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Environmental education resource for fifth grade science instruction

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ENVIRONMENTAL EDUCATION RESOURCE FOR FIFTH GRADE SCIENCE INSTRUCTION

A Project

Presented to the

Faculty of

California State University,

San Bernardino

In Partial Fulfillment

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in

Education:

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ABSTRACT

An environmental education resource guide was developed to be used by fifth grade teachers in the San Bernardino Unified School District. This resource guide aligns California's Environmental Principles and Concepts (California Environmental Protection Agency, 2006a) and California's Science Standards (California Department of Education, 1998) with lessons in the fifth grade California Science (Cooney et al., 2007) text in which they are addressed. The science lessons are further aligned with activities from well-known environmental education guides that employ constructivist teaching methods. This resource guide also includes suggested children's literature appropriate for the science lessons and some models to demonstrate how children's literature can be incorporated into instruction to enhance learning of the California Science Standards and the Environmental Principles and Concepts.

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CHAPTER ONE

INTRODUCTION

As an educator facing the tremendous task of preparing children to become functional and valuable members of society, I believe that environmental education is a critical component of education. Fifth grade was chosen for this project because of my professional expertise with this grade level.

The goal of this project was to develop an environmental education resource for fifth grade teachers using the California Science (Cooney et al., 2007) textbook. The goal is for teachers to be able to use this guide as a convenient resource to incorporate environmental education and environmental literature into science instruction. Using this resource could help teachers improve the effectiveness of their teaching and better prepare students for standardized tests in science and ultimately to develop them into environmentally literate citizens. This is a new resource that is not currently available to educators. It is hoped that in the future this resource will be disseminated through in-services to teachers in the San Bernardino City Unified School District and that it will be used by teachers as a

model of how environmental education and children's literature can be incorporated into instruction. While this resource is created specifically to be used by fifth grade teachers, teachers at other grade-levels could use this resource as a model for incorporating environmental education and children's literature into their grade-level curriculum.

This resource guide includes the alignment of California's Environmental Principles and Concepts (California Environmental Protection Agency, 2006a) and California's Science Standards (California Department of Education, 1998) with lessons in the fifth grade California Science text in which they are addressed. The science lessons are further aligned with activities from well-known environmental education guides that employ constructivist teaching methods. The guides include: Project WET (The Watercourse and the Council for Environmental Education, 2004), Project WILD (Council for Environmental Education, 2000), Project Learning Tree (American Forest Foundation, 2006b), Teaching Population (Population Connection, 2003), and Women in Mining (Mineral Information Institute, 2005).

This resource guide includes suggested children's literature appropriate for the science lessons. It also

includes some models to demonstrate how children's literature can be incorporated into instruction to enhance learning of California Science Standards (California Department of Education, 1998) and the Environmental Principles and Concepts (California Environmental Protection Agency, 2006a). Learning is enhanced by providing students with experiences that might not otherwise be possible. These experiences develop science process skills and problem-solving skills. The make content comprehensible to students. They promote greater understanding through fiction. They motivate reluctant readers, and develop vocabulary.

Teachers select from the suggested books to supplement science their lessons. These selections serve as springboards to introduce new concepts, or to function as the core of lessons. The use of children's literature in the context of science lessons is intended to add to the depth and scope of students' understanding of environmental and science concepts as well as to increase their motivation to learn in these subject areas. By using children's literature relevant to environmental and science topics, teachers can infuse more science learning into the busy school day by incorporating it into time

allocated to language arts (Stoner & Morrison, n.d., p. vi).

A major inspiration for this project was Lieberman and Hoody's study, Closing the Achievement Gap (1998). In this study, Lieberman and Hoody found using the Environment as an Integrating Context for Learning (EIC) to be effective for achieving specific educational outcomes. The researchers reported that EIC-based instruction, which includes using the environment to teach all subject areas, led to increased student engagement in learning as well as positive changes in behavior, attendance, and student attitudes about school in Kindergarten through twelfth grade (p. 20). Further, teachers and administrators reported substantial gains in students' over-all learning as a result of EIC. These gains include the development of personal responsibility, achievement of better grades, increased interest in learning, and increased motivation to succeed (p. 21). Evidence from the study demonstrated that using EIC led to increased student achievement on both authentic assessments such as projects or portfolios as well as standardized tests in reading, writing, math, social studies, and science (p. 22).

Through using the resource guide developed for this project, the teachers may be able to increase their students' motivation and achievement in mastering the California Science Standards (California Department of Education, 1998) and the new Environmental Principles and Concepts (California Environmental Protection Agency, 2006a). Greater motivation and academic achievement will likely lead to improved scores on standardized tests in science (Lieberman & Hoody, 1998, pp. 20, 21).

The use of this resource may also help teachers develop students' environmental literacy. Environmental literacy is defined as (1) having an empathetic perspective towards the environment; (2) understanding of the environment and its problems and issues; (3) skills for identifying and solving environmental problems and issues; and (4) motivation to participate in working toward resolution of environmental problems and issues (Hungerford & Volk, 2005, p. 314).

The Environmental Principles and Concepts are new for California education. In 2003, The Education and the Environment Initiative (EEI) was signed into law through Assembly Bill 1548 and more recently in AB 1721. "It mandates a broad-ranging strategy to bring education about the environment into California's K-12 schools"

(California Environmental Protection Agency, 2006a, para. 1). Under this initiative, California's resource agencies were required to develop Environmental Principles and Concepts to complement the state's academic content standards (California Environmental Protection Agency, 2006b). As the result of a collaborative effort between the California Environmental Protection Agency and the California Integrated Waste Management Board, in cooperation with the Resources Agency, State Department of Education, State Board of Education, and the Secretary for Education, the Environmental Principles and Concepts for California document was developed and approved by the Office of the Secretary of the California Protection Agency and the Integrated Waste Management Board in 2004 (California Environmental Protection Agency, 2006b).

It is my observation as a classroom teacher that environmental education is not often addressed in classrooms for a variety of reasons. These reasons include: (1) a plethora of pressures placed on teachers in California to improve test scores in language arts and math; (2) lack of teacher training in environmental education; and (3) the time constraints placed on educators by demanding work loads. Very few teachers know about the new Environmental Principles and Concepts, let

alone know how to address them in their teaching. This project is designed to assist teachers in easily including relevant learning activities and environmental literature in science lessons that incorporate the Environmental Principles and Concepts.

It is expected that, in addition to helping teachers incorporate environmental education into instruction, teachers using this resource will enhance what they are already teaching, using techniques that have been proven to be effective in helping students to reach deeper levels of understanding of science concepts.

Environmental education is a critical component in preparing our children to be future decision makers, and it should not continue to be ignored in classrooms. This guide will help teachers incorporate environmental education into various curriculum areas and thus develop environmental literacy while working towards other academic goals including science and language arts.

Incorporating the new California Environmental Principles and Concepts (California Environmental Protection Agency, 2006b) into the curriculum is absolutely crucial. As human population continues to grow, society will continue to place greater and greater demands upon the fragile environment. Because today's children

will be the decision makers whose actions and decisions will impact the health of the environment, it is essential that education provide them with the knowledge, skills, and motivation necessary to make those decisions responsibly. Ramsey, Hungerford, and Volk pointed out that "because education is the vehicle through which society prepares its citizens to carry out their responsibilities, education must be environmental" (2005, p. 127).

The health and well-being of present and future societies are inextricably linked to the health of the planet's natural resources. Humans depend on nature for all of the resources to meet basic needs for food, water, shelter, and air. There are also those resources that provide comforts, improve quality of life, and even provide sources of income. A large portion of society, especially youth, seem to have become so disconnected from nature that they don't even realize that their livelihood is dependent upon nature (Mineral Information Institute, 2005, p. 1). From the toothpaste used to brush teeth in the morning (which is made from minerals extracted from the earth) to the box that holds cereal (made from paper products procured from trees) to the fuel (drilled from the earth in the form of fossil fuels) used to run cars, everything people use and everything people do depends

upon nature and natural resources (Mineral Information Institute, 2005, p. 1). Survival depends on the resources gleaned from nature. Human actions have an enormous impact upon the health of the environment and either result in the destruction and degradation of the environment or allow people to live harmoniously with nature.

According to the Science Framework for California Public School: Kindergarten Through Grade Twelve, "educating children for the future is one of the principle aims of any well-balanced curriculum" (California Department of Education, 1990, p. 12). Environmental education can do just that. Preparing future citizens to make decisions that consider the impacts on the environment and to have the knowledge, skills, and motivation to make decisions that will allow them and future generations to live sustainably on the planet is one rationale for environmental education.

Organization of the Project

This project is divided into five chapters. Chapter One provides an introduction to the context of the problem, purpose of the project, and significance of the project. Chapter Two consists of a review of relevant literature. Chapter Three documents the steps and

rationale used in developing the project. Chapter Four presents the discussions and conclusions related to the project. The appendices for the project consists of: Appendix A: correlations of California's Environmental Principles and Concepts and California's Science Standards with lessons in the fifth grade California Science text and activities from environmental education Guides; Appendix B: correlations of California's Environmental Principles and Concepts and California's Science Standards with lessons in the fifth grade California Science text and environmental Literature supporting the lessons; and Appendix C: Models Demonstrating how Literature can be incorporated into instruction to achieve a variety of educational benefits. Finally, the project references are listed.

CHAPTER TWO

REVIEW OF THE LITERATURE

This project provides a resource for fifth grade teachers using the California Science (Cooney et al., 2007) text. This resource correlates California's Environmental Principles and Concepts and fifth grade California Science Standards with lessons in the text. This resource further correlates the lessons with activities from well-known environmental education guides that are intended to help teachers enhance lessons using constructivist methods. Finally, lessons are accompanied by a list of suggested children's literature, as well as some models which demonstrate how teachers can use literature to enhance learning while helping students develop important skills such as observation and problem solving. This resource is intended to assist teachers in their efforts to help students achieve mastery of the science standards and the environmental Principles and Concepts and to develop environmental literacy.

In preparing this project, several relevant topics and their contributions to education were researched. This review of literature looks at several definitions and goals of environmental education and explores the

importance and effectiveness of environmental education in improving achievement in science and preparing students for the future. Important findings from a landmark study called Closing the Achievement Gap (Lieberman & Hoody, 1998) are included in order as supporting evidence of the effectiveness of integrating environmental education into education. Next, the value of constructivism in teaching and learning is reviewed. Finally, an extensive review of the research on the use of environmental children's literature led to the development of six categories of educational benefits of using environmental literature as part of an integrated approach to teaching science. These categories are presented along with an explanation of how children's literature can enhance the classroom experience and increase student motivation, understanding, and achievement.

Definitions and Goals of Environmental Education

There has been a great deal of debate over the precise definition of environmental education. In fact, there has not been a consensus as to the definition. Many of the definitions presented in the early literature came out of fields closely related to environmental education, including conservation education, nature study, and

outdoor education. In 1967 Brandwein and Brennan (in Disinger, 2005, p. 18) provided a definition for environmental education as "the recognition by man of his interdependence with his environment and all of life and his responsibility to maintain the environment in a manner fit for life and fit for living." Brennan later reported that he never had any intention of using the term environmental education in any other manner than as a synonym for conservation education. Some researchers have taken the position that environmental education resulted from a metamorphosis between outdoor education and conservation education that occurred when both began to suffer the pressures of an increasingly urbanized society that was also becoming increasingly more aware of environmental problems such as pollution, overpopulation, and excess energy demands (Disinger, 2005, pp. 20, 21).

In 1969 William Stapp et al. provided the following definition:

> Environmental education is aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems, and motivated to work toward their solution. (Stapp et al., 1969, p. 31)

In 1996, The Environmental Protection Agency (in Disinger, 2005, p. 30) produced the following definition:

> Environmental education enhances critical-thinking, problem-solving, and effective decision-making skills. It also teaches individuals to weigh various sides of an issue to make informed and responsible decisions. Environmental education does not advocate a particular viewpoint or course of action.

Also in 1996, the National Environmental Education Advisory Council (in Disinger, 2005, p. 30) recorded the following definition:

> (Environmental education is) a learning process that increases people's knowledge and awareness about the environment and its associated challenges, develops the necessary skills and expertise to address these challenges, and fosters attitudes, motivations, and commitments to make informed decisions and take responsible action.

Despite variations in the definition of environmental education, the general goals of environmental education are similar. Thus, environmental educators strive to develop environmentally literate citizens and encourage environmentally responsible behavior (Culen, 2005, p. 37). The definitions all emphasize movement beyond knowledge to

the development of skills including critical-thinking, problem solving, and effective decision-making. These definitions further call for motivation and willingness on the part of students to take action on behalf of the environment (Disinger, 2005, p. 30).

To add to the definitions of environmental education, the goals of environmental education were defined in the founding document, The Tbilisi Declaration (2005). This document was adopted at the close of the world's first Intergovernmental Conference on Environmental Education which was held in Tbilisi, Georgia (USSR) in October 1977. The Tbilisi Declaration endorsed three important goals for environmental education.

- to foster clear awareness of and concern about economic, social, political, and ecological interdependence in urban and rural areas;
- to provide every person with opportunities to acquire the knowledge, values, attitudes, commitment, and skills needed to protect and improve the environment;
- to create new patterns of behavior of individuals, groups, and society as a whole towards the environment. (2005, p. 13)

This project's goals are consistent with the Tbilisi goals. Resources are provided to fifth grade teachers to enable them to effectively incorporate environmental education and literature into classroom lessons to enhance science and environmental instruction as well as language arts; to improve student learning in these areas; and ultimately to promote environmental literacy. Stapp's definition of environmental education has become widely accepted and is the definition chosen as the foundation in the design of this project.

