. (1998). *The angel tree*. New York: Dial Books for Young Readers.  
Reason: Insufficient plant science.

- Posada, M. (2000). *Dandelions: Stars in the grass*. Minneapolis, MN: Lerner Publishing. Reason: Factual, no story event occurs.
- Primavera, E. (1994). *Plantpet*. New York: Putnam.  
Reason: Inaccurate plant science.
- Rockwell, A. (1989). *Apples and pumpkins*. New York: Macmillan.  
Reason: Insufficient plant science; does not meet inclusive page length of study (p.24).
- Romanova, N. (1985). *Once there was a tree*. New York: Dial Books for Young Readers.  
Reason: Insufficient plant science.
- Schaefer, L. (2000). *This is the sunflower*. New York: Greenwillow Books.  
Reason: No story event occurs; insufficient plant science.
- Selsam, M. (1983). *Catnip*. New York: William Morrow & Co.  
Reason: Factual, no story event; does not meet inclusive page length of study (46 p.).
- Selsam, M. (1978). *Mimosa: The sensitive plant*. New York: William Morrow & Co.  
Reason: Factual, no story study event; does not meet inclusive page length of study (48 p.).
- Selsam, Millicent. (1977). *The amazing dandelion*. New York: William Morrow & Co.  
Reason: Factual, no story event; does not meet inclusive page length of study (46 p.).
- Shecter, B. (1966). *Partouche plants a seed*. New York: Harper & Row Publishers.  
Reason: Insufficient plant science.
- Sloat, T. (1999). *Patty's pumpkin patch*. New York: Putnam's Sons.  
Reason: No story event occurs; insufficient plant science.
- Smith, M. (1998). *This is your garden*. New York: Crown.  
Reason: Insufficient plant science.
- Stern, M. (1997). *The missing sunflowers*. New York: Greenwillow Books.  
Reason: Insufficient plant science.
- Stewart, S. (1991). *The money tree*. New York: Farrar, Straus, and Giroux.  
Reason: Inaccurate plant science.
- Stewig, J. (2002). *Making plum jam*. New York: Hyperion Books for Children.  
Reason: Insufficient plant science.

- Tresselt, A.(1972). *The gift of the tree*. New York: Lothrop, Lee, & Shepard Books.  
Reason: Insufficient plant science.
- Tresselt, A. (1972). *The dead tree*. New York: Parents Magazine Press.  
Reason: Does not meet inclusive page length of study (28 p.).
- Vieira, L. (1994). *The ever-living tree*. New York: Walker Publishing Co.  
Reason: Reading level appears to be above inclusive age range of study.
- Waddell, M. (1999). *The hollyhock wall*. New York: Candlewick.  
Reason: Insufficient plant science.
- Wallace, K. (2000). *Scarlette Beane*. New York. Dial Books for Young Readers.  
Reason: Insufficient plant science.
- Wallace, N. E. (2000). *Paperwhite*. New York: Houghton Mifflin.  
Reason: Insufficient plant science.
- Wallace, N. (2002). *Pumpkin day!* New York: Cavendish.  
Reason: Insufficient plant science.
- Watson, A. (1970). *A maple tree begins*. New York: Viking Press.  
Reason: Reading level appears to be above inclusive age range of study.
- Watson, A. (1962). *My garden grows*. New York: Viking Press.  
Reason: Reading level appears to be above inclusive age range of study.
- Webber, I. (1944) *Travelers all: The story of how plants go places*. New York: William Scott, Inc. Reason: Published before inclusive dates of study; factual, no story event occurs.
- Wexler, J. (1985). *From spore to spore: Ferns and how they grow*. New York: Dodd, Mead & Co. Reason: Factual, no story event occurs; does not meet inclusive page length of study (47p.).
- Wexler, J. (1993). *Jack-in-the-pulpit*. New York: Dutton Children's Books.  
Reason: Factual, no story even occurs.
- Wexler, J. (1994). *Queen anne's lace*. Morton Grove, IL: Albert Whitman & Co.  
Reason: Factual, no story event occurs.
- Wexler, J. (1981). *Secrets of the Venus's fly trap*. New York: Dodd, Mead & Co.  
Reason: Factual, no story event occurs.

- Wexler, J. (1992). *Wonderful pussy willows*. New York: Duttons Children's Books.  
Reason: Factual, no story event occurs.
- Wexler, J. (1995). *Dew strangers: Plants that eat insects*. New York: Duttons Children's Books. Reason: Factual, no story event occurs.
- Wiesner, D. (1999). *June 29, 1999*. New York: Houghton Mifflin Co.  
Reason: Inaccurate plant science.
- Williams, B. (1979). *Hello, dandelions!* New York: Holt, Rinehart & Winston.  
Reason: Does not meet inclusive page length of study (28 p.).
- Wilson-Max, K. (1998). *Max loves sunflowers*. United Kingdom: David Bennett Books.  
Reason: Insufficient plant science.
- Witman, M. (1943). *The golden book of flowers*. New York: Simon & Schuster.  
Reason: Published before the inclusive dates of study.
- Wong, H. (1969). *Our tree*. New York: Addison-Wesley.  
Reason: Insufficient plant science.
- Yolen, J. (2002). *Harvest home*. New York: Harcourt Books.  
Reason: Insufficient plant science.
- Yolen, J. (1993). *Welcome to the green house*. Canada: G. P. Putnam's Sons  
Reason: Factual, no story event occurs.
- Yolen, J. (2001). *Welcome to the river of grass*. New York: Putnam's Sons.  
Reason: Factual, no story event occurs.
- Zion, G. (1956). *Really spring*. New York: Harper & Row Publishers.  
Reason: Insufficient plant science.

APPENDIX C: PLANT-CENTERED CHILDREN'S SCIENCE PICTURE BOOKS  
USED FOR THIS STUDY

- Baker, J. (1987). *Where the Forest Meets the Sea*. New York: Greenwillow Books.  
On a camping trip in an Australian rain forest with his father, a young boy thinks about the history of the plant and animal life around him and wonders how much longer things will remain as they are.
- Baker, J. (1995). *The Story of Rosy Dock*. New York: Greenwillow Books.  
A newcomer to Australia plants rosy dock in her desert garden. Over a period of years and years, the seed is carried by the wind and soon covers most of the country.
- Baker, J. (2000). *The Hidden Forest*. New York: Greenwillow Books.  
When a friend helps him retrieve the fishtrap just off the coast of eastern Tasmania, Ben comes to see the Giant Kelp forest where he lost his fishtrap in a new light.
- Bourgeois, P. & Clark, B. (2001). *Franklin Plants a Tree*. New York: Scholastic, Inc.  
Franklin can hardly wait to plant a tree, but his excitement quickly turns to disappointment when he is given a tiny sapling. Then he discovers the tree with the fantastic tree house he adores so, was once such a tiny sapling.
- Brandenberg, A. (1963). *A Weed is a Flower: The Life of George Washington Carver*. New York: Simon & Schuster.  
Text and pictures present the life of the man, born a slave, who became a scientist and devoted his entire life to helping the South improve its agriculture.
- Brisson, P. (1998). *The Summer My Father Was Ten*. New York: Caroline House  
Boyd's Mills Press.  
A father tells his son the story of how he damaged a neighbor's garden when he was a boy and what he did to make amends.
- Budbill, D. (1974). *Christmas Tree Farm*. New York: Macmillan Publishing Co.  
The story describes how Christmas trees are grown, harvested and replenished concluding with taking one home to a young child.
- Bunting, E. (1993). *Someday a Tree*. New York: Clarion Books.  
A young girl, her parents, and their neighbors try to save an old oak tree that has been poisoned by pollution.
- Bunting, E. (1996). *Sunflower House*. New York: Harcourt Brace & Co.  
A young boy creates a summer playhouse by planting sunflowers and saves the seeds to make another house the next year.

- Busch, P. (1968). *Once There Was a Tree: The Story of the Tree, A Changing Home for Plants and Animals*. New York: World Publishing Co.  
Reveals the diversity of organisms that interact with a tree and the role they play in the decomposition.
- Carle, E. (1987). *The Tiny Seed*. New York: Simon & Schuster Books.  
The many paths that seed may travel before it finally falls upon fertile soil where it germinates, sprouts, and becomes a new plant.
- Carrier, L. (1996). *A Tree's Tale*. New York: Dial Books for Young Readers.  
The huge, 400-year-old oak tree sees many people come and go during the course of its life as a Mai-Methug or "path-tree" to the inland forest.
- Cherry, L. & Plotkin, M. (1998). *The Shaman's Apprentice: A Tale of the Amazon Rain Forest*. New York: Harcourt Brace & Co.  
Young Kamanya discovers the importance of healing plants in the Amazon Rain Forest and aspires to become the next shaman of the village.
- Cherry, L. (1990). *The Great Kapok Tree: A Tale of the Amazon Rain Forest*. New York: Harcourt, Inc.  
The story reveals a glimpse of the vast plant and animal life that lives in an Amazon rain forest.
- Cooney, B. (1982). *Miss Rumphius*. New York: Viking Press.  
Great-aunt Alice Rumphius was once a little girl who loved the sea, longed to visit faraway places, and wished to do something to make the world a more beautiful.
- deMariscal, B. (1995). *The Harvest Birds*. San Francisco, CA: Children's Book Press.  
A Mexican folktale of how a young man attains his dream by learning the art of farming from an elder farmer.
- DiSalvo-Ryan, D. (1994). *City Green*. New York: William Morrow & Co.  
Marcy and Miss Rosa, along with friends and neighbors, turn a vacant city lot into a beautiful community garden.
- Fleischman, P. (1999). *Weslandia*. Cambridge, MA: Candlewick Press.  
Wesley's garden produces a crop of huge, strange plants, which provide him with clothing, shelter, food, and drink which allows him to create his own civilization and change his life.
- Franklin, K. (1995). *When the Monkeys Came Back*.  
Marta remembers the sounds of the monkeys in the village forest before the trees were cut down. When she grows up, she plants more trees and the monkeys come back.