Research Supporting Environmental Education Integrated into Education

Education strives to move students from a level of basic understanding and recall of information to higher order thinking skills, the ability to make inferences, draw connections between learning in various realms, and problem solve (Bloom, 1968, p. 15). Bloom's Taxonomy of Educational Objectives, which has been widely used by educators, indicates a hierarchy of understanding which moves students through the following stages: knowledge, comprehension, application, analysis, synthesis, evaluation (Bloom, p. 18). Similarly, environmental education strives to progress learners along a continuum beginning with knowledge of the biophysical environment

and its associated problems, becoming aware of how to solve these problems, and eventually developing into citizens who are motivated to work toward the solution of environmental problems (Stapp et al., 1969, p. 31).

Environmental education can be incorporated into the education curriculum across all content areas. In this way, it can become a powerful tool due to the fact that it can help learners draw connections between the various content areas, thus making learning more meaningful and deepening understanding. As stated by educator Judy Zimney, "Skills and concepts taught within the context of a meaningful whole...are learned more easily, and...are retained longer" (in Lieberman & Hoody, 1998, p. 7).

In 1998 Lieberman and Hoody prepared a report which reported the results of a nationwide study in which 40 schools, ranging from elementary to high school, used the environment provided by their surroundings and communities as a framework for learning in all subject areas. This educational model is referred to as using the Environment as an Integrating Context (EIC) for learning. The schools involved in the study represented a diversity of geographical settings and socio-economic levels across America. Each school in the program used its own program design based on its unique location, resources, and

student needs to address a common goal: providing students with the opportunity to connect and integrate what they are learning to their surroundings. While the 40 programs in the study employed different designs, goals, and locations, they shared several fundamental commonalities that characterize exceptional EIC-based instruction. These include: "interdisciplinary integration of subject matter; collaborative instruction; emphasis on problem solving and projects; combinations of independent and cooperative learning; and, learner-centered and constructivist approaches" (Lieberman & Hoody, 1998, p. 10). The results reflected a broad range of benefits. The results of the study were gathered both in the form of quantitative data including actual grade point averages and scores from standardized tests and qualitative data. Qualitative data for the purpose of this report were collected through interviews and surveys. There were three separate surveys used. A "Learning Survey" was used to determine teachers' and administrators' perceptions of the effects of EIC on students and learning. A "Teachers Survey" was used to determine teachers' and administrators' perceptions of the effects of EIC on teachers and instruction. Lastly, a third survey called the "Domains Survey" measured teachers' and administrators' observations of the effects

of EIC on students' learning in language arts, math, science, and social studies in terms of knowledge, skills, retention, attitudes toward learning, and opportunities for further understanding (Lieberman & Hoody, 1998, p. 103).

One important benefit of EIC found by the study was improved performance on standardized tests. Fourteen of the schools in the study, including six elementary schools, five middle schools, and three high schools, conducted comparative analysis of EIC and traditional students' performance on standardized tests. The results showed that, on average, 92% of the students who had been in the EIC programs academically outperformed their peers in traditional programs on standardized assessments in language arts, math, science, and social studies (Lieberman & Hoody, 1998, p. 23). Six of the fourteen schools compared academic achievement on comprehensive standardized tests and all of them found that EIC students outperformed traditional students.

Data from the Lieberman and Hoody (1998) study demonstrated that students in EIC programs experienced greater academic growth in language arts than their peers taught with traditional curricula. Nine schools in the study conducted comparative analysis of language arts

achievement data from both EIC and traditional students using several different standardized tests. There were four elementary schools, five middle schools, and one high school included in the study. On every one of the comparisons done, students from EIC programs outperformed their peers. In addition to the hard data, results from the Learning Survey and Domains Survey revealed that a great majority of EIC teachers perceived that the programs had positive impacts on student learning in language arts. "Evidence from the study schools indicates that language arts skills of students in EIC programs improved in three important ways: reading with improved understanding; writing more effectively; and, speaking with increased skill and confidence" (Lieberman & Hoody, 1998, p. 30). Teachers involved in the programs attributed the improvements in their students' language arts skills largely to students' increased interest in what they were doing, increased motivation, and the fact that students felt that what they were learning and doing was meaningful (Leiberman & Hoody, 1998, p. 30). Teachers in the EIC schools also reported that students were better able to apply language arts skills to real-world situations than students in traditional programs. They reported growth in the writing skills of students in the EIC programs as

demonstrated by greater volumes of higher quality work, use of more complex ideas, and more variety in genres, styles, and strategies (Lieberman & Hoody, 1998, p. 34).

Ninety-four percent of the educators in EIC programs that responded to the study's Learning Survey reported that EIC students were more successful in communicating to others than their peers in traditional programs. EIC programs provide frequent opportunities for students to make presentations about topics that are important to them, thus enabling the students to "increase the effectiveness of their oral communications; increase the ease and confidence of their speaking; and create better-conceived, more sophisticated oral presentations" (Lieberman & Hoody, 1998, p. 37). Many teachers noted that EIC students appeared to experience growths in their vocabulary and increased their use of technical and more sophisticated vocabulary (Lieberman & Hoody, 1998, p. 37).

In the content area of science EIC students scored higher, on three of four comparative studies of standardized science achievement data, than their peers from traditional programs (Lieberman & Hoody, 1998, p. 47). The study involved two elementary schools, one middle school, and one high school and included three different standardized tests.

One hundred percent of teachers that responded to the Learning Survey reported that EIC approaches helped their students learn science better than teaching science through traditional methods. As a result, Leiberman and Hoody concluded, "As EIC students move from studying abstract scientific concepts to participating in concrete experiences, they gain improved proficiency in learning science content and processes" (1998, p. 46).

According to the Domains Survey, teachers and administrators perceived that the primary effects of EIC on students' learning in science spanned four main areas. Firstly, 99 percent of educators responding to the survey reported that students of all ability levels were able to achieve "increased knowledge and understanding of science content, concepts, processes, and principles" (Lieberman & Hoody, 1998, p. 47). Educators found EIC methods allowed them to employ creative means of using the environment to more effectively help students in understanding all areas of scientific study. Through hands-on experiences in the local environment, educators felt their students had gained and were able to demonstrate deeper understandings of complex scientific knowledge than their peers in traditional programs (Lieberman & Hoody, 1998, p. 47).

Secondly, students benefited from improved abilities to apply science to real-situations. Involvement in real-world projects led to improved abilities in scientific observation, data collection, analysis, and formulating conclusions (Lieberman & Hoody, 1998, p. 49). "Rather than plugging away week after week in the lab, solving someone else's questions, EIC students venture into the real world where a variety of experiences prompt them to develop questions of their own" (Lieberman & Hoody, 1998, p. 49). Ninety-seven percent of educators responding to the survey said that EIC students were more capable of solving problems and thinking strategically than their traditionally educated peers. Teachers reported that students in EIC programs gained significant growth in higher-level scientific skills. As an indication of this increased growth, many teachers reported that science projects submitted by students who had participated in EIC programs showed noticeable improvements over earlier products conducted within traditional learning settings. Leiberman and Hoody noted that the design of EIC programs allows EIC students to experience the rigor of actual research as they apply scientific skills and research in authentic situations. These students were reported to "formulate their own research designs, set up, and monitor

their own studies, rather than waiting for teachers to propose and supervise projects" (Lieberman & Hoody, 1998, p. 50). Participation in the type of authentic scientific activities provided by EIC programs allows students to cultivate the scientific skills they will need to solve the types of real-world problems they will encounter throughout their lives.

Thirdly, students engaging in learning about their communities and natural surroundings built interest and motivation for studying science (Lieberman & Hoody, 1998, p. 51). "A full 98 percent of Domains Survey respondents reported that students demonstrated increased engagement, enthusiasm, and interest in science after the implementation of EIC curricula" (Lieberman & Hoody, 1998, p. 51).

Finally, educators found EIC students to have a "deeper more personal understanding of the significance of science to their daily lives" than their traditionally educated peers (Lieberman & Hoody, 1998, p. 46). Ninety-eight percent of EIC teachers surveyed reported that EIC allowed them to teach science in ways that allowed students to relate the academic content directly to their own lives (Lieberman & Hoody, 1998, p. 52).

The successes of EIC programs are attributed in part to the fundamental educational strategies it employs: drawing connections between disciplines, providing hands-on learning experiences, problem-solving and project-based activities, and the ability to adapt to students' unique skills and abilities (Lieberman & Hoody, 1998, p. 47). Teachers of EIC programs felt that:

> In addition to traditional subject-matter knowledge and basic life skills, EIC students gain a wealth of added educational benefits, including: a comprehensive understanding of the world; advanced thinking skills leading to discovery and real-world problem-solving; and, awareness and appreciation of the diversity of viewpoints within a democratic society. (Lieberman & Hoody, 1998, p. 2)

This project will help fifth grade classroom teachers employ some of the same instructional techniques and strategies that the EIC teachers in Leiberman and Hoody's study have found to generate such profound gains for their students. These strategies include using constructivist approaches, providing hands-on learning experiences that often involve problem solving and critical thinking, and using the environment as a context for teaching and learning across many subjects and skill sets. An essential

component of EIC programs and one of the main thrusts of this project is the use of constructivist activities.

Constructivism

EIC often employs the constructivist learning theory. "Constructivism is an educational theory that emphasizes hands-on, activity-based teaching and learning" (Johnson, Dupris, Musial, Hall, & Gollnick, 1996, p. 400). The constructivist theory is based on the tenant that "students create new understandings by combining previous knowledge with new discoveries" (American Forest Foundation, 2006b, p. 5). Constructivist methods, therefore, place emphasis on the learner and the process of making meaning through discovery. Students play an active role in their education as opposed to being passive recipients of knowledge. Instead of the teacher dispensing knowledge to the students as traditional teaching methods have emphasized, the teacher's role becomes that of a facilitator of learning who provides students with opportunities to make discoveries and build upon their previous knowledge.

Constructivist theorists encourage the development of critical thinking and the understanding of big ideas rather than the mastery of factual information. They

contend that students who have a sound understanding of important principles that were developed through their own critical thinking will be better prepared for the complex, technological world (Johnson et al., 1996, p. 400).

Using constructivist methods allows learning to take on a personal quality. Students can draw connections to what they already know, and create new knowledge that is meaningful and rooted in deep understanding so that it can be internalized and retained (Ballantyne & Packer, 1996).

Constructivism has important implications for environmental education. Individuals construct their own conceptions of the world based on their existing knowledge, attitudes, values, and behavioral-orientations regarding various phenomena (Ballantyne & Packer, 1996).

In order to assist students in meeting particular knowledge, value, and behavioral objectives, it is necessary for an environmental educator to recognize and address any conceptions students may have of the subject under consideration. The teacher must then help learners to become aware of the different conceptions they hold and provide opportunities to compare the relative merits of different conceptions. Students should engage in learning experiences which challenge existing misconceptions and help them to form new understandings that are

scientifically grounded. "Thus, the constructivist framework provides a teaching approach that links an individual's conception of a phenomenon with his or her knowledge, attitudes/values, and behavior in relation to that phenomenon" (Ballantyne & Packer, 1996, p. 4).

In the resource guide developed in this project, fifth grade teachers will find an extensive list of environmental activities that are aligned to the California Science Standards and California's Environmental Principles and Concepts as well lessons in the California Science textbook. These environmental activities from the well-known environmental activity guides Project WET, Project WILD, Project Learning Tree, Teaching Population, and Women in Mining use constructivist teaching techniques. Teachers may use this resource guide to incorporate relevant learning activities into science instruction that are based on constructivist techniques, helping them to improve classroom instruction and increase student mastery of the California Science Standards. Also, the use of children's literature easily lends itself to the use of constructivist techniques. The literature models included in this resource guide include many examples that demonstrate the use of constructivist teaching techniques in conjunction with the use of

literature to help students gain a comprehensive understanding of science concepts and vocabulary. Teachers may be able to use these models of constructivist teaching as a guide and apply the techniques to other lessons to create more effective learning experiences for their students.

Using Environmental Children's Literature in the Classroom

According to the Reading/Language Arts Framework for California Public Schools, Kindergarten through Grade Twelve, authored by the California Department of Education (CDE), the goal of developing life-long readers and writers requires development of competence in language arts skills, and academic language, motivation, accessibility of reading and writing materials, and experiences with print (2007, p. 12). Infusing environmental literature into the classroom is an effective avenue through which to meet these instructional goals while simultaneously developing environmental literacy.

In the reading/language arts framework it is pointed out that motivation to read, a critical component in building literacy among students, is linked to four key features of a literacy program: providing access to books,

offering choice of texts, establishing familiarity about a topic, and promoting social interactions about books (CDE, 2007, p. 21). Because students often have a natural sense of wonder about the world that surrounds them as well as wild animals, teachers may be served very well by incorporating environmental literature into the classroom in order to help develop motivated readers. This may be especially successful when the literature is presented along side of hands-on activities that help to reinforce and extend concepts and vocabulary the students have explored through literature.

According to the Reading/Language Arts Framework, vocabulary is a vital element of academic language. A study done of low-income students found a trend of declining word-meaning scores for students beginning after third grade and declining scores for oral and silent reading comprehension in the sixth and seventh grades (California Department of Education, 2007, p. 22). Difficulties with vocabulary are often the result of a lack of experiences, exposure to, and interactions with high volumes of print. In order to develop academic language and help combat these trends, four strategies are suggested including: reading aloud to students, conducting instructional discussions, reading by students, and

writing (California Department of Education, 2007, p. 23). Environmental literature is ideal for serving each of these purposes. Since much of environmental literature is science-based, using environmental literature can help teachers accomplish literacy goals while also helping to build knowledge of science concepts and vocabulary, thus creating more time for science without detracting time from other subject areas (Stoner & Morrison, n.d., p. vi). When environmental education is taught as a theme, it can be applied across numerous subject areas. This provides a link between concepts and skills, giving students a greater context for understanding and making learning more meaningful. Environmental literature can be used in various subject areas to accomplish a variety of instructional objectives (Stoner & Morrison, n.d., p. 4).