- Hiscock, B. (1991). *The Big Tree*. Honesdale, PA: Caroline House Boyds Mills Press.  
From a small sprouting seed, to an extraordinary tree, the story unfolds as people and animals interact with the tree.
- Hodges, M. (1997). *The True Tale of Johnny Appleseed*. New York: Holiday House.  
Relates the story of the man who traveled west planting apple seeds to make the country a better place to live.
- Hughes, M. (1996). *A Handful of Seeds*. New York: Orchard Books.  
Forced into the barrio by her grandmother's death, Concepcion takes with her a legacy of chili, corn, and bean seeds and finds that they hold the key to her survival.
- Perkins, L. (1995). *Home Lovely*. New York: Greenwillow Books.  
Hoping for trees or a flower garden, Tiffany transplants and cares for some seedlings that she finds and is surprised by what they become.
- Petit, G. (1992). *The Seventh Walnut*. Chicago, IL: Wellington Publishing.  
Little John loses a walnut from his pocket and various animals and predators affect the fate of this stray walnut, demonstrating the food chain in nature.
- Petty, K. (1997). *Sam Plants a Sunflower*. New York: Macmillan Children's Books.  
Sam discovers the joy of raising sunflowers even though he often becomes impatient for faster growth.
- Pfeffer, W. (1997). *A Log's Life*. New York: Simon & Schuster Books for Young Readers.  
A giant oak tree, the unsung center of a living community of organisms, big and small, topples one day during a storm and breaks apart. Finally, it decomposes and ultimately becomes the soil in which an acorn sprouts and grows into another massive oak tree presenting a "circle-of-life".
- Rudolph, M. (1967). *How a Shirt Grew in the Field*. New York: McGraw-Hill Book Company.  
A young Russian boy observes his father sow flax seeds, which grows into a plant and after many stages evolves into his new shirt.
- Rylant, C. (1984). *This Year's Garden*. New York: Simon & Schuster.  
A child's perspective of planting, harvesting, and storing the harvest of the family's garden.
- Schussler, E. & Wandersee, J. (1999). *The Lost Plant*. Victoria, Canada: Trafford Publishing.  
Abby and her best friend, Tate solve the mystery of the lost African Violet and in doing so learn very important and interesting things about their plant.



- Stevens, J. (1995). *Tops & Bottoms*. New York: Harcourt, Inc.  
Hare tricks Bear into letting him use his field to plant a garden by sharing either the top or bottom of the plants harvested.
- Stewart, S. (1997). *The Gardener*. New York: Farrar, Straus, & Giroux.  
Lydia Grace Finch transforms a somber, city dwelling into a cheerful place full of flowers and smiles.
- Urduy, J. (1956). *A Tree is Nice*. New York: Harper Collins.  
Tells of the beauty, value, and usefulness of trees.
- White, L. (1996). *Too Many Pumpkins*. New York: Holiday House.  
Rebecca Estelle, an old woman who has hated pumpkins ever since she was a child when her family had nothing else to eat, finds herself with a full crop of them.
- Wondriska, W. (1964). *The Tomato Patch*. New York: Holt, Rinehart, & Winston.  
A wise little girl brings together two mythical countries that have been at odds with each other for years and years by simply sharing her knowledge of growing a tomato patch.
- Yacowitz, C. (1998). *Pumpkin Fiesta*. New York: Harper Collins.  
Hoping to win a prize for the best pumpkin at the fiesta, foolish Fernando tries to copy Old Juana's successful gardening techniques, overlooking the most important work.
- Zion, G. (1959). *The Plant Sitter*. New York: Scholastic Books.  
Tommy discovers many important facts about plant care when he decides to plant sit for his neighbors while they are away on vacation.

APPENDIX D: CATEGORIZATION OF BOOKS USED FOR THIS STUDY  
 ACCORDING TO PUBLICATION YEAR, BOOK TITLE, AND AUTHOR

<b>Publication Year</b>	<b>Book Title</b>	<b>Author</b>
1956	A Tree is Nice	Urdu, Janice May
1959	The Plant Sitter	Zion, Gene
1964	The Tomato Patch	Wondriska, William
1965	A Weed is a Flower: The Life of George Washington Carver	Brandenberg, Alike
1967	How a Shirt Grew in the Field	Rudolph, Marguerita
1968	Once There Was a Tree	Busch, Phyllis
1974	Christmas Tree Farm	Budbill, David
1982	Miss Rumphius	Cooney, Barbara
1984	This Year's Garden	Rylant, Cynthia
1987	Where the Forest Meets the Sea The Tiny Seed	Baker, Jeannie Carle, Eric
1990	The Great Kapok Tree: A Tale of the Amazon Rain Forest	Cherry, Lynne
1991	The Big Tree	Hiscock, Bruce
1992	The Seventh Walnut	Petit, Genevieve
1993	A Handful of Seeds Someday a Tree	Hughes, Monica Bunting, Eve
1994	City Green When The Monkeys Came Back	DiSalvo-Ryan, DyAnne Franklin, Kristine
1995	Home Lovely The Harvest Birds The Story of Rosy Dock Tops & Bottoms	Perkins, Lynne Rae DeMariscal, Blanca Baker, Jeannie Stevens, Janet

<b>Publication Year</b>	<b>Book Title</b>	<b>Author</b>
1996	Sunflower House A Tree's Tale Too Many Pumpkins	Bunting, Eve Carrier, Lark White, Linda
1997	The True Tale of Johnny Appleseed Sam Plants a Sunflower A Log's Life The Gardener	Hodges, Margaret Petty, Kate Pfeffer, Wendy Stewart, Sarah
1998	The Summer My Father Was Ten The Shaman's Apprentice: A Tale of the Amazon Rain Forest Pumpkin Fiesta	Brisson, Pat Cherry, Lynne & Plotkin, Mark Yacowitz, Caryn
1999	Weslandia The Lost Plant	Fleischman, Paul Schussler, Elisabeth & Wandersee, Jim
2000 2001	The Hidden Forest Franklin Plants a Tree	Baker, Jeannie Bourgeois, Paulette & Clark, Brenda

## APPENDIX E: THE PILOT STUDY

### Purpose

The purpose of the pilot study was to locate, compile, and analyze a set of plant-centered children's science picture books. The pilot study also served as a practicum by familiarizing me with the methods, techniques and applications of a content analysis study. The four steps used were as follows:

1. Description of the target books' characteristics;
2. Data collection and content analysis;
3. Development of instrumentation for further data collection; and
4. Reporting of pilot study findings.

### Description of the Books

The books selected for the pilot study were located through an extensive search at the de Grummon Children's Literature Collection in Hattiesburg, Mississippi. This collection of literature is housed at one of North America's leading research centers in the field of children's literature.

Prior to my visit, in March of 2002, I contacted Dee Jones, the Curator of the Collection. I conveyed to her my area of interest and criteria for selecting the literature.

The criteria were:

1. Fiction and nonfiction literary plant science picture books that tell about an event or series of events involving a plant or plants that have a plot and characters;
2. Children's plant science books that have pictures and/or text on at least every other page;

3. Children's plant science picture books published in the English language from 1950-present;
4. Children's plant science picture books with a target audience of ages 4 to 8; and
5. Children's plant science picture books with approximated page length of 32 to 40 pages.

When I arrived at the library, 99 books were reserved for me that might meet the criteria of my intended pilot study. Of the 99 books reviewed, 42 were selected for a second review. Through the results of the second review, eight books, which met my search criteria, were selected for the pilot study. Two additional books, suggested by a local veteran librarian, were also included--*City Green* by DyAnne DiSalvo-Ryan (1994) and *The Plant Sitter* by Gene Zion (1959). I read all of the books at least four times to better understand how the text and illustrations conveyed scientific concepts and principles.

### Research Questions

#### Research Question 1

What are the book titles, authors, and dates of publication of children's picture books that emphasize an awareness of plants?

Each of the books chosen for the pilot study is described in Pilot Study: Appendix A. Pilot Study: Appendix B lists the books that were omitted from the study, by author's name and the reason for omission. All the books, including the omitted ones, were located and reviewed using the resources of the de Grummond Collection. Table 2

presents the books that were used for this study according to publication year, title, and author.

**Table 1.**

**Categorization of Books Used for The Pilot Study According to Publication Year, Title, and Author**

Year of Publication	Title of Book	Author
1959	<i>The Plant Sitter</i>	Zion, Gene
1968	<i>Once There Was a Tree</i>	Busch, Phyllis S.
1970	<i>A Maple Tree Begins</i>	Watson, Aldren A.
1989	<i>Once There Was a Tree</i>	Romanova, Natalia
1989	<i>Desert Giant</i>	Bash, Barbara
1991	<i>The Big Tree</i>	Hiscock, Bruce
1992	<i>The Seventh Walnut</i>	Petit, Genevieve
1994	<i>City Green</i>	DiSalvo-Ryan, DyAnne
1996	<i>In the Heart of the Village</i>	Bash, Barbara
2000	<i>This is the Tree</i>	Moss, Miriam

First, the set of books were analyzed with the rubric: Assessing the Quality of Plant-Centered Children’s Literature (see Pilot Study: Appendix C). Eight categories and levels of criteria were established. The categories included: introduction; focus on main topic; organization; creativity; setting; accuracy of facts; and illustrations. The levels of

criteria were assigned using a rating scale of 1-4: Four points being the highest possible points per category, and one point the lowest. The highest total rating score is 32 points.

The rating of the individual books and their total score are shown in Table 2.

**Table 2.**  
**Rating of Individual Books Listed by Title**

Book Title	Introduction	Focus on Main Topic	Organization	Creativity	Setting	Accuracy of Facts	Characters	Illustrations	Total Score
A Maple Tree Begins	4	4	4	4	4	4	3	4	31
City Green	4	4	4	4	4	4	4	4	32
Desert Giant	4	4	4	4	4	4	4	4	32
In the Heart of the Village	4	4	4	4	4	3	4	4	31
Once There Was a Tree (Busch)	4	4	4	4	4	4	4	4	32
Once There Was a Tree (Romanova)	3	4	4	3	2	4	4	4	28
The Big Tree	4	4	4	4	4	4	4	4	32
The Plant Sitter	4	4	4	4	3	3	3	3	28
The Seventh Walnut	4	4	4	4	4	4	4	4	32
This is the Tree	3	4	3	4	4	2	4	4	28

An individual category analysis revealed the areas in which the combined set of books appeared the most and least strong. Table 3 presents the mean for each category analyzed.

**Table 3.**  
**Mean Score of Each Category Analyzed**

Category	Score
Introduction	3.8
Focus on Main Topic	4.0
Organization	3.9
Creativity	3.9
Setting	3.7
Accuracy of Facts	3.6
Characters	3.8
Illustrations	3.8

Research Subquestions 2 and 3

What are the plant science characteristics of content of these books?

What are the range and frequency of plant science concepts and principles presented?