Children's literature has been noted by many educators as being an indispensable teaching and learning tool (Lamme & Pringle, 2005; O'Brien & Stoner, 1987; Parsons, 2000; Stoner & Morrison, n.d.; Wells & Zeece, 2007). A review of available research on the use of environmental children's literature in the classroom revealed a number of benefits for education. For this master's project, these benefits were organized into six main categories of educational outcomes including the

following: Literature helps the teacher provide students with experiences that might not otherwise be possible (Stoner & Morrison, n.d., p. 7). Literature selections can provide a springboard for vocabulary building discussions (American Forest Foundation, 2006b, p. 7, 8). Books can be motivational for reluctant students (O'Brien & Stoner, 1987, p. 15). Fiction books are helpful in explaining information in ways that children can understand and relate to personally, promoting greater understanding of science concepts (O'Brien & Stoner, p. 15). Environmental children's literature explains science content in ways that make content comprehensible to students (O'Brien & Stoner, p. 15). And finally, some books are useful for helping to develop science process skills, such as observation, as well as problem solving skills (Lamme & Pringle, 2005, p. 2). Teachers can use environmental literature to align classroom instruction with the curriculum frameworks and help develop skills across the curriculum (Stoner & Morrison, n.d., p. vi).

These categories, used as a basis for literature examples in this master's project, are now further explored.

Using Environmental Children's Literature to Provide Experiences Not Otherwise Possible

Environmental literature allows teachers to expand the experiences of their students beyond the confines of the classroom walls, allowing students to experience ideas and concepts and see things they might not otherwise have access to. Environmental literature can provide students opportunities to explore places and things that are too far away or inconvenient to experience firsthand (Stoner & Morrison, n.d., p. 7).

According to Lamme and Pringle (2005), quality environmental literature, used appropriately, can enhance the classroom experience in ways that cannot be accomplished as successfully through any other means. Books, for example, are an invaluable resource for studying animals. Most students do not have many opportunities to study animals in their natural habitats, but literature can provide access to a wide range of information about any animal students may wish to investigate. Books can help students learn basic factual information about an animal, its habitat, what it eats, etc., and can also help to extend the child's learning to another level. Many stories, for example, allow students to see the world through the perspective of the animal,

giving a deeper understanding of the animal and possibly helping to develop a greater appreciation for it (Lamme & Pringle, 2005).

Lamme and Pringle (2005) noted that books can provide learning opportunities leading to deeper, more extensive understanding, including dealing with misunderstandings, of the natural world that could not be accomplished through other avenues of learning in the classroom. Using a picture book, for instance, students can study a close up picture of an animal, allowing them to observe details in a way that would not be possible with a wild animal that would move or is not safe to get that close to. Through books, students can explore, learn about, and gain an appreciation for aspects of nature they might otherwise be afraid of such as spiders or thunderstorms. Illustrations can magnify size, allowing students to study things in greater detail. Books can make it possible to view things not normally available for human observation such as rare plants or animals. They can describe events or phenomena that are difficult to see with human eye. Books can explain events or phenomena such as the lifecycle of a plant or animal which could not be observed during the time frame available in a classroom (Lamme & Pringle, 2005, p. 2).

Using Environmental Children's Literature to Develop Vocabulary

Reading aloud to children provides abundant opportunities to discuss new vocabulary that is encountered in the text. It can lead to discussions about words and help increase students' vocabulary knowledge. One difficulty experienced by many students from low-income families and students for whom English is the second language is a lack of vocabulary knowledge. Every opportunity should be considered to help these students expand their working vocabulary. By carefully selecting high-quality literature to read-aloud to children, teachers can seize the opportunity to introduce and involve students in discussion of important terms in an engaging setting (American Forest Foundation, 2006b, p. 7, 8).

Using Environmental Children's Literature to Motivate Reluctant Readers

O'Brien and Stoner (1987) noted that using environmental literature in the classroom can help motivate reluctant students as literature choices may provide less intimidating sources of information than expository textbooks. Literary sources may present the material in way that is more appealing to students, for

example, by presenting the information in the context of a story. As pointed out by O'Brien and Stoner,

> Careful selection of literature, in addition to helping students better understand these concepts, can arouse interest in the environment … The books often help them to understand and appreciate the environment by portraying cause-effect relationships, presenting vivid descriptions and accurate pictures, and providing vicarious experiences. (p. 15)

The books, therefore, can serve as motivators to arouse children's interest in learning about a particular topic or their desire to read about it on their own.

Using Fictional Environmental Children's Literature to Promote Greater Understanding of Science Concepts

Fictional titles often more clearly explain major concepts or complicated processes (O'Brien & Stoner, 1987, p. 15). A very abstract concept such as interdependence, for example, becomes much easier to understand in the context of a story. Through a variety of selections, students can be exposed to numerous examples. Stoner and Morrison (n.d.) noted that stories allow students to understand environmental concepts in terms that are developmentally appropriate. Stories for younger students may employ anthropomorphism and other make-believe

characters, which make stories enjoyable for the children while promoting understanding of environmental concepts (p. 6).

Fictional selections of environmental literature can enhance instruction in some important ways that cannot be achieved through other methods. Providing information in the format of a story allows students to experience from the viewpoint of the wildlife (Parsons, 2000). Students can relate to the experiences of wildlife, helping them to gain an understanding of the technical consequences of something like habitat loss/destruction, and also helping to develop empathy to what it means to the wildlife. Students may be able to gain a clearer understanding because they are able to relate to how they themselves may feel with the loss of their own home; they can draw a connection between their own life and the phenomena of nature. Stories allow students to gain understanding through a point of view other their own, develop empathetic engagement with the natural world, and gain a more objective perspective of the natural world (Parsons, 2000, p. 7). In other words, through the literature, students can move beyond ecological knowledge and awareness, and begin developing sensitivity and personal connection with nature.

Using Environmental Children's Literature to Make Content Comprehensible to Students

Children's literature often explains difficult concepts in ways that are more comprehensible to children than text books, and "the books often help them to understand and appreciate the environment by portraying cause-effect relationships, presenting vivid descriptions and accurate pictures, and providing vicarious relationships" (O'Brien & Stoner, p. 15).

Students are naturally curious about the world around them and have many questions about plants, animals, and the natural phenomena they experience or hear about. Many of these questions can be answered in the classroom setting through the regular curriculum, but the use of high-quality environmental literature can open up the doors of understanding and comprehension of nature even wider (Lamme & Pringle, 2005, pp. 4, 5). Children's literature can teach ecological concepts in a context that is familiar to students, helping them establish connections between their own lives and the world around them and providing a basis for understanding. Through literature, students can conceptualize a relationship between their own lives and experiences and the ecosystem (Wells & Zeece, 2007, p. 4).

Children's literature explains the world in a variety of ways. This is beneficial because, in order for students to understand and appreciate ecological concepts, the concepts must be presented in ways that match their way of thinking and are relevant to their life and experiences (Wells & Zeece, 2007, p. 4). Books can explain difficult concepts in manageable parts using simple words and pictures (Wells & Zeece, 2007, p. 4).

Using Environmental Children's Literature to Develop Science Process Skills and Problem Solving Skills

Observation is an important scientific process skill and is an essential component in learning about and gaining appreciation for natural phenomena (Lamme & Pringle, 2005). Environmental literature can help convey the importance of this skill to students and develop their motivation to make observations about the world around them. This may include a wide array of books, including books that contain story characters who themselves make observations about nature (Lamme & Pringle, 2005, p. 2). The development of observation skills is essential, not only for building competence in science within the classroom, but for students to become observers of the world around them, developing environmental sensitivity

(an empathetic perspective toward the environment), and moving towards becoming action-oriented citizens.

Parsons (2000, p. 7) pointed out that stories help to cultivate imagination. In an environmental context, imagination may be a powerful force because it leads to the ability to question what the future may look like. This, in turn, inspires consideration of priorities and how personal actions affect the world or how actions could lead to a better world. This type of critical thinking and consideration of personal responsibility and connection within the world is a major crux of environmental education as well as general education. "Good stories call us to critical thought and, as a result, deeper insights into ourselves, our relationships, our relative places within the world" (Parsons, 2000, p. 9).

Many children's books provide opportunities to discuss multiple perspectives and to engage students in discussions that help them to consider the values of themselves and others. These types of opportunities help students develop and use critical-thinking skills and promote better decision-making (Christenson, 2004, p. 12).

Stories can help to develop inquisitiveness in students, providing experiences that lead them to ask questions or desire to find out how they can help

(Parsons, 2000). This increased interest may provide a catalyst, leading students to seek out and read further to gain more information about the environment or seek avenues to help work towards solutions to environmental problems or issues. Stories help students gain insight into what is really important in the world and in the environment and can provide a motivational building point for them to pursue additional information though nonfiction text (Parsons, 2000, p. 7).

According to Stoner and Morrison (n.d.), by analyzing the ideas and actions of story characters and considering personal choices and applications students can develop their problem-solving skills through stories. Also, children develop logical thinking skills as the consider sequence of events, cause and effect, and possible associations in stories (p. 6).

Books cannot replace first hand observations and real-life experiences outdoors, however, they can bring to students an extensive array of information and experiences that would not be readily accessible in the classroom (Lamme & Pringle, 2005; O'Brien & Stoner, 1987; Stoner & Morrison, n.d.). They can also encourage observation, serve as a catalyst for the kind of dialogue that is essential to critical thinking, and function as a

significant instructional tool to assist teachers in helping students master academic content standards, learn essential vocabulary, and achieve the goals of environmental education (Lamme & Pringle, 2005, p. 5). The literature models developed for this project demonstrate how literature can be incorporated into instruction to serve each of these important academic functions. Using the provided models as examples, teachers can choose from the suggested list of literature developed in this project to create additional lessons to accomplish a limitless number of learning goals. This will help teachers to select appropriate literature to incorporate into the curriculum, and to combine use of the literature with activities that reinforce and extend essential environmental and science concepts, skills, and vocabulary.

The research demonstrates that environmental children's literature can be a teaching powerful tool boasting a variety of benefits for educational outcomes (Lamme & Pringle, 2005; O'Brien & Stoner, 1987; Parsons, 2000; Stoner and Morrison, n.d.; Wells & Zeece, 2007). Although teachers may be aware of literature's potential benefits and the richness its use could add to the classroom, already overworked teachers may not have the

time in their busy schedules to identify high-quality literature books to fit their instructional needs. In order for teachers to be empowered to use literature copiously in their classrooms, they need a resource that makes identifying high-quality literature aligned with instructional goals a quick and easy task. Thus this resource guide was developed for this master's project that would make such a resource available to fifth grade teachers. It was also recognized that teachers may not be sure of how to use literature effectively aside from simply reading aloud to students. To become effective in using literature to enhance instruction, teachers would need models to demonstrate how literature could be effectively incorporated into the classroom. A resource was created in this project that demonstrates how literature can be used to achieve the benefits of literature identified in the literature review. Teachers could easily follow the models to develop additional lessons with other books to achieve whatever educational objectives they desire.

CHAPTER THREE

DESIGN OF PROJECT

Introduction

This project provides a resource guide that fifth grade teachers in San Bernardino City Unified School District could use to align California's Environmental Principles and Concepts and the California Science Content Standards with the science curriculum using constructivist activities and environmental literature. This project was based on research supporting the effectiveness of constructivism, the Environment as an Integrating Context for learning model (EIC), and research supporting the effectiveness of using children's literature in the classroom.

The resource guide provided in Appendix A is intended to provide teachers with a resource that will help them incorporate environmental activities which use constructivist teaching techniques into their instruction. Thus teachers could more effectively teach the California Science Standards as well as the Environmental Concepts and Principles. Use of these environmental activities will help teachers improve instruction and student learning in a few ways. First, the activities employ constructivism

which has been widely accepted in the field of education as a successful method of teaching and learning (American Forest Foundation, 1995). Secondly, the activities involve students in activities which use the environment as a basis for teaching the science concepts. This model, known as using the Environment as and Integrating Context (EIC), has been shown to have many positive benefits for educational outcomes (Leiberman & Hoody, 1998). Thirdly, the environmental activities employ many of the techniques that Leiberman and Hoody (1998) found to be successful components of EIC programs, including an interdisciplinary integration of subject matter, emphasis on problem solving and projects, combinations of independent and cooperative learning, and learner-centered and constructivist approaches.

In developing the correlations of California's Environmental Principles and Concepts and the California Science Content Standards with environmental activities from three environmental education guides, the Project Learning Tree website was consulted (Amercian Forest Foundation, 2006a). The three guides include: Project WET (The Watercourse and the Council for Environmental Education, 1995), Project WILD (Council for Environmental Education, 2000), and Project Learning Tree (American

Forest Foundation, 2006b). Activities from Teaching Population (Population Connection, 2003) and Women in Mining (Mineral Information Institute, 2005) were added to those obtained from the original three activity guides found on the website. Activities were selected based on their strength in underscoring the California Science Standards and Environmental Principles and Concepts and useability in a classroom setting based on personal experience.

The Grade Five California Science Standards and the Environmental Principles and Concepts were then further aligned with the lessons in the California Science (Cooney et al., 2007) text. The California Science Standards for fifth grade fall into four main branches of science: physical science, life science, earth science, and investigations and experimentations. Under each branch there are one or two main topics that are emphasized as follows: physical science-- "elements and their combinations account for the varied types of matter in the world", life sciences-- "plants and animals have structures for respiration, digestion, waste disposal, and transport of materials", earth sciences-- "water moves between the oceans and land through the process of evaporation and condensation" and "energy from the sun

heats earth unevenly, causing air currents that result in changing weather patterns", and lastly investigation and experimentation-- "scientific progress is made my asking meaningful questions and conducting careful investigations" (California Department of Education, 1998). An additional topic of emphasis, the planets and solar system, was not included in this project because there are no Environmental Principles and Concepts or environmental activities that applied to this topic.

A Constructivist Approach

Constructivism has been a guiding force in the revision of today's education. "Its teaching and learning strategies are aligned with how researchers now believe students learn best" (American Forest Foundation, 1995, p. 12). Constructivism emphasizes the process of discovery in which each individual creates his or her own understanding by combining previous knowledge with new discoveries (American Forest Foundation, 2006b, p. 5). In a constructivist classroom, the teacher plays the role of a facilitator who provides opportunities for students to participate in hands-on activities, work and cooperatively and individually to make discoveries, and develop new understandings. As lessons from the environmental

education activity guides are designed according to the constructivist philosophy of teaching and learning, teachers will be able to use these activities to apply constructivist techniques and help students master concepts in the Grade Five California Science Standards and the Environmental Concepts and Principles. For example, the Project Learning Tree activity "Water Wonders" (American Forest Foundation, 2006b, pp. 188-193) addresses California Earth Science Standards 3a-d and several of the Environmental Principles and Concepts (see Appendix A) using constructivist techniques. This activity begins by having students consider their current knowledge and understanding related to the water cycle. Students write down words or phrases that demonstrate their current knowledge of the water cycle. Students then write their own description of the water cycle and share it with their peers. This is an important step in a constructivist approach, because students build upon their previous knowledge and understanding of the concept. Next, the teacher asks the students some questions which require them to think critically about the topic. These questions include: (1) "If every living thing needs so much water, why isn't it used up?"; (2) "Where does the water go when a puddle dries up?"; (3) "Why don't oceans and lakes dry

up like puddles do?"; (4) "where does rain come from?"; (5) "Do you think water always follows the same path as shown in the water cycle?" (American Forest Foundation, 2006b, p. 189). Even though students are likely to be unable to answer some of these questions at this point or may answer them incorrectly due to their misconceptions, these questions give them a focus to think about while they are participating in the activity. During the activity, students pretend to be a drop of water traveling through the environment. There are seven stations set up, each representing a stop water might take in its journey though the water cycle including: oceans, icecaps/ glaciers, groundwater, stream, animal, plant, and cloud. At each station, students roll a die and then read a card set up at the station to determine what happens to them and what station they will go to next. At the stream station for example, a student may find out that he or she will evaporate into the air and end up in a cloud, get drunk by an animal, or roll downhill and end up in the ocean. As students continue to play the game, they begin to see many different ways that water can move though the water cycle. As demonstrated by Leiberman and Hoody's study of EIC programs which relied heavily on constructivist teaching methods, students would be more

likely to gain a real understanding of the complexities of the water cycle and how it works by participating in this activity than if they had simply read about it in a textbook. The concepts hold more personal meaning, because students are personally involved in the experience and learn through active participation. After students have traveled through the cycle at least a couple of times, the class analyzes some of the different routes of water through the water cycle experienced by various students. The teacher uses questioning to help draw students' attention to certain characteristics of the data such as similarities amongst the various paths and the fact that the ocean station seems to get visited by the most water molecules. The teacher asks some more questions that require students to make inferences based on the data (the teacher is helping the students discover the information on their own instead of just telling it to them). Students should be able to infer, for example, that the ocean station was visited the most often because most of the Earth's water is in the ocean. In part B of this activity, students are asked whether people can control or alter the water cycle and whether plants have any effect on the water cycle. Students then build a terrarium and make observations in order to draw their own conclusions. Again

the teacher asks questions, and students can use their observations to help them draw conclusions to relate what they have observed to the real world. Through the use of hands-on activities, students are given a frame of reference for building understanding and develop personal experiences to which they can attach meaning. This kind of deeper understanding would not be possible using a textbook alone or through a traditional teaching style in which the teacher simply provides the students with the information. Just as the students in schools with EIC programs use the environment, first-hand observations, and personal discovery as a context to make content more meaningful, students doing these activities would do the same.

In the activity "A Drop in the Bucket" from Project WET (The Watercourse and the Council for Environmental Education, 2004, pp. 238-241), students calculate the percentage of fresh water available for human use and use what they learn to explain why water is a limited resource. Following a constructivist approach to teaching, students use the data to draw their own conclusions and develop understanding on their own. This activity helps students gain an understanding of some of the Environmental Principles and Concepts and Grade Five

California Content Standards in science (see Appendix A) as well math. It also provides an opportunity to develop language arts and listening and speaking skills within a meaningful context as students explain their reasoning and then conduct additional activities to communicate what they've learned to others. Students also practice and develop skills such as analyzing information, drawing conclusions, and critical thinking.

Using Environmental Children's Literature

Research on the use of environmental children's literature in the classroom revealed many benefits in terms of educational outcomes. For this project, six categories were developed to describe the benefits of using environmental literature as part of an integrated approach to teaching science. First, literature can provide experiences that would not otherwise be available to students (Stoner & Morrison, n.d., p. 7). Second, literature selections are often useful for vocabulary building discussions (American Forest Foundation, 2006b, p. 7, 8). Third, environmental literature is often motivational for reluctant readers (O'Brien & Stoner, 1987, p. 15). Fourth, fictional literature often explains information in ways that children can understand and

relate to personally, promoting greater understanding of science concepts (O'Brien & Stoner, p. 15). Fifth, environmental children's literature explains science content in ways that make content comprehensible to students (O'Brien & Stoner, p. 15). Finally, environmental children's literature can help develop science process skills and problem solving skills (Lamme & Pringle, 2005, p. 2). Environmental literature is ideal for accomplishing literacy goals stated in the Reading/Language Arts Framework for California Public Schools, Kindergarten through Grade (CDE, 2007). The reading/language arts framework emphasizes the importance of motivating students to read and promotes using read alouds, instructional discussions, social interactions about books, reading by students, and writing to develop vocabulary and academic language as effective methods of accomplishing this goal. Using environmental literature is an especially effective tool, because it can help accomplish literacy goals while also helping to build knowledge of science concepts and vocabulary and develop environmental literacy. It can be a powerful tool in the classroom when combined with constructivist activities and science instruction as part of an integrated instructional approach.

In Appendix C, models were created to demonstrate how literature can be used to accomplish each of the educational outcomes listed above. The models include many examples that demonstrate the use of constructivist techniques in conjunction with the use of literature to help students gain a comprehensive understanding of science concepts, vocabulary, science process skills, and Environmental Principles and Concepts. The first two outcomes were combined into one category. The suggestions for use are based on personal experience as a classroom teacher in being familiar with a variety of teaching techniques. Specific applications for use that were drawn from a specific source are cited. Teachers can use the models provided in Appendix C as examples of how environmental children's literature can be used to incorporate environmental education into the classroom and enhance classroom instruction. Appendix B of this resource provides teachers with an extensive list of high-quality literature titles aligned to the California Science Standards and California's Environmental Principles and Concepts that they can use to extend the learning in their classrooms to accomplish any of the educational benefits previously described. Teachers can use environmental literature to align classroom instruction with the

curriculum frameworks and help develop skills across the curriculum (Stoner & Morrison, n.d., p. vi).

Guidelines for Using the Resource Guide

In order to use the resource guide provided in Appendices A and B, teachers will first decide upon a content standard to be taught. Teachers may decide to initiate instruction either with an environmental activity, using a hands-on/ constructivist approach to introduce the science concepts, or to begin by using a literature approach. Whichever approach is chosen, both approaches maybe ultimately be combined to create an integrated approach to teaching science. If teachers desire to begin with an environmental activity, they will first consult Appendix A. They will begin by locating the California Science Content Standard in the first column. Looking across the table, teachers will find the lessons in the California Science text and the Environmental Principles and Concepts that align with the standard. In the last column teachers will find activities from the environmental education guides that support the California Science Content Standard(s) and Environmental Principles and Concepts to be taught. The key preceding the appendix shows in which environmental education guide each activity

can be found. Teachers will look over the activities to determine which one(s) are best suited to their needs and whether they want to use the activities to introduce the lesson, as an on-going activity throughout the lesson, or as a follow-up.

The following is the step-by-step strategy that teachers would use for lesson planning based on the resources provided by this guide. I wish teach Life Sciences Standard 2f: "Plants and animals have structures for respiration, digestion, waste disposal, and transport of materials. As a basis for understanding this concept: Students know plants use carbon dioxide (CO_2) and energy from sunlight to build molecules of sugar and release oxygen" (California Department of Education, 1990). Because I know that my students have limited background knowledge of this concept, I have decided that I wish to engage my students with a constructivist based/ hands-on environmental activity to help them build a foundation of understanding. Therefore, I begin by consulting Appendix A. I find the standard in the first column, then look across the table to find that this lesson is taught in Chapter 3, lesson 3 of California Science. The Environmental Principles and Concepts related to this standard include: "(1) explain the role of photosynthesis

in the functioning of terrestrial, freshwater, coastal, and marine ecosystems; (2) explain why photosynthesis is essential to the survival of humans and human communities; and (3) provide examples of how humans and human communities can influence the process of photosynthesis and thus the flow of matter and energy within natural systems" (American Forest Foundation, 2006a). Environmental activities that can be used to teach this California Content Standard and Environmental Principles and Concepts are: Life Box (PW, p. 76), Air Plants (PLT, p. 120), Three Cheers for Trees (PLT, p. 130), and A Forest for Many Uses (PLT, p. 137). Next I consult my Project WET and Project Learning Tree teaching guides, preview the lessons listed above, and choose the activity or activities that I feel will be the most beneficial to my students.

Next the teacher may identify environmental literature helpful for teaching the identified standard and Environmental Principles and Concepts by consulting Appendix B. The teacher will use the same method described above to use this resource. For example, if I am teaching the standard identified previously, life sciences 2f, I will look at the first column on the table in Appendix B to find the standard. Looking across the table I will see

the same lessons in California Science and the same Environmental Principles and Concepts that were listed with this standard in Appendix A. Looking in the far right column I will find titles of environmental literature that I can use to teach this standard. These include The Secret Life of Trees, Shelterwood, The Giving Tree, Mighty Tree, Be a Friend to Trees, The Wump World, and The Big Tree. For ideas on how the literature may be used to enhance student learning, teachers may consult Appendix C. Teachers will find examples of how the literature can be used to accomplish each of the following educational outcomes: provide experiences not otherwise possible, develop vocabulary, motivate reluctant readers, promote greater understanding of science concepts through fiction, develop science process skills, and make content comprehensible to students. Teachers can use the suggestions provided as a model for how to incorporate the literature into their classroom to enhance instruction and accomplish the desired educational outcomes. For example, this standard requires understanding of quite a few vocabulary terms that may be new to students such as photosynthesis, chlorophyll, xylem, phloem, and carbon dioxide. Teachers, therefore, may choose to use this book as a starting point for introducing some of these

vocabulary words to students in a format and style that is easier for them to understand than their text books. The diagrams and pictures in this book are helpful for making the terms more understandable to visual learners. The book may be used as a context for discussion using the academic vocabulary students need to know to understand this standard. Because the book is presented in a story format, teachers may choose to use this book to motivate students and spark their interest in learning more on the topic. Also, teachers can use this book to develop environmental literacy. Because it draws a connection between the trees and humans- showing that each one is unique and has different experiences which determine how they grow into adulthood, it helps students relate to the tree promoting a sympathetic attitude towards trees. The story also provides a context for discussion of the Environmental Principles and Concepts. For example, it shows how human behaviors impact the trees and thus "influence the process of photosynthesis and thus the flow of matter and energy within natural systems." This book may be used to draw cross-curricular connections. In the context of the story, it alludes to the American Revolution which is a major topic of study in fifth grade social science as well as language arts. Teachers may choose to use this book in a

variety of different ways as best suited to meet the needs of their students to accomplish a variety of educational outcomes. The use of the literature can be combined with constructivist activities in an integrated approach to science instruction in order to help students develop a comprehensive understanding of California Science Standards and Environmental Principles and Concepts.

CHAPTER FOUR

DISCUSSION AND CONCLUSIONS

"Many things on which our future health and prosperity depend are in dire jeopardy: climate stability, the resilience and productivity of natural systems, the beauty of the natural world, and biological diversity" (Orr, 2004, p. 7). One need only take a deep breath outside on a smoggy day, open up a newspaper, or turn on the news, and it becomes alarmingly clear that these words speak the unfortunate truth. It is unmistakable that our education system has the immense responsibility of preparing students to develop into environmentally literate citizens who will act as stewards of the earth, working towards solutions to the environmental problems we currently face and preventing new problems instead of contributing to the earth's destruction. As David Orr (2004) pointed out, "all education is environmental education. By what is included or excluded, students are taught that they are part or apart from the natural world" (p. 12).

With all the demands currently placed on teachers to help their students achieve proficiency in mastering grade-level standards, many teachers are already feeling

overwhelmed. Teachers need a convenient way to incorporate environmental education into the curriculum without adding additional stress to their workload. This project provides a resource that is not currently available to teachers. This resource will make it easy for teachers to incorporate environmental concepts and environmental children's literature into their science teaching. In addition, teachers using this resource could improve the effectiveness of their teaching, use strategies that have proven effective, better prepare students for standardized tests in science and language arts, and ultimately enable students to develop into environmentally literate citizens.