After the books were chosen and read several times, a rubric was created to identify the plant content characteristics of science instruction within the text. The Life Science Standards (NRC, 1996) and the Principles of Plant Biology (ASPB, 2002) were used as a guides for rubric development.

The rubric addressed Life Science Content Standard C for grades K-4, which include; the characteristics of organisms; life cycles of organisms; and organisms and their environments (see Pilot Study: Appendix D). The rubric also addressed the K-4 Principles of Plant Biology which include Principles 1, 2, 4, 5, 7, 9, 10, 11, 12 (see Pilot Study: Appendix E).

The rubric was revised several times during the analysis of these books so that it became more and more specific to plant concepts. This rubric addressed 32 characteristics of plant-science (see Pilot Study: Appendix F).

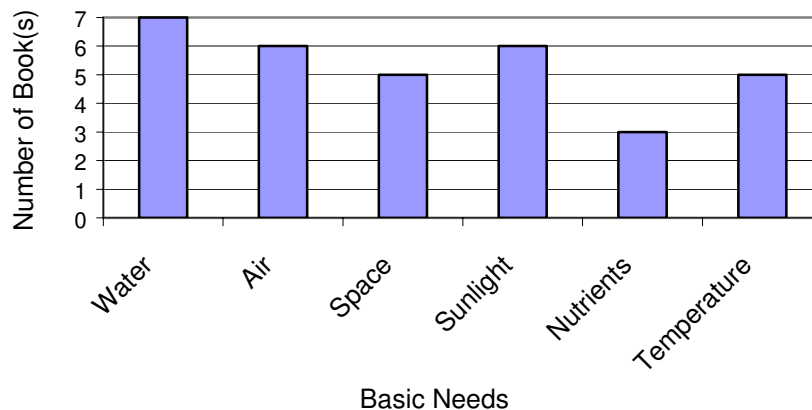


## Characteristics of Plants

The characteristics of plants included four categories. The first section distinguished plants as living rather than non-living objects. The second established that plants are producers and that they have basic needs which must be met for them to survive. The last category looked for identification of plant structures.

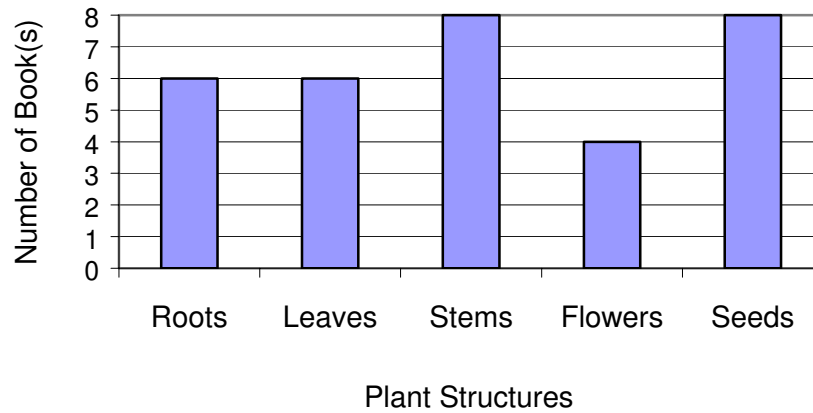
Out of the ten books analyzed through this pilot study, three of the books emphasized that plants are alive. Closely related to this concept is the concept of “producer” or “consumer.” Five, or 50% of the books, addressed the principle that plants have the ability to produce their own food.

All of the books addressed some, if not all, of the plant’s basic needs for survival as presented in Figure 1. The basic need for water was addressed in 7 of the 10 books. Air and sunlight were addressed in six of the books. In five books the concept of appropriate temperature and space was addressed. The basic need for nutrients was addressed only once, in *The Plant Sitter* by Gene Zion (1959), as “root powder.”



**Figure 1. Number of Books that Identified Basic Needs of Plants**

All of the books made reference to one or more plant structures as represented in Figure 2. Seeds and stems were discussed the most. Eight out of the ten books made reference to seeds and stems. The concepts of roots and leaves were next, being addressed in six of the books. Surprisingly enough, flowers were discussed only in four of these books. This may be due to the fact that many of the books had tree(s) as the main character and often times flowers of trees appear minute to the tree's over-all size. Stems and leaves were marked as inapplicable in one book because the plant was a saguaro cactus.

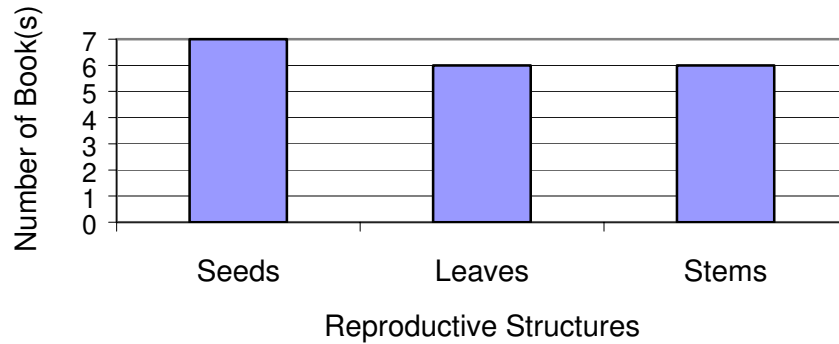


**Figure 2. Number of Books that Identified Plant Structures**

### Life Cycles of Plants

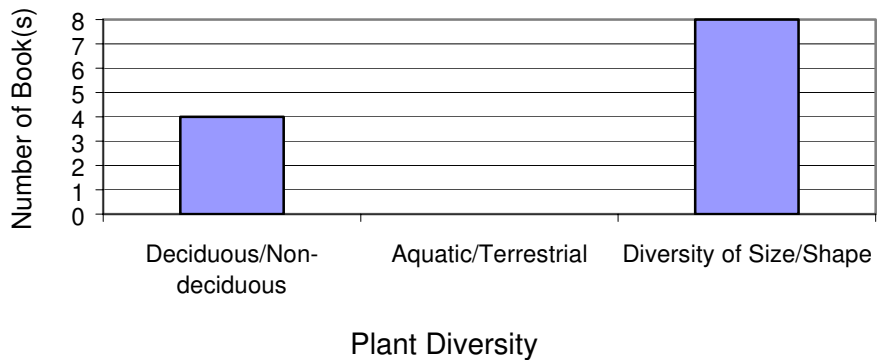
The “life cycles of plants” category identified the reproductive structures of plants, the diversity of plant life, and the external signals that often affect plant growth. These sub-categories were also divided into more defined concepts.

The reproductive structures of life cycles as presented in Figure 3 were addressed in the majority of the books. Seeds, identified in 7 of the 10 books, were the most identified reproductive structure. Leaves and stems were identified in six of the books.



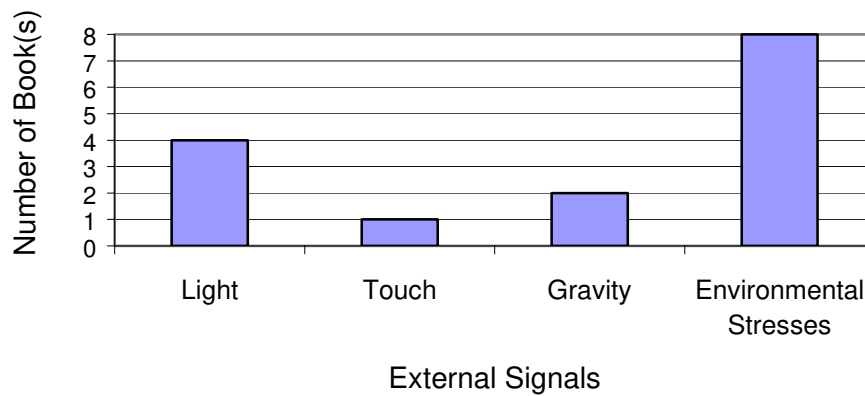
**Figure 3. Number of Books Identified that Addressed Reproductive Structures**

The diversity of plant life on this planet is enormous. This diversity, for the most part, was addressed indirectly by showing varying sizes and shapes of the same plant species. Eight of the ten books identified differences in such aspects as plants grow. Diversity, in terms of deciduous or non-deciduous plants, was identified in four of the books. There was not one book that addressed any kind of aquatic plant. Figure 4 represents the issues of diversity of plant life.



**Figure 4. Number of Books Identified that Addressed Diversity of Plant Life**

The next concept assessed, external signals affecting plant growth, was addressed in very few of the books. External signals were divided into four sub-categories; light, touch, gravity and environmental stresses such as drought or floods. The findings are represented in Figure 5.

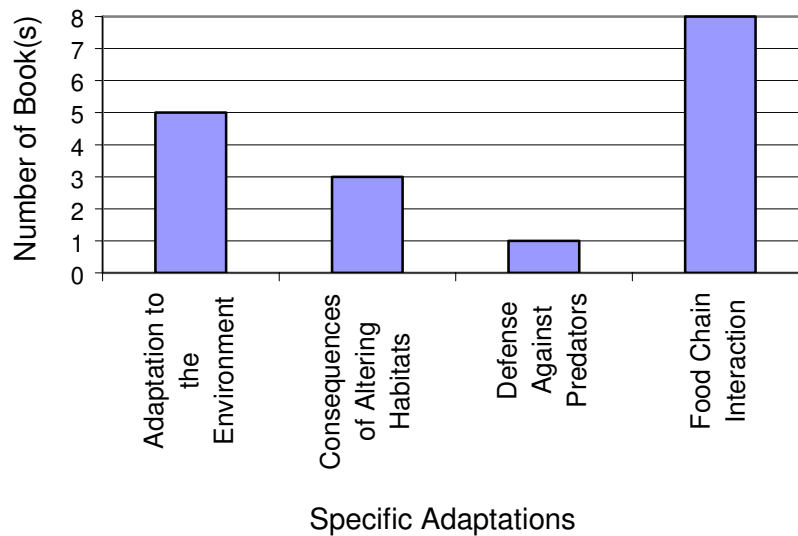


**Figure 5. Number of Books Identified that Addressed External Signals Affecting Plant Growth**

Plants in the environment, was the last major category assessed in the plant science picture books selected for the pilot study. This category included the concept of the topic of plant habitats and plant uses by people.

Plant habitats were divided into four subcategories: plant adaptation to the environment; plant defense against predators such as thorns, poisons, or foul smell; consequences of altering plant habitats; and the interaction of plants and animals in the food chain.