It has been documented that environmental education incorporated into the curriculum can have such benefits as improving scores on standardized tests as well as improving motivation, developing critical thinking and problem solving skills, increasing personal responsibility in students, among other benefits (Lieberman & Hoody, 1998). The effectiveness of using the environment as an integrating context for learning (EIC) in all subject areas was demonstrated in Closing the Achievement Gap (1998). This project is designed to help fifth grade teachers incorporate into their instruction the effective

strategies used in EIC programs such as interdisciplinary integration of subject matter, emphasis on problem solving and projects, combinations of independent and cooperative learning, and learner-centered and constructivist approaches.

Topics discussed in the Literature Review guided the development of this project. Knowing the effectiveness of using the environment to teach science and the lack of teacher training in this area, a resource was created to help teachers incorporate environmental education into the curriculum (see Appendix A). Titles of high-quality literature that correlate with the fifth grade science curriculum were provided (see Appendix B). Also, knowing that children's literature can enhance the classroom experience and increase student motivation, understanding, and achievement, models were developed to demonstrate to teachers how they can use literature to enhance instruction and achieve numerous educational benefits (see Appendix C).

While this project is designed to provide a resource for fifth grade teachers and mainly focuses on the content area of science, the effectiveness of the EIC at all grade-levels and across all content areas shows that there

should be similar support materials for teachers at all grade-levels and across all disciplines.

This is a new resource that is not currently available to educators. It is hoped that in the future this resource will be disseminated through in-services to teachers in The San Bernardino City Unified School District and that it will be used by teachers as a model of how environmental education and children's literature can be incorporated into instruction. The critical need to address environmental education should no longer be ignored. Environmental education should not be considered an additional discipline for which there is just no time in the already jam-packed school day; rather, as is demonstrated throughout this project, environmental education should be considered a valuable tool that can be used to enhance teaching and learning throughout the curriculum.

Two colleagues were asked to review the resources in the appendices and provide feedback on the materials. Both colleagues are classroom teachers at the school site where I currently teach. One of the teachers has a background in environmental education and the other does not.

Both teachers said that the resource was easy to read and would be useful for improving their current science

programs. Both teachers felt that their students would benefit from being engaged in the hands-on learning experiences provided by the environmental activity guides and by using the environment to provide a context for learning. One teacher stated that she thought this would be especially beneficial for the many students in her classroom for whom English is a second language or who have very limited life experiences and thus have trouble relating the science content and vocabulary to their current knowledge base. Using hands-on activities and relating the content back to those experiences gives the students a basis for understanding the material.

The two teachers thought the suggested uses for literature were helpful. It was suggested that more activities for vocabulary would be helpful as well as some suggestions for how to help struggling learners and English language learners. In response to this suggestion, some additional activities for developing vocabulary were added in Appendix C as well as some strategies that are helpful for struggling learners and language learners including the use of graphic organizers and Total Physical Response-- "a language learning method based on the coordination of speech and action" (SIL International, 1999).

Both teachers stated that they believe that environmental education is important and would like to see more support for its inclusion in the classroom. Both teachers expressed frustration that so much of the school day is currently devoted to test preparation and that content is taught as isolated skill sets. They felt that many of their students seem to have become unmotivated and have trouble seeing the relevance of what they are learning in their lives. The teachers felt this resource would make it easier for them to provide meaningful activities related to the real world and help their students become more motivated and more successful in learning science content. Both teachers said that they thought it would be beneficial for a portion of our in-service time to be devoted to incorporating environmental education into the curriculum, including the use of constructivist techniques, using the Environment as an Integrating Context, and environmental literature. Also, these teachers said that they would be willing to attend workshops to be trained on the use of the environmental activity guides, and were hopeful that administration would be supportive of allotting a portion of staff development time to this endeavor. Two other teachers, unfamiliar with the project reviewed the

guidelines for clarity. Steps were slightly modified in their wording.

APPENDIX A

ALIGNMENT OF CALIFORNIA'S ENVIRONMENTAL PRINCIPLES AND CONCEPTS AND CALIFORNIA'S SCIENCE STANDARDS WITH LESSONS IN THE FIFTH GRADE CALIFORNIA SCIENCE TEXT AND ACTIVITIES FROM ENVIRONMENTAL EDUCATION GUIDES

In order to use this guide, first decide on the California Science Content Standard(s) that you wish to teach. Look across the table to determine which lessons in the California Science text cover the standard(s) and find the Environmental Principles and Concepts that correlate with the standard(s). In the last column you will find activities from the environmental education guides that support the California Science Content Standard(s) and Environmental Principles and Concepts you wish to teach. Use the key on this page to determine in which environmental education guide each activity can be found. Look over the activities to determine which one(s) are best suited to your needs and whether you want to use the activities to introduce the lesson, as an on-going activity throughout the lesson, or as a follow-up.

Key

PW: Project WET, 2004
WILD: Project WILD, 2000
PLT: Project Learning Tree, 2006
PC: Population Connection, 2003
WIM: Women in Mining, 2005

California Science Content Standards	Lessons in California Science	California's Environmental Principles and Concepts	Environmental Activities
Physical Sciences 1. Elements and their combinations account for all the varied types of matter in the world. As a basis for understanding this concept:			
a. Students know that during chemical reactions the atoms in the reactants rearrange to form products with different properties.	Ch 1 lesson 1 Ch 2 lesson 1, 2		•Molecules in Motion (PW, p.47) • What's the Solution? (PW, p.54)
b. Students know all matter is made of atoms, which may combine to form molecules.	Ch1 lesson 3		•Hanging together (PW, p. 35) • What's the Solution? (PW, p. 54)
f. Students know differences in chemical and physical properties of substances are used to separate mixtures and identify compounds.	Ch1 lesson 4 Ch 2 lesson 4		•Hanging together (PW,p. 35) •Is there Water on Zork? (PW, p. 43) •Water Models (PW, p.203) •What's the Solution? (PW,p.54)
g. Students know properties of solid, liquid, and gaseous substances, such as sugar ($C_6H_{12}O_6$), water (H_2O), helium (He), oxygen (O_2), nitrogen (N_2), and carbon dioxide (CO_2).	Ch1 lesson 3 Ch 2 lesson 2		•H_2O Olympics (PW, p. 30) •Hanging together (PW, p. 35) •Molecules in Motion (PW, p. 47) •Let's Even Things Out (PW, p. 72) •Water in Motion (PW, p. 450)
h. Students know living organisms and most materials are composed of just a few elements.	Ch 1 lesson 1		• Aqua Bodies (PW, p. 65)
i. Students know the common properties of salts, such as sodium chloride (NaCl).			•Irrigation Interpretation (PW, p. 254)
Life Sciences 2. Plants and animals have structures for respiration, digestion, waste disposal, and transport of materials. As a basis for understanding this concept:			
a. Students know many multicellular organisms have specialized structures to support the transport of materials.	Ch 3 lesson 1, 2 Ch 4 lesson 1, 2, 3		•Water Address (PW, p.122) •Let's Even Things Out (PW, p.72) •Thirsty Plants (PW, p.116) •Owl Pellets (WILD) •Seed Need (WILD) •Aqua Notes (WILD)
e. Students know how sugar, water, and minerals are transported in a vascular plant.	Ch 3 lesson 2	• Provide examples of the role of materials transport in vascular plants on the movement of byproducts of human activities (e.g. *contaminants*) into natural systems (e.g. entering plant tissue, soil)	•Thirsty Plants (PW, p.116) •Water Address (PW, p. 122) •Tree Factory (PLT, p.269) •Tree Cookies (PLT, p.327)
f. Students know plants use carbon dioxide (CO_2) and energy from sunlight to build molecules of sugar and release oxygen.	Ch 3 lesson 3	• Explain the role of photosynthesis in the functioning of terrestrial, freshwater, coastal, and marine ecosystems.	•Life Box (PW, p.76) •Air Plants (PLT,p.120) •Three Cheers for Trees (PLT,p.130)

California Science Content Standards	Lessons in California Science	California's Environmental Principles and Concepts	Environmental Activities
		• Explain why photosynthesis is essential to the survival of humans and human communities. • Provide examples of how humans and human communities can influence the process of photosynthesis and thus the flow of matter and energy within natural systems.	•A Forest for Many Uses (PLT, p.137)
g. Students know plant and animal cells break down sugar to obtain energy, a process resulting in carbon dioxide (CO_2) and water (respiration).	Ch 3 lesson 3		•Air Plants (PLT,p.120) •Plant a Tree (PLT,p.31) •A Forest for Many Uses (PLT, p.32) •Sunlight and Shades of Green (PLT,p.182)
Earth Sciences 3. Water on Earth moves between the oceans and land through the processes of evaporation and condensation. As a basis for understanding this concept:			
a. Students know most of Earth's water is present as salt water in the oceans, which cover most of Earth's surface.	Ch 5 lesson 1, 2, 3	• Identify that humans are living things and clean fresh water is essential to their survival. • Recognize that because most of the Earth's water is salt water located in the oceans, the vast majority of water is not available for human consumption. • Describe freshwater, coastal and marine ecosystems and compare the chemical characteristics of the water in these systems. • Provide examples of the goods that are produced by freshwater, coastal, and marine ecosystems (e.g. clean fresh water, oxygen, food, energy resources). • Explain how humans and human communities can influence the quantity, distribution and chemical characteristics of the water in freshwater, coastal, and marine ecosystems (e.g. global climate change, water management practices).	•Drop in the Bucket (PW,p.238) •Imagine! (PW, p. 157) • A-Maze-ing Water (PW,p.219) •Water Wonders (PLT, p.188)
b. Students know when liquid water evaporates, it turns into water vapor in the air and can reappear as a liquid when cooled or as a solid if cooled below the freezing point of water.	Ch 5 lesson 4, 5	• Describe the roles of evaporation, liquefaction, and freezing in the water cycle. • Describe the role of the water cycle, evaporation, liquefaction, and freezing in the	•Molecules in Motion (PW, p. 47) •Imagine! (PW, p. 157) •The Incredible Journey (PW, p. 161)

California Science Content Standards	Lessons in California Science	California's Environmental Principles and Concepts	Environmental Activities
		functioning of natural systems. ◦ Provide examples of the roles these cycles and processes play in human communities.	• Water Wonders (PLT,p.188-a)* very similar to The Incredible Journey •Water Models (PW, p. 201)
c. Students know water vapor in the air moves from one place to another and can form fog or clouds, which are tiny droplets of water or ice, and can fall to Earth as rain, hail, sleet, or snow.	Ch 5 lesson 4, 5	• Identify the role of precipitation (rain, hail, sleet, or snow) in terrestrial, freshwater, coastal, and marine ecosystems). • Provide examples of how humans and human communities directly and indirectly depend on precipitation and the water cycle (e.g. agricultural systems, water delivery systems). • Provide examples of how human activities can influence the quantity, distribution, and chemical characteristics of precipitation.	•Thirsty Plants (PW, p.116) •Imagine! (PW, p. 157) •The Incredible Journey (PW, p.161) •Stormy Weather (WILD) •Water Wonders (PLT,p.44-a) •Poetic Precipitation (PW, p.182) •Hanging together (PW, p 35) •Water Models (PW, p. 203) •Piece it Together (PW,p.174)
d. Students know that the amount of fresh water located in rivers, lakes, under-ground sources, and glaciers is limited and that its availability can be extended by recycling and decreasing the use of water.	Ch 5 lesson 2, 3	• Identify sources of fresh water and describe the reservoirs of Earth's water. • Recognize that water moves from one reservoir to another over time. • Describe the ways in which humans, human communities and their practices use water. • Recognize that the supply of fresh water is limited at any given time and discuss how some resources within an ecosystem are finite in supply and others are less limited. • Describe the methods by which wastewater can be treated and cycled back into the environment. • Provide examples of how water can be decreased by humans and human communities. • Explain potential consequences when quantity, distribution or chemical characteristics of water are changed (e.g. contamination of an aquifer can compromise the use of the groundwater supply by humans and other organisms). • Describe how changes to the quantity,	•Water Meter (PW, p.271) •Water Works (PW,p.274) •Every Drop Counts (PW,p.307) •Money Down the Drain (PW,p.328) •Renewable or Not (PLT,p.69) •Every Drop Counts (PLT,p.163) • Water Wonders (PLT,p.188-a) •Pass the Jug (PW, p. 392) •Every Drop Counts (PC)

California Science Content Standards	Lessons in California Science	California's Environmental Principles and Concepts	Environmental Activities
		distribution and chemical characteristics of water in natural systems can influence the functioning of terrestrial, freshwater, coastal, and marine ecosystems (e.g. acid precipitation affecting the growth of trees).	
e. Students know the origin of the water used by their local communities.	Ch 5 lesson 3	• Identify sources of freshwater in their local community. • Describe the process by which water is supplied to students' homes and their community. • Identify the steps used to make water potable in their community. • Describe the ways in which humans use water in their local community. • Provide examples of how human activities can influence the quantity, quality and reliability of water supplies. • Explain how changes to the quantity, quality and reliability of water supplies can influence humans, human communities and their practices.	•Every Drop Counts (PW,p.307) •Super Bowl Surge (PW,p.353) •Easy Street (PW,p.382) •Reaching Your Limits (PW, p.344) •Sum of the Parts (PW,p.267) •Common Water (PW,p.232) •Who Polluted the Potomac (PC)
4. Energy from the Sun heats Earth unevenly, causing air movements that result in changing weather patterns.			
a. Students know uneven heating of Earth causes air movements (convection currents).	Ch 6 lesson 1,2		•Piece it Together (PW,p.174) •The Thunderstorm (PW,p.196) •Dust Bowl and Failed Levees (PW,p.303) •Wet Vacation (PW,p.206)
b. Students know the influence that the ocean has on the weather and the role that the water cycle plays in weather patterns.	Ch 6 lesson 3		•Imagine! (PW, p. 157) •Old Water (PW,p.171) •The Incredible Journey (PW,p.161)
c. Students know the causes and effects of different types of severe weather.	Ch 6 lesson 3	• Provide examples of how human practices can influence weather. • Identify the human potential consequences of severe weather on human communities and natural systems.	•The Thunderstorm (PW,p.196)

California Science Content Standards	Lessons in California Science	California's Environmental Principles and Concepts	Environmental Activities
d. Students know how to use weather maps and data to predict local weather and know that weather forecasts depend on many variables.	Ch 6 lesson 4		•Wet Vacation (PW,p.206) •Poetic Precipitation (PW, p.182)
Investigation and Experimentation 6. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations. Students will:			
a. Classify objects (e.g., rocks, plants, leaves) in accordance with appropriate criteria.		The environmental principles and concepts provide fertile ground for the development of investigations and experiments that are directly related to achieving mastery of California's Science Content Standards. As stated by the California State Board of Education, such "activities must be cohesive, connected and build on each other to lead students to a comprehensive understanding of the California Science Content Standards." Environment-based investigations and experiments can also help teachers conform to recommendations of the California State Board of Education that "hands-on activities compose at least 20 to 25 percent of the California Science Framework."	•Mineral Identification (WIM) •Classifying Minerals (WIM) •Mineral and Rock Match (WIM) •Good Buddies (WILD) •Graphanimal (WILD) •Here Today, Gone Tomorrow (WILD) •How Many Bears Can Live in This Forest (WILD) •Lobster in Your Lunchbox (WILD) •Make a Coat! (WILD) •Microtrek Treasure Hunt (WILD) •Urban Nature Search (WILD) •Can it Be Real? (PLT,p.54) •Get in Touch with Trees (PLT,p.20) •Habitat Pen Pals (PLT,p.37) •Charting Diversity (PLT,p.50) •We all Need Trees (PLT,p.65) •Renewable or Not (PLT,p.69) •A Few of My Favorite Things (PLT,p.75) •Pass the Plants, Please (PLT,p.79) •Birds and Worms (PLT,p.111) •Looking at Leaves (PLT)
b. Develop a testable question.			•What's in the Cereal You Eat? (WIM) •Crystals (WIM) •Earthquake Hazard (WIM) The Geologists' Dilemna (WIM)

California Science Content Standards	Lessons in California Science	California's Environmental Principles and Concepts	Environmental Activities
			•H2O Olympics (PW,p.30) •How to Make a Nut Float (WIM) •Resource Depletion (WIM) •The Pucker Effect (PW,p.338) •Money Down the Drain (PW,p.328) •Water Models (PW,p.201) •What's the Solution (PW,p.54) •Water's Going On? (WILD) •How Plants Grow (PLT,p.41)
c. Plan and conduct a simple investigation based on a student-developed question and write instructions others can follow to carry out the procedure.			•Resource Depletion (WIM) •Can Do! (WILD) •Environmental Barometer (WILD) •Ethi Thinking (WILD) •First Impressions (WILD) •Flip the Switch for Wildlife (WILD) •Here Today, Gone Tomorrow (WILD) •Migration Barriers (WILD) •Planting Animals (WILD) •Polar Bears in Phoenix (WILD) •Improving Wildlife Habitats (WILD) •Lobster in Your Lunchbox (WILD) •Urban Nature Search (WILD) •Wildwork (WILD) •How Plants Grow (PLT,p.41)
d. Identify the dependent and controlled variables in an investigation.			•Flip the Switch for Wildlife (WILD) •Forest in a Jar (WILD) •How many Bears Can Live in the Forest (WILD) •Muskox Manuevers (WILD) • Oh Deer! (WILD) •Smokey The Bear Said What? (WILD) •Planting Animals (WILD) •Urban Nature Search (WILD)

California Science Content Standards	Lessons in California Science	California's Environmental Principles and Concepts	Environmental Activities
			•What's for Dinner (WILD) •How Plants Grow (PLT,p.41)
e. Identify a single independent variable in a scientific investigation and explain how this variable can be used to collect information to answer a question about the results of the experiment.			•Coal Flowers (WIM) •Changing Attitudes (WILD) •Environmental Barometer (WILD) •First Impressions (WILD) •Flip the Switch for Wildlife (Wild,p.308) •Here Today, Gone Tomorrow (WILD) •Improving Wildlife Habitats (WILD) •Interview with a Spider (WILD) •Planting Animals (WILD) •Seed Need (WILD) •Smokey The Bear Said What? (WILD) •Wildwork (WILD) •Adopt a Tree (PLT,p.21-PartB) •Nature's Recyclers (PLT,p.24) •How Plants Grow (PLT,p.41) •Sunlight and Shades of Green (PLT,p.42) •Water Wonders (PLT,p.44-PartB) •Soil Stories ((PLT,p.70-PartB) •Trees in Trouble (PLT,p.77-PartB)
f. Select appropriate tools (e.g., thermometers, meter sticks, balances, and graduated cylinders) and make quantitative observations.			•A Penny's Secret (WIM) •A Drop in the Bucket (PW,p.238) •Aqua Bodies (PW,p.65) •Life in the Fast Lane (PW,p.79) •Rainy Day Hike (PW,p.186) •Thirsty Plants (PW,p.116) •Water Meter (PW,p.271) •Wetland Soils in Living Color (PW,p.212) •What's The Solution (PW,p.54) •Grasshopper Gravity (WILD)

California Science Content Standards	Lessons in California Science	California's Environmental Principles and Concepts	Environmental Activities
			•Forest in a Jar (WILD) •Make a Coat! (WILD) •Polar Bears in Phoenix (WILD) •Urban Nature Search (WILD) •Seed Need (WILD) •Planet Diversity (PLT,p.9) •Nature's Recyclers (PLT,p.24) •Every Drop Counts (PLT,p.38) •How Plants Grow (PLT,p.41) •Water Wonders (PLT,p.44-PartB) •How Big is Your Tree (PLT,p.67) •Soil Stories (PLT,p.70) •Trees in Trouble (PLT,p.77) •Nothing Succeeds Like Succession (PLT,p.80)
g. Record data by using appropriate graphic representations (including charts, graphs, and labeled diagrams) and make inferences based on those data.			•A Drop in the Bucket (PW, p.238) •Choices and Preferences (PW, p.367) •Every Drop Counts (PW, p.307) •The Thunderstorm (PW, p. 196) •The Incredible Journey (PW, p.161) •Irrigation Interpretation (PW, p.254) •Get the Groundwater Picture (PW,p.136) •The Great Story Book (PW, p.150) •Piece It Together (PW, p. 174) •The Pucker Effect (PW, p. 338) • And the Wolf Wore Shoes (WILD) •Bearly Growing (WILD) •Changing Attitudes (WILD) •Environmental Barometer (WILD) •Flip a Switch for Wildlife (WILD) •Forest in a Jar (WILD) •Graphananimal (WILD)

California Science Content Standards	Lessons in California Science	California's Environmental Principles and Concepts	Environmental Activities
			•Here Today (WILD) •Gone Tomorrow (WILD) •How Many Bears Can Live in •This Forest (WILD) •Lobster in Your Lunchbox (WILD) •Migration Barriers (WILD) •Oh Deer (WILD) •Polar Bears in Phoenix (WILD) •Saturday Morning Wildlife •Watch (WILD) •Seed Need (WILD) •Smokey the Bear Said •What? (WILD) •Urban Nature Search (WILD) •Water's Going On? (WILD) •What Did Your Lunch Cost Wildlife (WILD) •What's For Dinner? (WILD) •Planet Diversity (PLT, p.45) •Trees as Habitats (PLT, p. 102 Part B), •Birds and Worms (PLT,p.111) •Every Tree for Itself (PLT,p.117) •Recycle, Reduce, Reuse (PLT, p.159, Part A), •Every Drop Counts (PLT, p. 163) •How Plants Grow (PLT,p.179) •Are Vacant Lots Vacant (PLT, p.200) •How Big is Your Tree (PLT, p.284) •Soil Stories (PLT, p.297) •Trees in Trouble (PLT, p.332,Part B) •Nothing Succeeds Like Succession (PLT, p.345, Parts B&C)
h. Draw conclusions from scientific evidence and indicate whether further information is needed to support a specific conclusion.			•H2Olympics (PW, p. 30) •Macroinvertebrate Mayhem (PW, p. 322)

California Science Content Standards	Lessons in California Science	California's Environmental Principles and Concepts	Environmental Activities
			•The Pucker Effect (PW, p. 338) •A Grave Mistake (PW, p.311) •Poison Pump (PW, p. 93) • Rainy Day Hike (PW, p. 186) •Bearly Growing (WILD) •First Impressions (WILD) •Grasshopper Gravity (WILD) •Good Buddies (WILD) •Graphananimal (WILD) •Habitat Rummy (WILD) •Interview a Spider (WILD) •Oh Deer! (WILD) •Migration Barriers, (WILD) •Planting Animals (WILD) •Seed Need (WILD) •Planet Diversity (PLT, p.45) •Trees as Habitats (PLT, p.102, Part B) •The Fallen Log (PLT, p.105) •Reduce, Reuse, Recyle (PLT, p.159Part A) •Every Drop Counts (PLT, p.163) •How Plants Grow (PLT, p.179) •Water Wonders (188) •Are Vacant Lots Vacant (PLT, p.200) •Soil Stories (297) •Trees in Trouble (PLT, p. 332, Part B) •Nothing Succeeds Like Succession (PLT, p.345, Part B & C) •In the Driver's Seat (PLT, p.370)

APPENDIX B

ALIGNMENT OF CALIFORNIA'S ENVIRONMENTAL PRINCIPLES AND CONCEPTS AND CALIFORNIA'S SCIENCE STANDARDS WITH LESSONS IN THE FIFTH GRADE CALIFORNIA SCIENCE TEXT AND ENVIRONMENTAL LITERATURE SUPPORTING THE LESSONS

In order to use this guide, first decide on the California Science Content Standard(s) that you wish to teach. Look across the table to determine which lessons in the California Science text cover the standard(s) and find the Environmental Principles and Concepts that correlate with the standard(s). In the last column you will find titles of suggested children's literature that support the California Science Content Standard(s) and Environmental Principles and Concepts you wish to teach.

California Science Content Standards	Lessons in California Science	California's Environmental Principles and Concepts	Supporting Children's Literature
a. Students know that during chemical reactions the atoms in the reactants rearrange to form products with different properties.	Ch 1 lesson 1 Ch 2 lesson 1, 2		•Watson, Philip.1982. *Liquid magic*
b. Students know all matter is made of atoms, which may combine to form molecules.	Ch1 lesson 3		
f. Students know differences in chemical and physical properties of substances are used to separate mixtures and identify compounds.	Ch 1 lesson 4 Ch 2 lesson 4		• Cast, Vance C. 1992. *Where does water come from?* p.203 • Mayes, Susan.1989. *What makes it rain?* • Schmid, Elenore:1990. *The water's journey*
g. Students know properties of solid, liquid, and gaseous substances, such as sugar ($C_6H_{12}O_6$), water (H_2O), helium (He), oxygen (O_2), nitrogen (N_2), and carbon dioxide (CO_2).	Ch 1 lesson 3 Ch 2 lesson 2		• Warson, P. (1982). *Liquid magic*
h. Students know living organisms and most materials are composed of just a few elements.	Ch 1 lesson 1		
i. Students know the common properties of salts, such as sodium chloride (NaCl).			
Life Sciences 2. Plants and animals have structures for respiration, digestion, waste disposal, and transport of materials. As a basis for understanding this concept:			
a. Students know many multicellular organisms have specialized structures to support the transport of materials.	Ch 3 lesson 1, 2 Ch 4 lesson 1, 2, 3		•Parker, Steve.1988. *Pond and river* •Taylor, Barbara. 1992. *Desert life:A close-up look at the natural world of a desert* • Cole, J.(1989). *The magic school bus: Inside the human body*
e. Students know how sugar, water, and minerals are transported in a vascular plant.	Ch 3 lesson 2	• Provide examples of the role of materials transport in vascular plants on the movement of byproducts of human activities (e.g. contaminants) into natural systems (e.g. entering plant tissue, soil)	• Gibbons, Gail.(2002). *Tell me tree* • Hiscock, B.(1991). *The big tree* • Notkin, Lenore.(1997). *The magic school bus gets planted: A book about photosynthesis* • Podendorf, Illa. 1982. *Trees* • Markle, S. (1993). *Outside and inside trees*