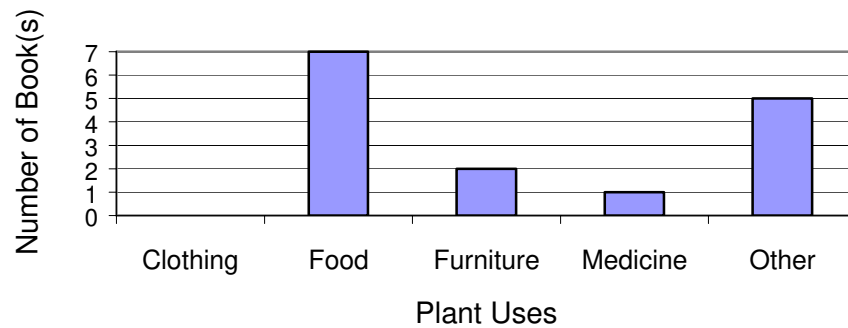
The concept of a food chain or the flow of energy from plants to animals was addressed in 8 of the 10 books. A plant's ability to adapt to environmental conditions was addressed in five books. The consequences of altering a plant's habitat were addressed in 3 books and a plant's defense against predators in 1 book. Figure 6 represents the findings regarding these ideas.



**Figure 6. Number of Books Identified that Addressed Issues of Plant Habitats**

The last plant science topic identified was the role of plant use by people. Three books presented aspects of ethnobotany--the study of the relationships between plants and people. These books were: *This is the Tree* by Miriam Moss (Moss, 2000); *In the Heart of the Village: The World of the Indian Banyan Tree* by Barbara Bash (1996); and *Desert Giant: The World of the Saguaro Cactus* by Barbara Bash (1989). These books described ways in which the natives use plants or plant materials for food, medicine, shelter, and so forth, as they have done for centuries.

Other books presented instances where plants were used for furniture and building houses. A category of “other” was created for the rare instances where plants were used as boats or food containers. Rather surprisingly, though, there was no instance where plants were used for clothing. Figure 7 represents these findings.



**Figure 7. Number of Books Identified that Addressed Primary Uses of Plants by People**

#### Research Question 4

What are the types and range of graphic representations illustrated in these books?

To better understand the graphic representations found in these illustrations discovered in the pilot study, a rubric was created to identify plant science graphics (see Pilot Study: Appendix G). I began by comparing the number of illustrated pages to the number of illustrated/text pages. Table 4 represents the number of pages according to each category defined by author and year of publication.

**Table 4.****Number of Pages Corresponding to Illustrations/Text According to Author of Book and Year of Publication**

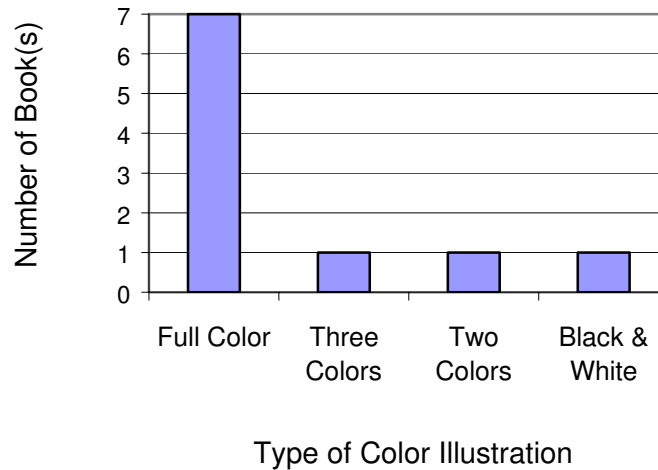
Category	Bash, 1989	Bash, 1996	Busch, 1968	DiSalvo-Ryan, 1994	Hiscock, 1991	Moss, 2000	Petit, 1992	Romanova, 1983	Watson, 1970	Zion, 1959
Full page illustrations w/o text	14	12	7	13	6	10	12	9	10	0
Full page illustrations with text	14	12	0	7	9	12	8	6	0	28
Number of pages relevant to story	28	29	21	29	24	22	26	24	25	28
Partial page illustrations w/o text	0	0	0	0	0	0	0	0	0	0
Partial page illustrations with text	0	5	10	9	8	0	0	9	14	0
Page with no illustrations, text only	0	0	4	0	1	0	6	0	1	0

The relevant page numbers were then converted to percentages and used to calculate a measure of central tendency for each. The resulting mean indicated that 95 % of the pages have illustrated pages with or without text. Only 5% of the pages are without any type of illustration.

The favored type of medium for graphic illustration appeared to be watercolors (80%), along with a combination of pencil colors and crayons. Photographs were used to illustrate one book and one book was illustrated with ink blocks. The authors/illustrators stated specifically which type of medium was used in two books.

Ten books used realistic characterization. In one of the books (Moss, 2000), the faces of the animals were rather distorted. In another book the illustrator drew a style of

animated people (Zion, 1959). For the most part, the books employed full-color for the illustrations. Figure 8 represents the other color choices identified.



**Figure 8. Number and Type of Color Illustrations Identified**

Many of the books had various informative qualities. Page numbers were used in only three of the ten books. Timelines were present in three books. The timelines were: stages of tree growth (2 books); seed germination (2 books); and stages of budding (1 book). Other unique aspects included: steps for creating a community garden, a recipe for walnut cake, and an illustrated food chain.

Question 1 addressed the issue of whether or not the graphics were drawn to scale. All, except one, of the books appeared drawn to scale. Exceptions were for the illustrations of over-sized animals. A chameleon appeared the same size as a fly and elephants seemed overly small beside a baobab tree (Moss, 2000).

Cutaway diagrams were illustrated in two of the books. Barbara Bash (1989) in the book, *Desert Giant: The World of the Saguaro Cactus*, presented a cutaway of the



flower of a saguaro cactus, with labels identifying the stamen, stigma, ovary, and style.

She also included a cutaway of the fruit, labeling the flower, stalk, and developing seeds.

Alden Watson (1970), in *A Maple Tree Begins*, included a cutaway of the trunk of a maple tree. The labels were: bark, sapwood, and heartwood. Later in the book, the rings of growth were labeled to correspond to possible historical events during the life of the tree such as the: first Independence Day, Lewis & Clark expedition, Civil War, Klondike gold rush, and Lindbergh's trans-oceanic flight.

Two books contained internal view cutaway diagrams: *Desert Giant* (Bash, 1989) and *The Big Tree* (Hiscock, 1991). Internal cutaway graphics allowed the viewer to see what normally could not be seen.

The saguaro cactus is the home for many animals. In *Desert Giant: The World of the Saguaro Cactus*, Bash (1989) illustrated how the Gila woodpeckers drill holes into the soft flesh of the cactus and build homes to lay their eggs. She also illustrated the niches of many other animals that live in the cactus, including termites, black widow spiders, and centipedes.

In *The Big Tree*, Hiscock(1991) included a cutaway of a root hair. The graphic illustrates how water and sugar travel through the tree. Hiscock achieved zoom magnification inside a circle. It seems as though a magnifying glass is being placed over the object. There was a cutaway graphic of the root hair and with a maple leaf. He also magnified a leaf to show the tiny green specks of chlorophyll. He labeled carbon dioxide gas with an arrow entering the leaf and oxygen gas with an arrow exiting from the leaf.

The last aspect of illustrations analyzed was the cultural relationship between plants and animals. Three of the books established this relationship (Bash, 1989; Bash, 1996; Moss, 2000).

In *Desert Giant: The World of the Saguaro Cactus* (Bash, 1989), the Tohono O'odham Indians harvested fruit of the saguaro cactus as they have for centuries. This method of gathering and preparing the jams, candies, syrups, and wines has been passed down through many generations.

The Indian Banyan Tree was shown to be the hub of social activity in the book *In the Heart of the Village: The World of the Indian Banyan Tree* (Bash, 1996). The tree, which often covers many acres, was where the Indians gather. Under this tree, the native children had their lessons, the people worshiped their gods, traders came to barter their goods, and animals grazed.

In the book, *This is the Tree* (Moss, 2000) indigenous Africans interacted with the baobab tree by hunting for insects hidden beneath its bark. The illustrations depicted this interaction, but there was no accompanying textual explanation about what was done with the insects.

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- Watson, A. (1970). *A Maple Tree Begins*. New York: The Viking Press.
- Zion, G. (1959). *The plant sitter*. New York: Scholastic Book Services.

## PILOT STUDY APPENDIX A: DESCRIPTION OF PILOT STUDY BOOKS

Bash, Barbara. (1989). *Desert giant: The world of the Saguaro Cactus*. San Francisco, CA: The Sierra Club.

Illustrator: same

Number of pages: 32

ISBN: 1-57805-085-5

Abstract:

A venerable saguaro cactus stands like a statue in the hot desert landscape, its arm like branches reaching fifty feet into the air. From a distance it appears to be completely still and solitary – but appearances can be deceptive. In fact, this giant tree of the desert is alive with activity. Its spiny trunk and branches are home to a surprising number of animals, and its flowers and fruit feed many desert dwellers.

Gila woodpeckers and miniature elf owls make their homes inside the saguaro's trunk. Long – nosed bats and fluttering doves drink the nectar from its showy white flowers. People also play a role in the saguaro's story: each year the Tohono O'odham Indians gather its sweet fruit in a centuries-old harvest ritual. (Book Jacket)

Setting: In the Sonoran Desert, which stretches through parts Arizona, California, and Mexico.

Illustrations: Appears as vivid watercolors, for the most part the illustrations are full page.

Unique characteristics:

Pronunciation given for: Saguaro (sa-WAHR-o) Latin name: *Cereus giganteus*; Gila (HEE – la) woodpecker; Tohono O'odham (toh- HO-no o-O-dahm) Indians

Graphics depict animal living within the giant saguaro.

Cutaway graphics (with labels) reveals the parts of the saguaro flower, fruit, and seeds.

Time line of seedling growth.

Plant-Science Concepts Addressed:

1. Distinguishes between living/non-living (decomposition)
2. Basic needs of; water and air
3. Plant structures/reproductive structures of: flowers (pollination) and seeds
4. Diversity of plant life in size and shape.
5. External signal affecting growth: environmental stresses
6. Plants defense against predators: sharp spines
7. Food chain; interaction of plants/animals
8. Primary use of plant; food & animal shelter

Bash, Barbara. (1996). *In the heart of the village: The world of the Indian Banyan Tree*. San Francisco, CA: The Sierra Club.

Illustrator: same

Number of pages: 36

ISBN: 0-87156-575-7

Abstract:

In the center of a small village in India, a banyan tree rises from the earth like a great green mountain. Known as the Many Footed One, this remarkable tree has so many trunks it is a virtual forest, covering many acres. A place for laughing, bartering, conversing and resting, romping and chasing, meeting and imagining, the banyan is not only *in* the heart of the village, it is the heart of the village. (Book jacket)

Setting: India village

Illustrations: vivid watercolors; for the most part full-page illustrations

Unique characteristics:

Some bird's eye view illustrations

Plant-Science Concepts Addressed:

1. Distinguishes between producer and consumer
2. Plant structures of: roots, stems, and flowers
3. Deciduous/non-deciduous
4. Diversity of plant life in size and shape.
5. External signals affecting growth; light and gravity
6. Plant adaptation to the environment
7. Food chain; interaction of plants/animals
8. Primary use of plant; food & people/animal shelter

Possible Misconceptions:

The beginning of the book tells a story about Niratali, mother of the earth, created the world. She supposedly brought the seeds of the banyan tree and pulled the leaves apart so that it grows as it does today.

Busch, Phyllis S. (1968). *Once there was a tree*. New York: The World Publishing Co.

Illustrator: same

Number of pages: 40

ISBN: none

Abstract: The story begins “No matter how lonely a tree looks, it is never alone”. It then reveals the vast diversity of organisms that interact with the tree. Age, parasites, and weather eventually bring about the death of the tree even though it is still never alone. Then a seed ball that had fallen from the tree, sprouts and the life of a tree begins again.

This picture book tells the fascinating story of how a living tree becomes a log, and how it and its accompanying varieties of plants and animals interact with each other and with their environment.

Setting: a tree on a hill

Illustrations: Black & white photographs

Unique characteristics:

Photographs show minuscule details

Plant-Science Concepts Addressed:

1. Distinguishes between living/non-living (decomposition)
2. Distinguishes between producer and consumer
3. Basic needs of; water, air, space, sunlight, and nutrients
4. Plant structures/reproductive structures of: roots, leaves, stems, and seeds
5. Diversity of plant life in size and shape.
6. External signal affecting growth: touch, gravity, and environmental stresses
7. Plant adaptation to the environment
8. Consequences of altering habitats
9. Food chain; interaction of plants/animals
10. Primary use of plant; animal shelter

DiSalvo-Ryan, D. (1994). *City green*. New York: William Morrow & Co.

Illustrator: same

Number of pages: 32

ISBN: 0-688-12786-X

Abstract:

Right in the middle of Marcy's city block is a vacant lot, littered and forlorn. Sometimes just looking at it makes March feel sad. Then one spring, Marcy has a wonderful idea: Instead of a useless lot, why not a green and growing space for everyone to enjoy? So Marcy, an African American girl about 8 years of age, along with neighbors in the community starts a community garden.

Setting: Inner city

Illustrations: watercolors, pencil, and crayons

Unique characteristics:

Ethnic diversity portrayed, all ages, as well as, children with physical disability

Last page describes the steps for "Starting a Community Garden" contact:

American Community Gardening Association

100 N. 20<sup>th</sup> Street 5<sup>th</sup> Floor

Philadelphia, PH 19103

Plant-Science Concepts Addressed:

1. Basic needs of; water and air
2. Plant structures/reproductive structures of: water, air, space, sunlight, temperature, stems, flowers and seeds
3. Diversity of plant life in size and shape.

Hiscock, Bruce. (1991). *The big tree*. Honesdale, PA: Caroline House-Boyds Mills Press.

Illustrator: same

Number of pages: 32

ISBN: 1-56397-810-5

Abstract:

In 1775, a small seed sprouted in a dark forest. Now that sprout is an extraordinary sugar maple tree. Time and people have changed over the past two hundred years, but the tree goes on, silently providing shade and shelter, a living link with the past. Intertwining botany and history, Bruce Hiscock tells not only the story of the tree and its growth, but also the lives of the people and animals who have lived near this ancient maple. (Book jacket)

Setting: On a hill in upstate New York, “by the last farmhouse on a dirt road” (p. 2)

Illustrations: appear as watercolors

Unique characteristics:

Time line from 1775-2000 depicting the tree size and the mode of transportation

Magnified graphic illustrations

Plant-Science Concepts Addressed:

1. Distinguishes between producer and consumer
2. Basic needs of; water, air, space, sunlight, nutrients, and temperature
3. Plant structures/reproductive structures of: roots, leaves, stems, flowers, and seeds
4. Deciduous/non-deciduous
5. Diversity of plant life in size and shape.
6. External signal affecting growth: light and environmental stresses
7. Plant adaptation to the environment
8. Food chain; interaction of plants/animals
9. Primary use of plant; food & wood for houses



Moss, Miriam. (2000). *This is the tree*. Brooklyn, NY: Kane/Miller Book Publishers.

Illustrator: Kennaway, Adrienne

Number of pages: 28

ISBN: 0-916291-98-7

Abstract:

The ancient and extraordinary baobab tree takes center stage in this poetic and informative story of the wildlife of Africa. Old as a volcano, the distinctive “upside-down” tree plays a vital role in the lives of numerous creatures. Buffalo doze beneath it, the bushbaby pilfers its flowers, elephants feed on it, and the turaco bird nests among its branches. (Book jacket)

Setting: African plain

Illustrations: appears as vivid watercolor; all full page illustrations

Unique characteristics:

Well-defined glossary about the Baobab tree

Plant-Science Concepts Addressed:

1. Basic needs of; water and air
2. Plant structures/reproductive structures of: water, roots, leaves, stems, flowers, & seeds
3. Deciduous/non-deciduous
4. Diversity of plant life in size and shape.
5. External signal affecting growth: environmental stresses
6. Plant adaptation to the environment
7. Food chain; interaction of plants/animals
8. Primary use of plant; food, medicine, animal shelter and boats

Possible Misconceptions:

1. The tree is often described with anthropomorphic qualities such as “tosses and turns..., wrinkles on knuckles and knees..., huge rounded belly..., points long crooked toes ...(and) dances with monkeys”
2. Many of the illustrations are not drawn to scale. A bumblebee is about the same size as a squirrel’s head. The centipede appears the size of a lizard.
3. The face of a chameleon has distorted features that appear almost human like.

Petit, Genevieve. (1992). *The seventh walnut*. Chicago, IL: Wellington Publishing.

Illustrator: Boucher, Joelle

Number of pages: 36

ISBN: 0-922983-10-7

Abstract:

Seven walnuts bouncing in John's pocket make a wonderful sound. John is very happy. Then he loses one. The seventh walnut, lost in the woods. Who will find it? Who will eat it? A squirrel or a weasel? A magpie or perhaps dormouse? The fascinating life of a forest unfolds before your eyes. (Book jacket)

Setting: country-farm

Illustrations: appear as watercolors

Unique characteristics:

At the conclusion there are answers for curious children about interesting walnut facts, as well as, the nine animals that find the walnut during the story.

Illustrates a of energy flow from a walnut, to a squirrel, then to a weasel.

Gives a scrumptious walnut cake recipe.

Plant-Science Concepts Addressed:

1. Distinguishes between producer and consumer
2. Basic needs of; space, sunlight, and temperature
3. Plant structures/reproductive structures of: roots, leaves, stems, and seeds
4. Food chain; interaction of plants/animals
5. Primary use of plant; food & furniture

Romanova, Natalia. (1983). *Once there was a tree*. New York: Puffin Books.

Illustrator: Spirin, Gennady

Number of pages: 32

ISBN: 0-14-054677-4

Abstract:

The story tells of the life that continues to live in the stump of a tree long after the tree is gone. As each organism (bark beetle, ants, bear, titmouse, frog, etc.) inhabits the stump they treat it as their own: each taking part in the decomposition of the tree. "But who really owns the tree stump?" (p. 20)

At the conclusion of the story a new tree has grown in the place of the stump and the same occupants continue to interact with it. So actually, "The tree belongs to all, because it grows from the earth that is home to all" (p. 24)

Setting: forest

Illustrations: appears as watercolors

Unique characteristics:

The illustrations are framed on each page by various shapes.

Some of the text is written similar to a rebus; however, the picture is beside the word.

Plant-Science Concepts Addressed:

1. External signal affecting growth: environmental stresses, lighting
2. Plant adaptation to the environment
3. Consequences of altering habitats
4. Food chain; interaction of plants/animals
5. Primary use of plant; food & animal shelter

Watson, Aldren A. (1970). *A Maple Tree Begins*. New York: The Viking Press.

Illustrator: same

Number of pages: 32

ISBN: none

Abstract:

The old sugar maple was down – cracked at its base by a high wind – and its giant trunk lay in the front yard. For 194 years it had stood there, Peter said, ever since the signing of the Declaration of Independence – and he showed Caitlin how to count the tree's rings. (Book jacket)

The author, through Peter and his sister, Caitlin, describes the growth of a maple tree. This story includes the dispersal of the germination of the winged seed, the growth of the young seedling and the first adult years. He also illustrates and describes how to calculate the age of a tree by counting its rings.

Setting: A New England state

Illustrations: Detailed drawing of two colors (orange and black)

Unique characteristics:

An index of relevant maple concepts that includes italicized numbers that refers to the page of illustration.

Many sequenced detailed drawings with labels which include; sequence of seed growth (a wheat penny is show beside the seed as a reference to size); cutaway of tree with parts labeled; graphic of bud growth which includes magnified as well as actual size of bud;

Time line of tree diameter to historic event i.e. Lewis & Clark, Civil War, Klondike, and Lindbergh.

Time line of tree growth

Plant-Science Concepts Addressed:

1. Distinguishes between living/non-living (decomposition)
2. Distinguishes between producer and consumer
3. Basic needs of; water, air, space, sunlight, and temperature
4. Plant structures/reproductive structures of: roots, leaves, stems, and seeds
5. Deciduous/non-deciduous
6. Diversity of plant life in size and shape.
7. External signal affecting growth: light and environmental stresses
8. Food chain; interaction of plants/animals
9. Primary use of plant

Zion, Gene. (1959). *The plant sitter*. New York: Scholastic Book Services.

Illustrator: Graham, Margaret Bloy

Number of pages: 32

ISBN: none

**Abstract:** Tommy, after learning that the family will not be going on a summer vacation this year, decides to be a plant sitter. While his neighbors go on vacation he plant sits their plants for a fee of 2 cents per day per plant. This plants blossom under his care because he goes to the library and finds out just how much sunlight, water, and space they need. In fact they blossom so much, he has a dream that they take over his house. He learns how to propagate the plants and when his neighbors return home he has plants for everyone, including the children.