California Science Content Standards	Lessons in California Science	California's Environmental Principles and Concepts	Supporting Children's Literature
f. Students know plants use carbon dioxide (CO_2) and energy from sunlight to build molecules of sugar and release oxygen.	Ch 3 lesson 3	• Explain the role of photosynthesis in the functioning of terrestrial, freshwater, coastal, and marine ecosystems. • Explain why photosynthesis is essential to the survival of humans and human communities. • Provide examples of how humans and human communities can influence the process of photosynthesis and thus the flow of matter and energy within natural systems.	• Chevallier, C. (1999). *The secret life of trees* • Shetterly, S. C. (1919). *Shelterwood* • Silverstein, S. (1964). *The giving tree* • Gackenbach, S. (1992). *Mighty tree* • Lauber, P. (1994). *Be a friend to trees* • Peet, B. (1970). The wump world • Hiscock, B.(1991). *The big tree*
g. Students know plant and animal cells break down sugar to obtain energy, a process resulting in carbon dioxide (CO_2) and water (respiration).	Ch 3 lesson 3		(see books listed in 3 e&f)
Earth Sciences 3. Water on Earth moves between the oceans and land through the processes of evaporation and condensation. As a basis for understanding this concept:			
a. Students know most of Earth's water is present as salt water in the oceans, which cover most of Earth's surface.	Ch 5 lesson 1, 2, 3	• Identify that humans are living things and clean fresh water is essential to their survival. • Recognize that because most of the Earth's water is salt water located in the oceans, the vast majority of water is not available for human consumption. • Describe freshwater, coastal and marine ecosystems and compare the chemical characteristics of the water in these systems. • Provide examples of the goods that are produced by freshwater, coastal, and marine ecosystems (e.g. clean fresh water, oxygen, food, energy resources). • Explain how humans and human communities can influence the quantity, distribution and chemical characteristics of the water in freshwater, coastal, and marine ecosystems (e.g. global climate change, water management practices).	•Simon, Seymour. (1990). *Oceans* • Macquitty, M. (2004). *Ocean (eyewitness books series)* • Nye, B. (1999). *Bille nye the science guy's big blue ocean* • Ganeri, Anita. (2003). *I wonder why the sea is salty and other questions about the oceans*

California Science Content Standards	Lessons in California Science	California's Environmental Principles and Concepts	Supporting Children's Literature
b. Students know when liquid water evaporates, it turns into water vapor in the air and can reappear as a liquid when cooled or as a solid if cooled below the freezing point of water.	Ch 5 lesson 4, 5	• Describe the roles of evaporation, liquefaction, and freezing in the water cycle. • Describe the role of the water cycle, evaporation, liquefaction, and freezing in the functioning of natural systems. • Provide examples of the roles these cycles and processes play in human communities.	• Mayes, S. (1992). *What makes it rain?* • Schmid, E. (1989). *What makes it rain?* • Hooper, M. (1998). *The drop in my drink: The story of water on our planet* • Johnston, T. (1988). *Water, water!*
c. Students know water vapor in the air moves from one place to another and can form fog or clouds, which are tiny droplets of water or ice, and can fall to Earth as rain, hail, sleet, or snow.	Ch 5 lesson 4, 5	• Identify the role of precipitation (rain, hail, sleet, or snow) in terrestrial, freshwater, coastal, and marine ecosystems). • Provide examples of how humans and human communities directly and indirectly depend on precipitation and the water cycle (e.g. agricultural systems, water delivery systems). • Provide examples of how human activities can influence the quantity, distribution, and chemical characteristics of precipitation.	• Walker, S. (1992). *Water up, water down: The hydrolic cycle* • Cole, Joanna. (1986). *The magic school bus at the waterworks* • Schmid, Eleonore. (1989). *The water's journey* • Yolen, Jane. (1995). *Water music: Poems for children*
d. Students know that the amount of fresh water located in rivers, lakes, under-ground sources, and glaciers is limited and that its availability can be extended by recycling and decreasing the use of water.	Ch 5 lesson 2, 3	• Identify sources of fresh water and describe the reservoirs of Earth's water. • Recognize that water moves from one reservoir to another over time. • Describe the ways in which humans, human communities and their practices use water. • Recognize that the supply of fresh water is limited at any given time and discuss how some resources within an ecosystem are finite in supply and others are less limited. • Describe the methods by which wastewater can be treated and cycled back into the environment. • Provide examples of how water can be decreased by humans and human communities. • Explain potential consequences when quantity, distribution or chemical characteristics	• Green, C. (1991). *Caring for our water* • Wald, M. (1993). *What you can do for the environment* • Bang, M. (1997). *Common ground: The earth, water, and air we all share* • Dangleish, S. (2002). *Saving water* • Paula, J. (1997). *How science works: Water*

California Science Content Standards	Lessons in California Science	California's Environmental Principles and Concepts	Supporting Children's Literature
		of water are changed (e.g. contamination of an aquifer can compromise the use of the groundwater supply by humans and other organisms). • Describe how changes to the quantity, distribution and chemical characteristics of water in natural systems can influence the functioning of terrestrial, freshwater, coastal, and marine ecosystems (e.g. acid precipitation affecting the growth of trees).	
e. Students know the origin of the water used by their local communities.	Ch 5 lesson 3	• Identify sources of freshwater in their local community. • Describe the process by which water is supplied to students' homes and their community. • Identify the steps used to make water potable in their community. • Describe the ways in which humans use water in their local community. • Provide examples of how human activities can influence the quantity, quality and reliability of water supplies. • Explain how changes to the quantity, quality and reliability of water supplies can influence humans, human communities and their practices.	
4. Energy from the Sun heats Earth unevenly, causing air movements that result in changing weather patterns.			
a. Students know uneven heating of Earth causes air movements (convection currents).	Ch 6 lesson 1,2		•Gould,A. (1998). *Convection: A current event (great explorations in math and science series).*
b. Students know the influence that the ocean has on the weather and the role that the water cycle plays in weather patterns.	Ch 6 lesson 3		•Dk Publishing. (2004). *Weather (eye wonder)* •Twist, C. (2008). *1,000 things you should know about oceans* • Woodward, J. (2007). *Weather* • Simon, S. (1993). *Weather*

California Science Content Standards	Lessons in California Science	California's Environmental Principles and Concepts	Supporting Children's Literature
			• Konvicka, T. (1999). *Teacher's weather sourcebook* • Eubank, M., & Hicks, M. (2004). *The weather detectives*
c. Students know the causes and effects of different types of severe weather.	Ch 6 lesson 3	• Provide examples of how human practices can influence weather. • Identify the human potential consequences of severe weather on human communities and natural systems.	• DK Publishing. (2004). *Hurricane & tornado (dk eyewitness books)* • Hopping, L., & Wheeler, J. (1999). *Wild weather: Blizzards!* • Faidley, W., & Harris, C. (2005). *Wild weather* • Boskey, M. (2004). *Natural disasters: A chapter book (true tales)* • Hopping, L. (2000). *Wild weather: Floods!* • Hopping, L. (1994). *Tornadoes!* • Ruckman, I. (1986). *Night of the twisters*
d. Students know how to use weather maps and data to predict local weather and know that weather forecasts depend on many variables.	Ch 6 lesson 4		• Rabe, T. (2004). *Oh say can you say what's the weather today? All about weather* • Gibbons, G. (1993). *Weather forecasting* • Eckart, E. (2004). *Watching the weather: Watching nature* • Dk Publishing. (2004). *Weather* • Adams, S. (2001). *The best book of weather*
Investigation and Experimentation 6. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations. Students will:			
a. Classify objects (e.g., rocks, plants, leaves) in accordance with appropriate criteria.		The environmental principles and concepts provide fertile ground for the development of investigations and experiments that are directly related to achieving mastery of California's Science Content standards. As stated by the	• Oppenheim, J. (1967). *Have you seen trees?* • Carmichael, N. (1996). *Nature's wild!* • Heller, R. (1999). *Plants that*

California Science Content Standards	Lessons in California Science	California's Environmental Principles and Concepts	Supporting Children's Literature
		California State Board of Education, such "activities must be cohesive, connected and build on each other to lead students to a comprehensive understanding of the California Science Content Standards." Environment-based investigations and experiments can also help teachers conform to recommendations of the California State Board of Education that "hands-on activities compose at least 20 to 25 percent of the California Science Framework."	*never bloom* • Wechesler, D. (1995). *Bizarre bugs* • Schwartz, D. (1988). *The hidden life of the forest* •Johnson, R. (2000). *A walk in the desert*
b. Develop a testable question.			• Nye, B. (1999). *Bille nye the science guy's big blue ocean* • Jordan, H. (1992). *How a seed grows* • Kudlinski, K. V. (2003). *How plants survive* • Pascoe, E. (1996). *Seeds and seedlings*
c. Plan and conduct a simple investigation based on a student-developed question and write instructions others can follow to carry out the procedure.			
d. Identify the dependent and controlled variables in an investigation.			
e. Identify a single independent variable in a scientific investigation and explain how this variable can be used to collect information to answer a question about the results of the experiment.			
f. Select appropriate tools (e.g., thermometers, meter sticks, balances, and graduated cylinders) and make quantitative observations.			
g. Record data by using appropriate graphic representations (including charts, graphs, and labeled diagrams) and make inferences based on those data.			

California Science Content Standards	Lessons in California Science	California's Environmental Principles and Concepts	Supporting Children's Literature
h. Draw conclusions from scientific evidence and indicate whether further information is needed to support a specific conclusion.			

APPENDIX C

MODELS DEMONSTRATING HOW LITERATURE CAN BE INCORPORATED INTO INSTRUCTION TO ACHIEVE A VARIETY OF EDUCATIONAL BENEFITS

In Appendix C, models were created to demonstrate how literature can be used to accomplish each of the educational benefits identified in the literature review. In this resource, the first two benefits, using environmental literature to provide experiences not otherwise possible and using environmental literature to develop vocabulary, were combined into one category. The suggestions for use are based on personal experience as a classroom teacher in being familiar with a variety of teaching techniques. Specific applications for use that were drawn from a specific source are cited.

The literature models are organized according to their educational benefits. For each category, an appropriate literature selection is included along with bibliographic information, a brief summary, the California Science Standards and Environmental Principles and Concepts that are addressed, the lessons in California Science that the book aligns to, and several suggestions for how the book can be used in the classroom.

Using Environmental Children's Literature
to Provide Experiences Not Otherwise Possible
and to Develop Vocabulary

Title: Hiscock, B. (1991). The big tree. Honesdale, PA: Boyd Mills Press.

Summary: This story portrays the life of one particular sugar maple tree in New York from the time it was a seed to two hundred years later. The book describes what was going on in the country over that time period and explains how various factors including the environmental conditions, weather, and human actions influenced how the tree grew in the particular way that it did.

California Science Standards:

Life Sciences 2

e. Students know how sugar, water, and minerals are transported in a vascular plant.

f. Students know plants use carbon dioxide (CO_2) and energy from sunlight to build molecules of sugar and release oxygen.

g. Students know plant and animal cells break down sugar to obtain energy, a process resulting in carbon dioxide (CO_2) and water (respiration).

Lessons in California Science: Chapter 3, Lessons 2 & 3

Environmental Principles:

- Provide examples of the role of materials transport in vascular plants on the movement of byproducts of human activities (e.g. contaminants) into natural systems (e.g. entering plant tissue, soil)
- Explain the role of photosynthesis in the functioning of terrestrial, freshwater, coastal, and marine ecosystems.
- Explain why photosynthesis is essential to the survival of humans and human communities.
- Provide examples of how humans and human communities can influence the process of photosynthesis and thus the flow of matter and energy within natural systems.

Suggestions For Use:

- Read the book to students before beginning lessons on photosynthesis to spark student interest.
- Read parts of it throughout the unit to reinforce concepts developed in the text.
- Have students make predictions or record what they already know about key vocabulary terms such as: photosynthesis, stem, root, branch, seed, carbon dioxide, oxygen, chlorophyll, sap. Then have students listen for these terms as you read and check and revise their definitions. Have students include drawings with their definitions.
- After reading about photosynthesis, have students stand and do hand motions with the teacher as they orally (with help from the teacher) describe each part of the process. (This is a helpful activity for kinesthetic learners and language learners to help develop vocabulary.) For example:

1. "The sun gives off light energy" -- touch hands together over the head to represent the sun.
2. "CO_2 goes into the leaf" -- wiggle fingers in a downward motion to emulate the oxygen going into the leaf.
3. "Water goes up through the roots and stem" -- wiggle fingers in a scooping motion to represent water going through the roots and up the stem.
4. "The plant gives off Oxygen" -- wiggle fingers in an upward motion going away from the body to represent CO_2 going up into the atmosphere from the leaf.

- Using the diagrams in the book as a model, have students draw or create their own models of a tree or plant and label the parts and give an explanation of what each part does and/or its role in photosynthesis.
- During or after reading the book to students, have the students draw a small tree in the center of a piece of paper with lines radiating out from it. On each of the lines, students can write vocabulary words relating to photosynthesis or list ways that they affect trees or trees affect them.

- After reading the story, have students create their own stories about a tree's life from the time it sprouts from a seed until it gets old. Students should include in their stories how weather and the actions of people affect the life and growth of the tree.
- Have students do an experiment in which they place small plants in different locations: one under a lamp, one in a cupboard where it receives almost no light, and one in a position where it will receive very limited light. Have Students observe the plants over time and make notes of the differences in their growth and develop explanations for the difference.
- Combine reading the story with activities such as Tree Factory or Tree Cookies from Project Learning Tree (American Forest Foundation, 2006b).

Why The Book Helps With Learning: This book explains some difficult concepts such as photosynthesis and how trees produce their own food in an easy to understand way with simple diagrams and magnified pictures. It presents the science content in a story format which is appealing to children. Throughout the story, a lot of information is provided about how plants grow and develop using easy to understand language. It can provide a context for introducing or developing science vocabulary. The book provides a unique way of looking at trees-- like humans, each one has different experiences which influence how they grow into adulthood. This may provide a context for students to relate to the tree. Because the story includes a historical context, alluding to the civil war and the American Revolution (a major topic in the fifth grade social studies and language arts curriculum), it can easily be used to draw connections across content areas. The story shows the life a maple tree over an expanse of 200 years- a time period too great for any one person to observe first hand. The story demonstrates how human actions impact the natural world. The story has a message of appreciation for nature and the necessity to protect it which can help promote environmental sensitivity and environmental action.