**Setting:** Tommy's house, library, and the local store

**Illustrations:** appears as pencil and crayons (only blue, yellow and green)

**Unique characteristics:**

Shows Tommy watering a cactus with a dropper.

Gaining knowledge produces success.

**Plant-Science Concepts Addressed:**

1. Basic needs of; water, air, space, sunlight, nutrients, and temperature
2. Plant structures/reproductive structures of: leaves and stems
3. Diversity of plant life in size and shape.
4. External signals affecting growth; light

**Possible Misconceptions:**

The growth of the plants seems accelerated. "He was such a good plant sitter that in a few weeks the plants grew into a tangles jungle" (p.12) Tommy then dreams the plants take over the entire house and cause the walls to fall outwards. The illustrations reinforce this accelerated growth.

PILOT STUDY APPENDIX B: BOOKS OMITTED FROM THE PILOT STUDY,  
BY AUTHOR'S NAME

- Allen, Laura. (1963). *A fresh look at flowers*. Franklin Watts, Inc. New York. Reason: No story event occurs; plants described anthropomorphically
- Bishop, Nic. (1997). *Strange plants*. Richard C. Owen Publishers. New York. Reason: Does not meet inclusive page length of study (lip.).
- Blane, Gertrude. (1965). *Flower box mystery*. Melmont Publishers. Chicago. Reason: Exceeds inclusive page length of study (62 p.).
- Busch, Phyllis. (1979). *Cactus in the desert*. Harriett Barton. New York. Reason: Factual, no story event occurs.
- Busch, Phyllis. (1968). *Lions in the grass*. World Publishing Co. New York. Reason: Factual, no story event occurs.
- Chevallier, Chiara. (1999). *The secret life of trees*. Dorling Kindersley. New York. Reason: Factual, no story event occurs.
- Florian, Douglas. (1986). *Discovering trees*. Macmillan Publishing Co. New York. Reason: Factual, no story event occurs.
- Heller, Ruth. (1984). *Plants that never ever bloom*. Sandcastle Books. New York. Reason: Factual, no story event occurs.
- Jenkins, Martin. (1996). *Fly traps! Plants that bite back*. Candle Wick Press. Cambridge, MA. Reason: Factual, no story event occurs; Does not meet inclusive page length of study (24 p.).
- Jones, Carol. (1995). *The tree in the ancient forest*. Dawn Publications. Nevada City. Reason: Reading level appears to be above inclusive age range of study; Does not meet inclusive page length of study (25p.).
- Kallen, Stuart. (1993). *If the trees could talk...* Abdo & Daughter. Edina, MN. Reason: Does not meet inclusive page length of study (21p.).
- Lauber, Patricia. (1994). *Be a friend to trees*. Harper Collins. New York. Reason: Factual, no story event occurs.
- Locker, Thomas. (1995). *Sky tree: seeing science through art*. Harper Collins. New York. Reason: Does not meet inclusive page length of study (28p.).
- Mabey, Richard. (1983). *Oak & company*. William Morrow & Co. New York. Reason: Factual, no story event occurs.

- Oppenheim, Joanne. (1995). *Have you seen trees?* Scholastic Inc. New York.  
Reason: Factual, no story event occurs.
- Parnall, Peter. (1988). *Apple tree*. Macmillan. New York.  
Reason: Does not meet inclusive page length of study (26 p.).
- Posada, Mia. (2000). *Dandelions: stars in the grass*. Lerner Publishing Co. Minneapolis, MN. Reason: Factual, no story event occurs.
- Selsam, Millicent. (1983). *Catnip*. William Morrow & Co. New York.  
Reason: Factual, no story event; Does not meet inclusive page length of study (46 p.).
- Selsam, Millicent. (1978). *Mimosa: the sensitive plant*. William Morrow & Co. New York. Reason: Factual, no story event; Does not meet inclusive page length of study (48 p.).
- Selsam, Millicent. (1977). *The amazing dandelion*. William Morrow & Co. New York. Co. New York. Reason: Factual, no story event; Does not meet inclusive page length of study (46 p.).
- Tresselt, Alvin. (1972). *The dead tree*. Parents Magazine Press. New York.  
Reason: Does not meet inclusive page length of study (28 p.).
- Vieira, Linda. (1994). *The ever-living tree*. Walker Publishing Co. New York.  
Reason: Reading level appears to be above inclusive age range of study.
- Wexler, Jerome. (1985). *From spore to spore: ferns and how they grow*. Dodd, Mead & Co. New York. Reason: Factual, no story event occurs; Does not meet inclusive page length of study (47p.).
- Wexler, Jerome. ( 1993). *Jack-in-the-pulpit*. Dutton Children's Books. New York.  
Reason: Factual, no story event occurs.
- Wexler, Jerome. (1994). *Queen Anne's lace*. Albert Whitman & Co. Morton Grove, IL.  
Reason: Factual, no story event occurs.
- Wexler, Jerome. (1981). *Secrets of the Venus's fly trap*. Dodd, Mead & Co. New York.  
Reason: Factual, no story event occurs.
- Wexler, Jerome. (1992). *Wonderful pussy willows*. Duttons Children's Books. New York.  
Reason: Factual, no story event occurs.

Wexler, Jerome. (1995). *Dew strangers: plants that eat insects*. Duttons Children's Books. New York. Reason: Factual, no story event occurs.

Williams, Barbara. (1979). *Hello, dandelions!* Holt, Rinehart & Winston. New York. Reason: Does not meet inclusive page length of study (28 p.).

Witman, Mabel. (1943). *The golden book of flowers*. Simon & Schuster: New York Reason: Published before the inclusive dates of study.



PILOT STUDY APPENDIX C: A RUBRIC TO ASSESS THE QUALITY OF PLANT-CENTERED CHILDREN'S LITERATURE

Book Title \_\_\_\_\_

Main Topic \_\_\_\_\_ Please Circle, Fiction or Nonfiction

Author's Name \_\_\_\_\_

Evaluator's Name \_\_\_\_\_

Directions: For each category below, assign points based on criteria description found on the form. Then add sub-score numbers and place this total in the "Total" box.

Criteria					
CATEGORY	4	3	2	1	Score
<b>Introduction</b>	First paragraph has a "grabber" or catchy beginning.	First paragraph has a weak "grabber".	A catchy beginning was attempted but was confusing rather than catchy.	No attempt was made to catch the reader's attention in the first paragraph.	
<b>Focus on Main Topic</b>	The entire story is related to the main topic and allows the reader to understand much more about the topic.	Most of the story is related to the main topic. The story wanders off at one point, but the reader can still learn something about the topic.	Some of the story is related to the main topic, but a reader does not learn much about the topic.	No attempt has been made to relate the story to the main topic.	
<b>Organization</b>	The story is very well organized. One idea or scene follows another in a logical sequence with clear transitions.	The story is pretty well organized. One idea or scene may seem out of place. Clear transitions are used.	The story is a little hard to follow. The transitions are sometimes not clear.	Ideas and scenes seem to be randomly arranged.	

<b>Criteria</b>					
<b>CATEGORY</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>Score</b>
<b>Creativity</b>	The story contains many creative details and/or descriptions that contribute to the reader's enjoyment. The author has really used his imagination.	The story contains a few creative details and/or descriptions that contribute to the reader's enjoyment. The author has used his imagination.	The story contains a few creative details and/or descriptions, but they distract from the story. The author has tried to use his imagination.	There is little evidence of creativity in the story. The author does not seem to have used much imagination.	
<b>Setting</b>	Many vivid, descriptive words are used to tell when and where the story took place.	Some vivid, descriptive words are used to tell the audience when and where the story took place.	The reader can figure out when and where the story took place, but the author didn't supply much detail.	The reader has trouble figuring out when and where the story took place.	
<b>Accuracy of Facts</b>	All facts presented in the story are accurate.	Almost all facts presented in the story are accurate.	Most facts presented in the story are accurate (at least 70%).	There are several factual errors in the story.	
<b>Characters</b>	The main characters are named and clearly described in text as well as pictures. Most readers could describe the characters accurately.	The main characters are named and described. Most readers would have some idea of what the characters looked like.	The main characters are named. The reader knows very little about the characters.	It is hard to tell who the main characters are.	

<b>Criteria</b>					
<b>CATEGORY</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>Score</b>
<b>Illustrations</b>	Original illustrations are detailed, attractive, creative and relate to the text on the page.	Original illustrations are somewhat detailed, attractive, and relate to the text on the page.	Original illustrations relate to the text on the page.	Illustrations are not present OR they are not original.	
				<u>Total</u>	

Notes:

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## PILOT STUDY APPENDIX D: LIFE SCIENCE CONTENT STANDARD “C” OF THE NATIONAL EDUCATION STANDARDS

Life Science Content Standard C of the National Science Education Standards (NRC, 1996)

### The Characteristics of Plant Organisms

1. Organisms have basic needs. Plants require water, air, nutrients, and light. They can only survive if these essential requirements are met.
2. Each plant has specific structures that serve different functions in growth, survival, and reproduction. Examples include; roots, leaves, stems, flowers, and seeds.
3. The behavior of plants is influenced by internal cues (such as a Venus fly trap closing on its prey) and by external cues (such as growing toward the source of light).

### Life Cycles of Organisms

1. Plants have life cycles that begin with germination, seedlings, and developing into mature adult plants that reproduce and eventually die.
2. Plants closely resemble the parent plant.
3. Many characteristics of a plant are inherited from the parent plant, but other characteristics may result from environmental influences.

### Organisms and Their Environments

1. All animals depend on plants for survival.
2. All plant patterns of behavior are related to their environment. When an environment changes, some plants may survive and reproduce, while others die off.

National Research Council. (1996). *National science education standards*. Washington, DC: National Academy Press.

PILOT STUDY APPENDIX E: K-4 PRINCIPLES OF PLANT BIOLOGY BY THE  
AMERICAN SOCIETY OF PLANT BIOLOGISTS

**K-4 Principles of Plant Biology developed by the American Society of Plant Biologists.** <http://www.aspb.org/education/foundation/principles.cfm>

Principles 3, 6, and 8 have been omitted in that they do not apply to grades K-4.