Using Environmental Children's Literature to
Motivate Reluctant Readers

Title: Cole, Joanna. (1986). The magic school bus at the waterworks. New York: Scholastic inc.

Summary: Ms. Frizzle takes her class to the water works. Instead of touring the plant, the students actually swim through it as they learn how it works. The students learn about the water cycle and how water purification systems work.

California Science Standards:

Earth Sciences

3 b. Students know when liquid water evaporates, it turns into water vapor in the air and can reappear as a liquid when cooled or as a solid if cooled below the freezing point of water.

c. Students know water vapor in the air moves from one place to another and can form fog or clouds, which are tiny droplets of water or ice, and can fall to Earth as rain, hail, sleet, or snow.

d. Students know that the amount of fresh water located in rivers, lakes, under-ground sources, and glaciers is limited and that its availability can be extended by recycling and decreasing the use of water.

Lessons in California Science: Chapter 5, Lessons 2, 3, 4, & 5

Environmental Principles:

- Identify that humans are living things and clean fresh water is essential to their survival.
- Recognize that because most of the Earth's water is salt water located in the oceans, the vast majority of water is not available for human consumption.
- Explain how humans and human communities can influence the quantity, distribution and chemical characteristics of the water in freshwater, coastal, and marine ecosystems (e.g. global climate change, water management practices).

- Describe the roles of evaporation, liquefaction, and freezing in the water cycle.
- Describe the role of the water cycle, evaporation, liquefaction, and freezing in the functioning of natural systems.
- Provide examples of the roles of these cycles and processes play in human communities.
- Identify the role of precipitation (rain, hail, sleet, or snow) in terrestrial, freshwater, coastal, and marine ecosystems.
- Provide examples of how humans and human communities directly and indirectly depend on precipitation and the water cycle (e.g. agricultural systems, water delivery systems).
- Provide examples of how human activities can influence the quantity, distribution, and chemical characteristics of precipitation.

Suggestions For Use:

- Do a few simple demonstrations to help students understand the terms evaporation and condensation. For example: boil water and observe how the water turns to steam and evaporates into the air, use a cold drink to demonstrate condensation (how did the drops of water get onto the outside of the glass?), leave a glass of water sitting out and observe what happens to the water level over time (it gets lower)--ask, "what happened to the water?" (it evaporated).
- To help students understand the terms precipitation, condensation, and evaporation, brainstorm a list of examples and non-examples of each.
- To help develop understanding of the terms precipitation, condensation, and evaporation, create a Venn Diagram and list similarities and differences between each (include temperature, water molecule direction, and state of matter).
- To develop understanding and help students remember key terms related to the water cycle, have them do hand and body motions as they say the

terms (this can be done whole group with the teacher leading- students can help come up with the body motions). For example:

Collection- stand with hands stretched out to the sides and rock back in forth to represent water in an ocean, lake, or stream.

Evaporation- wiggle fingers and move hands up towards the ceiling imitating the water evaporating up into the air.

Condensation- touch hands together above the head or in front of the body to represent the clouds.

Precipitation- wiggle fingers in a downward motion to represent rain, hail, sleet, or snow.

Have students do this repeatedly to demonstrate that it is a cycle that repeats itself over and over again. (This is a helpful activity for kinesthetic learners and language learners to help develop vocabulary.)

- Provide students with discussion questions such as the following:

1. What are the three forms of water found in nature?
2. What happens when water evaporates?
3. How much water do we have on Earth compared to one million years ago?
4. What percentage of the Earth's water is fresh?
5. If water is clear, does that mean it is clean?
6. What are the parts of the water purification system?
7. What in nature acts as a natural water purification system?
8. What do people do to make the water purification system work harder?
9. Do you think the water purification system can clean out all pollutants? (Stoner & Morrison, n.d., p. 47)

- Have students read the book on their own or with partners to answer these questions or have the students answer the questions as the book is read aloud to the class.
- Have students collect and discuss current events related to water resources (ie. the recent "toilet to tap" program in LA.

- Have groups of students work together to create a drawing of the water cycle. When they are finished, compare the drawings and compare the differences. Discuss the different paths water may take as it travels through the cycle.
- Discuss ways that human actions contribute to pollution of water. Do some research to find examples of how water supplies have been polluted by human actions. Have students create informational posters or brochures to educate community members about water pollution.
- Brainstorm ways that students and their families can conserve water at school and at home. Have students create posters or book marks to educate other students about how they can help conserve water. Have students create a water conservation plan to share with their families at home.
- Take students on a field trip to their community's water purification facility or have a representative from the facility come and speak to the class.
- Have students calculate how much water is wasted in a day by a leaky faucet by catching the water in a measuring cup and multiplying the amount by 24.
- Do the Project Learning Tree activity "Water Wonders" (American Forest Foundation, 2006b, pp. 188-193) in which students play the role of a drop of water and experience the numerous different routes water can follow as it moves through the water cycle.

Why The Book Helps With Learning: The book provides a plethora of information presented in a format that is appealing to children. It uses humor and vivid, cartoon-like illustrations combined with explicit simple text to convey the information. This book and others in its series are appealing to children and can get reluctant readers motivated not only to read, but to learn about important science concepts such as the water cycle.

Using Fictional Environmental Children's
Literature to Promote Greater Understanding of Science Concepts

Title: Peet, B. (1970). The wump world. Boston: Houghton Mifflin Company.

Summary: A species of peaceful, loveable animals live in a pristine world filled with grassy meadows and clumps of green bumbershoot trees. One day their peaceful existence is interrupted when the Pollutians arrive after having been forced to leave their own planet which they had destroyed. The Pollutians immediately begin chopping down the trees, building skyscrapers and freeways, causing all kinds of noise, and polluting the air and water. In a short time the Pollutians have destroyed the Wump's world just as they had destroyed their own, so they leave in search of a new planet to inhabit and the Wumps must deal with the destruction they caused.

California Science Standards:

Life Sciences

2 f. Students know plants use carbon dioxide (CO_2) and energy from sunlight to build molecules of sugar and release oxygen.

Lessons in California Science: Chapter 3, Lesson 3

Environmental Principles:

- Explain the role of photosynthesis in the functioning of terrestrial, freshwater, coastal, and marine ecosystems.
- Explain why photosynthesis is essential to the survival of humans and human communities.
- Provide examples of how humans and human communities can influence the process of photosynthesis and thus the flow of matter and energy within natural systems.

Suggestions For Use:

- Discuss the impacts of the Pollutians on Wump World. Ask students to describe similar impacts that humans have caused in real life. Brainstorm

ways that people can undo some of the problems they have caused to our planet and things that people can do to live harmoniously with nature instead of destroying it (i.e. recycling, driving fuel efficient cars, walking, or carpooling, not being wasteful, cleaning up the community, planting trees, etc.).

- Have students develop their own action plans for how they and their families can be more friendly to nature and contribute less to nature's detriment. Then have students share their plans with their families.
- Have students write their own stories warning about the negative impacts that careless behaviors can wreak on our environment. Then have students share their stores with other classes or younger students and inform them of how they can be a friend of nature instead of an enemy to it.

Why The Book Helps With Learning: This book is an example of how fictional text can be useful to convey important science and environmental concepts. This fictional story is appealing to children and contains colorful attention-grabbing illustrations. Students are likely to be sympathetic to the plight of the animals in the story and will be able to relate what they learn in the story to real world problems.

Using Environmental Children's Literature to Develop Process Skills Essential to Science and Environmental Literacy

Title: Oppenheim, Joanne. (1967). Have you seen trees? Boston: Scholastic Inc.

Summary: this book is written in poetic prose and accompanied by dramatic illustrations that depict the various trees across different seasons. The text and illustrations work together to draw readers' attention to the glory of each tree and each one's unique size, shape, and characteristics.

California Science Standards: Investigation and Experimentation

6. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations. Students will: a. Classify objects (e.g., rocks, plants, leaves) in accordance with appropriate criteria.

Lessons in California Science: (Can be applied to all lessons)

Environmental Principles:

- The environmental principles and concepts provide fertile ground for the development of investigations and experiments that are directly related to achieving mastery of California's science content standards. As stated by the California State Board of Education, such "activities must be cohesive, connected and build on each other to lead students to a comprehensive understanding of the California Science Content Standards."
- Environment-based investigations and experiments can also help teachers conform to recommendations of the California State Board of Education that "hands-on activities compose at least 20 to 25 percent of the California Science Framework."

  (American Forest Foundation, 2006a)

Why The Book Helps With Learning:

- Encourage students to focus on the details found on each page and discuss students' observations. Discuss the various ways that the trees could be categorized.

- Follow up with a trip outside where students can make observations of trees first-hand. Students can write observations in journals.
- Use the book's pattern to write a class version of the book.
- Take students outside and have them collect two or three different kinds of tree leaves, by picking up leaves that have fallen to the ground. Have them make observations of their leaves using prompts such as the following.
    - What are some differences between the leaves?
    - What do the leaves have in common?
    - Do any leaves have teeth?
    - Do any have hairs?
    - What do the leaves feel like?

  (American Forest Foundation, 2006b, p. 273)
    - Why are trees able to survive in this environment?
    - What characteristics promote the trees' survival?
- Have students use a Venn Diagram to compare and contrast two or more different trees on the school grounds. Ask what makes one tree healthier than another? What factors could have influenced the trees?
- Have students work in groups to develop categories for their leaves. Discuss the different categories groups came up with. Try categorizing trees and plants by their uses: eg. food, shelter, clothing. Discuss some of the ways scientists categorize plants: vascular/nonvascular, gymnosperm/angiosperm, etc.

Why The Book Helps With Learning: This book can help develop students' observation skills-- an important skill in developing environmental literacy. It is also helpful in developing categorizing and classifying skills which are important science process skills and are included in the California Science Standards. It provides an opportunity to talk about nature from an artistic perspective and may help foster appreciation for the beauty of nature. This book helps draw attention to the feelings that are evoked by nature and may help develop environmental sensitivity,

Using Environmental Children's Literature to Make Content Comprehensible to Students

Title: Schmid, E. (1989). The water's journey. New York: North-South Books Inc.

Summary: In this book the journey of water through the water cycle is explained. Each step of the journey is accompanied by attractive illustrations of the landscapes that the water travels through, from the mountains, to the fields, to the streams, to a crowded city harbor, and eventually out to the ocean. The story begins in the mountains where drops of water have been carried by wind and are then chilled by the air to form snowflakes. These flakes fall to earth and eventually melt and run into a stream. The journey continues as the water again evaporates only to fall again as rain and go on through the repeating cycle.

California Science Standards:

Earth Sciences

3. Water on Earth moves between the oceans and land through the processes of evaporation and condensation. As a basis for understanding this concept:

a. Students know most of Earth's water is present as salt water in the oceans, which cover most of Earth's surface.

b. Students know when liquid water evaporates, it turns into water vapor in the air and can reappear as a liquid when cooled or as a solid if cooled below the freezing point of water.

Lessons in California Science: Chapter 5, Lessons 1,2,3,4, & 5

Environmental Principles:

- Identify that humans are living things and clean fresh water is essential to their survival.
- Recognize that because most of the Earth's water is salt water located in the oceans, the vast majority of water is not available for human consumption.
- Describe freshwater, coastal and marine ecosystems and compare the chemical characteristics of the water in these systems.

- Describe the roles of evaporation, liquefaction, and freezing in the water cycle.
- Describe the role of the water cycle, evaporation, liquefaction, and freezing in the functioning of natural systems.
- Provide examples of the roles of these cycles and processes play in human communities.
- Identify the role of precipitation (rain, hail, sleet, or snow) in terrestrial, freshwater, coastal, and marine ecosystems).
- Provide examples of how humans and human communities directly and indirectly depend on precipitation and the water cycle (e.g., agricultural systems, water delivery systems).
- Provide examples of how human activities can influence the quantity, distribution, and chemical characteristics of precipitation.
- Recognize that water moves from one reservoir to another over time.

Suggestions For Use:

- Before starting, brainstorm words that describe what students know about the water cycle.
- Make a list of questions that students have about the water cycle.
- Ask the following questions to focus students' attention:
    - If every living thing needs so much water, why isn't it used up?
    - Where does the water go when a puddle is dried up?
    - Why don't oceans and lakes dry up like puddles do?
    - Where does rain come from?
    - Do you think water always follows the same path as it travels through the water cycle?

  (American Forest Foundation, 2006b, p. 189)
- As the teacher reads the book to the class, have students call out or hold up cards to tell what stage in the water cycle is being depicted: evaporation, condensation, precipitation, or collection.

- Follow with the Project Learning Tree activity, Water Wonders (American Forest Foundation, 2006b), in which students pretend to be a drop of water and travel between 7 stations (cloud, glacier, ocean, stream, groundwater, animal, and plant) following various routes. Afterwards, haves students share the different ways they traveled to each station (for example, students may have reached the clouds by evaporating from the ocean or a stream or by being transpired from a plant.) Discuss the following questions:
- Even though water molecules took different paths, were there any similarities in the paths they took?
- Which stations were visited the most often?
- What other parts of the water cycle were not included in the game?
- What energy source makes water move through the cycle? (the sun)
- How is the water cycle important to plants, humans, and animals?
- Have students write a story to explain their journey through the water cycle.

Why The Book Helps With Learning: This book put the abstract concept of the water cycle into context that students who may be more visual/ concrete learners can better understand it. This book presents the concept of the water cycle in a different way than the text book. The concept is presented using text and format that are not intimidating to students. It gives specific examples of what each stage in the cycle can look like. Illustrations help get students' attention and aid comprehension.

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