1. Plants contain the same biological processes and biochemistry as microbes and animals. However, plants are unique in that they have the ability to use energy from sunlight along with other chemical elements for growth. This process of photosynthesis provides the world's supply of food and energy.
2. Plants require certain inorganic elements for growth and play an essential role in the circulation of these nutrients within the biosphere.
4. Reproduction in flowering plants takes place sexually, resulting in the production of a seed. Reproduction can also occur via asexual propagation.
5. Plants, like animals and many microbes, respire and utilize energy to grow and reproduce.
9. Plants, like animals, are subject to injury and death due to infectious diseases caused by microorganisms. Plants have unique ways to defend themselves against pest and diseases.
10. Water is the major molecule present in plant cells and organs. In addition to an essential role in plant structure, development, and growth, water can be important for the internal circulation of organic molecules and salts.

11. Plant growth and development are under the control of hormones and can be affected by external signals such as light, gravity, touch, or environmental stresses.
  
12. Plants live and adapt to a wide variety of environments. Plants provide diverse habitats for birds, beneficial insects, and other wildlife in ecosystems

**PILOT STUDY APPENDIX F: IDENTIFICATION OF PLANT SCIENCE CONCEPTS  
IN PLANT-CENTERED CHILDREN'S PICTURE BOOKS**

Book Title \_\_\_\_\_

Author's Name \_\_\_\_\_

Evaluator's Name \_\_\_\_\_

Directions: For each category below, *check* yes or no as to whether or not the recommended plant science concept is addressed in the text or illustrations of the book. The concept or principle may be implied rather than directly addressed in the text: example, plants make their own food, rather than stating the science term *producer*. Please list any additional plant science concepts or principles--that you found the book addressed--on the following page.

Category	Concept Addressed (Yes)	Concept Not Addressed (No)
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<b>I. Characteristics of Plants</b>		
A. Distinguishes between living/non-living (ASPB # 1)		
B. Distinguishes between producer/consumer (ASPB # 5)		
C. Addresses Basic Needs (ASPB # 2, 10)		
1. Water		
2. Air		
3. Space		
4. Sunlight		
5. Nutrients (inorganic elements)		
6. Temperature		
D. Identifies Plant Structures		
1. Roots		
2. Leaves		
3. Stems		
4. Flowers		
5. Seeds		

<b>II. Life Cycles of Plants</b>		
A. Identifies Reproductive Structures (ASPB # 4)		
1. Seeds		
2. Leaves		
3. Stems		

Category	Concept Addressed (Yes)	Concept Not Addressed (No)
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<b>B. Addresses Diversity of Plant Life</b> (ASPB # 7)		
1. Deciduous/Non-deciduous		
2. Aquatic/Terrestrial		
3. Diversity of Size/Shape		

<b>C. Identifies External Signals affecting Growth</b> (ASPB # 9, 11)		
1. Light		
2. Touch		
3. Gravity		
4. Environmental stresses (drought, floods, injury, diseases, etc.)		

<b>III. Plants in the Environment</b>
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<b>A. Addresses plant habitats</b> (ASPB # 1, 12)		
1. Plant adaptation to the environment		
2. Plant defense against predators (scent, thorns, poisonous, etc.)		
3. Consequences of altering habitats		
4. Food Chain; interaction of plants/animals		

<b>B. Identifies Primary uses of plants by people</b> (ASPB # 8)		
1. Food		
2. Medicine		
3. Clothing		
4. Furniture		
5. Other		

Additional plant science concepts addressed.

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_



PILOT STUDY APPENDIX G: IDENTIFYING GRAPHICS OF PLANT SCIENCE

Book Title \_\_\_\_\_

Author/ Illustrator \_\_\_\_\_

Rater \_\_\_\_\_

<b>Number of Pages relevant to illustrations/test</b> – Identify the number and style of illustrated pages relevant to story.		#
Full page illustrations without text		
Full page illustrations with text		
Partial page illustrations without text		
Partial page illustrations with text		
No illustrations, text only		
Total # of pages relevant to story (may or may not include the title page)		
<b>Informative/ illustrated aspects</b>		X
Glossary		
Index		
Page Numbers		
Pictionary		
Rebus		
Timeline, please specify type(s)		
Other, please specify		

<b>Type of Illustration(s)</b> – Select as many as needed. Appears as:		X
Photographs		
Watercolors		
Collage		
Colored pencils		
Crayons		
Ink blocks		
Illustrations realistic characteristics		
Illustration non-realistic characteristics		

<b>Illustration Color(s)</b> – Select Only One Choice.		X
Full color		
3 colors		
2 colors		
Black & White		
Other, please specify		

1. Are the graphics of the illustrations drawn to scale? Yes or No

If no, please list examples of non-scale objects.

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2. Do the illustrations include cross-section diagram(s)? Yes or No

If yes, specify diagram(s) /and or labels.

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3. Do the illustrations include internal view diagrams (s)? Yes or No

If yes, specify diagram(s) /and or labels.

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4. Do the illustrations include magnified graphics? Yes or No

If yes, specify diagram(s) /and or labels.

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5. Do the illustrations depict a cultural relationship between plants and people? Yes or No. If so, describe how.

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Additional Comments:

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APPENDIX F: BOTANICAL SCIENCE ANALYSIS CODEBOOK  
AND CODING FORM

**Unit of Data Collection:** American Society of Plant Biologists (ASPB) plant science concepts and principles identified in plant science children's literature.

**Coder ID:** Indicate the number of the individual who coded that sheet (work phone #).

**Book ID:** Fill in the book's ID number as indicated on the top right corner of the book.

**Plant State:** Indicate whether the plant is presented as living, dying, or dead in the text and/or illustrations (ASPB Principles 5 & 9).

1. Living = a healthy plant that is normal in color and appears to be conducting photosynthesis
2. Dying = a plant or part of a plant that is removed from its original placement, but still has the ability to continue living if this part (leaf, stem, rhizome, etc.) is once again given the necessary nutrients for survival or a plant that appears "sick" or turning brown and it seems the plant will die (become a dead plant)
3. Dead = a plant that lacks the ability to conduct photosynthesis; the plant therefore has the appearance of being dead (dry, brown, brittle, etc.)
4. More than one of the above
5. All of the above
6. Unable to determine

**Producer/Consumer:** Indicate whether the author presents or suggests a difference between a producer and a consumer in the text and/or illustrations.  
(ASPB Principles 1 & 5)

1. Refers to plants as producers (self-sustaining)
2. Refers to animals and/or people as consumers
3. Refers to both
4. Does not address
5. Unable to determine

**Process of Photosynthesis:** Indicate the degree to which the process of photosynthesis is presented in the text and/or illustrations (ASPB Principle 1).

1. Clearly presented: The process of photosynthesis is described as the plant's ability to use energy from sunlight along with other chemicals (carbon dioxide and water) to make it's own food.
2. Refers to the ability of the plant to make it's own food
3. Does not address photosynthesis
4. Unable to determine

**Basic Needs:** Indicate the degree to which the basic needs of plants, water, air, space, sunlight nutrients, and temperature, are addressed in the text and/or illustrations. This designation would be determined as either clearly identified or vaguely implied. Clearly Identified = basic need is *explicitly stated or illustrated* (example, someone actually pouring water on a plant or seed) vaguely implied = basic need is *implied* though not stated or illustrated (example, a watering can shown, but no text or illustration of water) (ASPB Principles 2 & 10).

**Water:**

1. Clearly Identified
2. Vaguely Implied
3. Not addressed

**Air:**

1. Clearly Identified
2. Vaguely Implied
3. Not Addressed

**Space (not place):**

1. Clearly Identified (uniformly planted)
2. Vaguely Implied
3. Not addressed

**Sunlight:**

1. Clearly Identified
2. Vaguely Implied
3. Not addressed

**Nutrients (inorganic elements):**

1. Clearly Identified
2. Vaguely Implied
3. Not addressed

**Temperature:**

1. Clearly Identified
2. Vaguely Implied
3. Not addressed

**Plant Structures:** Indicate the degree to which each specific plant structure is identified in the text and/or illustrations (ASPB Principle 4).

**Roots:**

1. Roots shown or mentioned.
2. Roots are the source of entry for water/oxygen and or other nutrients into the plant.
3. Roots serve as the support system for the plant.
4. Both 1 & 2
5. All of the above
6. Not addressed

**Leaves:**

1. Leaves are shown or mentioned.
2. Leaves are presented as the location where the process of photosynthesis or food making begins.
3. Both 1 & 2
4. Not addressed

**Flowers:**

1. Flowers are shown or mentioned.
2. One or more part(s) of a flower is identified.
3. Flowers are presented as a site of reproduction (seeds).
4. Flowers are represented as typically requiring pollination.
5. More than one of the above
6. All of the above
7. Not addressed

**Seeds:**

1. Seeds shown or mentioned.
2. Seeds are presented as agents of plant reproduction
3. Seed dispersal is shown as occurring by multiple agents (examples: wind, rain, animals, etc.)
4. Both 1 & 2
5. More than one of the above
6. Not addressed

**Reproductive Structures:** Indicate the manner in which plants may reproduce (sexually or asexually) as presented in the text and/or illustrations (ASPB Principle 4).

1. Seeds
2. Stems
3. Leaves
4. Other modified structures (bulbs, runners, corms, rhizomes, etc.)
5. More than one of the above
6. All of the above
7. Not addressed

**Plant Life (Form) Diversity:** Indicate if a diversity of plant form is presented in text and/or illustrations (ASPB Principle 12).

1. Deciduous trees and shrubs (lose leaves in the fall)
2. Non-deciduous (evergreen) land plants
3. Soft-stemmed / non-woody trees, shrubs, or plants (includes most perennials and annuals)
4. Aquatic plants (freshwater or marine)
5. More than one of the above
6. All of the above

**Plant Size Diversity:** Indicate the manner in which the size of plant growth is presented in text and/or illustrations (ASPB Principle 7).

1. Plants < 1' (12") tall
2. Plants  $\geq$  1' but less than 5' tall
3. Plants  $\geq$  5' tall and taller
4. More than one of the above
5. All of the above

**External Signals:** Indicate the manner in which external signals affecting plant growth are presented in the text and/or illustrations (ASPB Principle 11).

1. Plants growing toward a light source (light source must be shown or stated)
2. Plants responding to a touch source (e.g., a vine, tendrils)
3. Roots growing toward gravity
4. More than one of the above
5. All of the above
6. Not addressed

**Environmental Stresses:** Indicate if, and the types of environmental stresses that are presented in the text and/or illustrations (ASPB Principle 11).

1. Drought (wilting)
2. Flooding
3. Biotic Stress (insects, animals/humans, disease coming from bacteria or fungi)
4. Fire (natural, not started by people)
5. More than one of the above
6. All of the above
7. Not addressed

**Plant Habitats:** Indicate the manner in which *plant as habitat* is presented in the text and/or illustrations (ASPB Principle 12).

1. Habitats for birds
2. Habitats for insects
3. Habitat for wildlife/aquatic life
4. More than one of the above
5. All of the above
6. Not addressed

**Plant Uses:** Indicate the manner in which plants are a primary source of materials used in products of everyday use by humans or characters personified. The need must be part of the plot and presented in the text and/or illustrations. (ASPB Principle 8)

1. Food
2. Medicine
3. Clothing
4. Shelter and furniture
5. Fuel
6. More than one of the above
7. All of the above
8. Not addressed

## Botanical Science Analysis Coding Form

Coder ID \_\_\_\_\_

<i>Book ID</i>						
Plant State						
Producer/Consumer						
Process of Photosynthesis						
Basic need of :    Water						
Air						
Space						
Sunlight						
Nutrients						
Temperature						
Plant Structure of:  Roots						
Leaves						
Flowers						
Seeds						
Reproductive Structures						
Plant Life Diversity						
Plant Size Diversity						
External Signals						
Environmental Stresses						
Plant Habitats						
Plant Uses						

APPENDIX G: IDENTIFYING INNOVATIVE GRAPHICS FOR PLANT SCIENCE  
DATA SHEET

Book ID \_\_\_\_\_ Coder ID \_\_\_\_\_

Please use a check where specified. You may also include comments.

<b>✓ Type of Graphic(s) – Select as many as needed.</b>	
Cutaway	
Exploded-view	
Flap-tab	
Gatefold	
Photo-realism	
Pop-up	
Sequence diagrams	
Zoom	
None of the above	
<b>✓ Illustration Color(s) – Select Only One Choice.</b>	
Full color	
Black & White	
Black & White/with spot color(s)	
Other, please specify	

1. Do the illustrations include artistic innovations (new or skillfully creative forms of illustrating)? Yes or No. If yes, please list examples of these innovations.

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2. Briefly describe the story plot.

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3. In 3 words or less describe the botanical aspect of the book.

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Additional Comments:

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APPENDIX H: INDEPENDENT CODERS OF THE BOTANICAL SCIENCE  
ANALYSIS CODEBOOK AND THE DATA SHEET: IDENTIFYING GRAPHICS OF  
PLANT SCIENCE

Nancy Christensen, M.A., Ed. S.  
Crescent Elementary School  
Plaquemine, Louisiana

Ms. Christensen teaches fourth grade at Crescent Elementary School.

Fannie Easterly, M.L.I.S.  
West Baton Rouge Parish Library  
Port Allen, Louisiana

Ms. Easterly is the Assistant Director of the West Baton Rouge Parish Library.

Sandra M. Guzman, M.S.  
River Parishes Community College  
Sorrento, Louisiana

Ms. Guzman is a biology instructor at River Parishes Community College.

James Wandersee, Ph. D.  
Louisiana State University  
Baton Rouge, Louisiana

Dr. Wandersee is Wm. Leblanc, Alumni Professor at Louisiana State University in the College of Curriculum and Instruction.

APPENDIX I: A RUBRIC TO ASSESS THE OVER-ALL QUALITY OF PLANT-CENTERED CHILDREN'S LITERATURE

Book Title \_\_\_\_\_

Main Topic \_\_\_\_\_

Author's Name \_\_\_\_\_

Evaluator's Name \_\_\_\_\_



Directions: For each category below, assign a number of performance level that best relates to the criteria of the book. Then add the score numbers for a total performance score.

Criteria					
CATEGORY	4	3	2	1	Score
<b>Introduction</b>	First paragraph has a "grabber" or catchy beginning.	First paragraph has a weak "grabber".	A catchy beginning was attempted but was confusing rather than catchy.	No attempt was made to catch the reader's attention in the first paragraph.	
<b>Focus on Main Topic</b>	The entire story is related to the main topic and allows the reader to understand much more about the topic.	Most of the story is related to the main topic. The story wanders off at one point, but the reader can still learn something about the topic.	Some of the story is related to the main topic, but a reader does not learn much about the topic.	No attempt has been made to relate the story to the main topic.	
<b>Organization</b>	The story is very well organized. One idea or scene follows another in a logical sequence with clear transitions.	The story is pretty well organized. One idea or scene may seem out of place. Clear transitions are used.	The story is a little hard to follow. The transitions are sometimes not clear.	Ideas and scenes seem to be randomly arranged.	

<b>Criteria</b>					
<b>CATEGORY</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>Score</b>
<b>Creativity</b>	The story contains many creative details and/or descriptions that contribute to the reader's enjoyment. The author has really used his imagination.	The story contains a few creative details and/or descriptions that contribute to the reader's enjoyment. The author has used his imagination.	The story contains a few creative details and/or descriptions, but they distract from the story. The author has tried to use his imagination.	There is little evidence of creativity in the story. The author does not seem to have used much imagination.	
<b>Setting</b>	Many vivid, descriptive words are used to tell when and where the story took place.	Some vivid, descriptive words are used to tell the audience when and where the story took place.	The reader can figure out when and where the story took place, but the author didn't supply much detail.	The reader has trouble figuring out when and where the story took place.	
<b>Accuracy of Plant Science Concepts</b>	All plant science concepts presented in the story are accurate.	Almost all plant science concepts presented in the story are accurate.	Most plant science concepts presented in the story are accurate (at least 70%).	There are several plant science concept errors in the story.	
<b>Characters</b>	The main characters are named and clearly described in text as well as pictures. Most readers could describe the characters accurately.	The main characters are named and described. Most readers would have some idea of what the characters looked like.	The main characters are named. The reader knows very little about the characters.	It is hard to tell who the main characters are.	
<b>Illustrations/ Graphics</b>	Original illustrations are detailed, attractive, creative and relate to the text on the page. Uses of graphics enhance plant science concepts/principles.	Original illustrations are somewhat detailed, attractive, and relate to the text on the page.	Original illustrations relate to the text on the page.	Illustrations are not present OR they are not original.	
<b>TOTAL</b>					

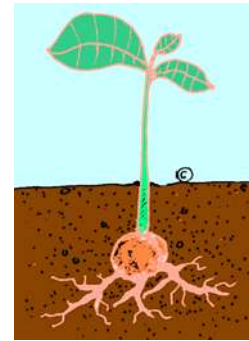
APPENDIX J: A RUBRIC TO ASSESS BOTANICAL SCIENCE IN CHILDREN'S  
PICTURE BOOKS

Book Title \_\_\_\_\_

Main Topic \_\_\_\_\_

Author's Name \_\_\_\_\_

Evaluator's Name \_\_\_\_\_



Directions: For each category below, assign a number of performance level that best matches the criteria of the book. Then add the score numbers for a total performance score of botanical science.

Criteria					
CATEGORY	4	3	2	1	Score
<b>Basic Plant Needs</b>	All of the basic plant needs are addressed; water, sunlight, space, temperature, nutrients, and air	Two or more of the basic needs are addressed	One or more of the basic needs are addressed	None of the basic needs are addressed	
<b>Roots</b>	Roots are presented as the entry for water and other nutrients into the plants <b>as well as</b> serve as the support system for the plant	Roots are presented as the entry for water and other nutrients into the plants <b>or</b> presented as the support system for the plant	Roots are shown or mentioned	Roots are not shown or mentioned	
<b>Leaves</b>	Leaves are presented as the location where the process of photosynthesis begins	Leaves are presented as a necessary structure for food making	Leaves are shown or mentioned	Leaves are not addressed	
<b>Flowers</b>	Flowers are presented as a site of reproduction that typically requires pollination	Flowers are presented as a site of reproduction	One or more parts of a flower is shown or identified	Flowers are not shown or mentioned	
<b>Seeds</b>	Seed dispersal is shown as occurring by multiple agents	Seeds are presented as agents of plant reproduction	Seeds are shown or mentioned	Seeds are not shown or mentioned	

<b>Criteria</b>					
<b>CATEGORY</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>Score</b>
<b>External Signals</b>	The external signals; plants growing toward light source; plants responding to touch (e.g. a vine or tendrils); and roots growing toward gravity are presented	Two external signals are presented	One external signal is presented	External signals are not addressed	
<b>Plant Diversity</b>	Plants rather than animals are the focused diversity life forms. Plants are presented in various sizes and types	Animals are the focused diversity life form, but plant diversity is also presented	Less than 3 types of plant diversity are presented	Plant diversity is not addressed	
<b>Environmental Stress</b>	Plants are presented damaged due to environment stresses caused by drought, flooding, biotic stress (caused by human or other living things), and by fire	Two or more forms of environmental stresses are presented	One form of environmental stress is addressed	Environment stress is not addressed	
<b>Plants as Value or Relationships</b>	Plants are presented as having economical value, ecological value, and ethno-botanical value	Plants are presented in two forms of value or relationships	Only one form of plant value or relationship is presented	The relationship of plants to people is not presented	
<b>Plant Awareness</b>	Due to the plant science events presented in the story the character(s) undergo a noticeable character change	The characters interact with plants, but a noticeable change in the character(s) disposition is not discernable	The story does not contain people or animals characters that have an ability to be influenced for plant awareness	The story does not appear to present any situations of plant awareness for people	
				<b>TOTAL</b>	

## VITA

Sheila Kay Lewis Goins was born February 26, 1959, in St. Louis, Missouri. She is married to Thomas G. Goins, Sr., formerly of Anna, Illinois, and they have three children. She attended public schools in Missouri and graduated from Lilbourn High School in 1977. She received a Bachelor of Science degree (1991), a Master of Arts degree (2000), and Education Specialist Certification (2001) from Louisiana State University in Baton Rouge, Louisiana. She received a Doctor of Philosophy in Curriculum and Instruction from the Louisiana State University in 2004. She taught middle and elementary grades in the West Baton Rouge Parish School System for several years. In 1998 was named the Lukeville Upper Elementary Teacher of the Year, as well as the West Baton Rouge Elementary Teacher of the Year. She has been awarded numerous grants which include: DOW Educational Grant of \$2,000 in 1996, 1998, 1999; Exxon Grant of \$1,000 in 1998; Quality Science and Math Grant of \$500 in 1995, 1996; Iberville Parish Academic Grant of \$2,000 in 2001 and \$4,600 in 2002. Currently she is the coordinator for the Science Materials Center a consortium of West Baton Rouge Parish School System and Iberville Parish School System.