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Connecting science and literature for first grade

Patricia Irene Braford

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CONNECTING SCIENCE AND LITERATURE
FOR FIRST GRADE

A Project
Presented to the
Faculty of
California State University,
San Bernardino

In Partial Fulfillment
of the Requirements for the Degree
Master of Arts
in
Education: Reading Option

by
Patricia Irene Braford
June 1993
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Date

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ABSTRACT

This project aligns appropriate science concepts with literature and experiments for the first grade. A year-long conceptually based, meaning-centered science program is developed which consists of three units based on physical, earth, and life sciences. Each unit has three sections identifying a unifying concept (which ties the entire school district together), a first grade subconcept (which all first grade students are to construct), a piece of literature (which begins the topic of study), a science focus (a specific area of concentration), some science vocabulary (language which dominates the section), some science related activities (15 to 20), and other pieces of fine literature related to a topic.

This program is built from a constructivist philosophy using the frameworks, district expectations, student interests, student needs, and literature. This program is designed to serve as a guide. Activities are arranged in such a sequence that new knowledge is built on past experiences. When implementing this program, students' interests and needs are to be the core of the program—not the activities themselves.
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INTRODUCTION

Literature-based language arts instruction has become very popular among elementary school teachers. However, science instruction remains closely tied to the science text and consists of reading chapters, answering questions, and demonstrating a few ideas. Armbruster (1993) recognized this problem and proposed the following solution.

In order for teachers to use trade books comfortably and effectively, they need to be better prepared to teach science... (and) someone needs to help them correlate trade books with their science curriculum (p.347).

How does science fit into a literature-based program? What literature can be used to tie-in concepts that need to be learned? What are the concepts that need to be taught? If answering the chapter questions should not be the only method of assessment, how should students be evaluated? Is there anything about the processes of reading that relates to the processes of science?

Statement of the Problem

At an elementary school inservice last year, junior high school teachers complained about the incoming students being turned off to science. This inservice was designed by the junior high school teachers and its purpose was to teach the
elementary staff how to make science easy and fun for both teachers and students. Following this event, the elementary teachers continued to struggle with how to teach science and continued to have many unanswered questions.

In attempts to make a meaningful science program, many teachers have reviewed and purchased science activity kits offered by publishers. One publisher's selling slogan states, "The science crisis in America begins in the elementary schools. You can help. . . ." (Macmillan Early Science Activities, 1992). Each unit contains "... over a hundred activities and experiments. . . .", thus implying their kits will provide a meaningful science curriculum. Teachers have spent their money on these kits and students have spent their science time with many hands-on activities. Unfortunately, most of these programs lack a minds-on connection which provides for a meaningful science curriculum (Thier, 1986); teachers continue to teach with many activities without guiding students towards making meaningful connections or life applications.

Typically, material provided by a district for first grade is usually limited to one text, such as the Silver Burdett Science text by Mallison, Smallwood and Valentino (1985). This Silver Burdett Science text is full of simplistic information; in writing about clouds the authors show a picture of dark clouds and state "These are storm
clouds. " There is a picture of white fluffy clouds and the authors state "This is fair weather." In response to these statements, students start to ask questions: how are clouds made, where do they come from, and do airplanes make them? This Silver Burdett text and teacher's guide for first grade does not provide enough information or resources to help the teacher respond to students' inquiries.

Because many activity kits and texts lack the science information necessary for a quality science program, teachers are unsure about how to expand on students' inquiries. Many primary teachers recognize this problem and desire help in developing a meaningful science curriculum (Roth, 1991; Cobb, 1991).

In contrast, many K-2 teachers have grown in their confidence and knowledge of literature-based language arts instruction and recognize the importance of literature across the curriculum. This literature-based approach stems from the California State Board of Education's English-Language Arts Framework (1987) which outlines the reading and writing program and its tie to curricula:

Reading of literature... captures students' individual interests and challenges them... (and) the usefulness of writing extends beyond the creative act of composing and expressing one's thoughts to the exploration of learning itself... (It) opens to young learners the worlds of history and science... (p. 11).

The California State Board of Education's Science
Framework for California public schools (1990) calls for making curriculum connections with other content areas. In designing a science program, the Science Framework lists qualities that exist in a meaningful science program; some of the items include a balanced curriculum (in physical, earth and life science), reinforcement of conceptual understanding, and integration of science with other curriculum areas; it also

. . . calls for the thematic presentation of science concepts so that students appreciate the connections across science disciplines and learn how science relates to other subjects (p. viii).

Because many elementary teachers have grown confident in their literature-based language arts instruction and since there is a call for science to make connections across the disciplines, it seems logical to begin enhancing science instruction by connecting literature and science; this connection benefits both students and teachers. Reading good literature helps students "... acquire, extend, and present concepts" (Goodman, 1986, p.44) and good science literature helps students construct knowledge (George, 1991). Beginning with literature, elementary teachers will be able to build upon their strengths of literature-based language arts instruction into their science instruction (Cobb, 1991; Armbruster, 1993). By aligning literature with science, teachers will grow confident in their ability
to develop and implement a meaningful science curriculum (Cobb, 1991; Armbruster, 1993; Butzow and Butzow, 1988).

Theoretical Foundation

Learning to read and learning science have many parallels. Readers learn to read by reading, and scientists learn science by doing science. Readers gain meaning by using predicting, confirming, and integrating strategies, identified by Goodman and Burke (1980). These strategies work for scientists as well. Scientists hypothesize (predict outcomes), check the validity their hypothesis (confirm), and integrate the newly acquired information with prior knowledge in order to generate a new hypothesis (Carin, 1993).

The above mentioned parallels exist because language arts and science curriculum are currently dominated by the constructivist theory of learning. Constructivists believe that learning is a creative process and constructed by the learner; this is evident in several ways in both language arts and science curriculum: both emphasize the learner, not the teacher; both view learning as an active process, not passive; and both believe learning is constructed by the learner building knowledge on previous experience with the content area (Yager, 1991; Goodman and Burke, 1980; Brooks,
Previous experience, or background knowledge, provides the foundation upon which students construct meaning from curriculum. Finley (1991) and Goodman (1986) note the importance of activating and developing prior knowledge for children and in not assuming that children automatically access their prior knowledge. Goodman says to begin language arts instruction by pointing out to children the environmental print to which they have been exposed (such as stop signs and fast food restaurant signs). Finley says to begin science instruction by becoming knowledgeable about the things of which children are aware and to develop curriculum that begins with this knowledge.

Providing experiences and activating children’s relevant prior knowledge to new curriculum allows students to make sense of curriculum. When students are able to make sense of curriculum, meaningful connections are made—which is the goal of all instruction (Caine and Caine, 1991). For students to make meaningful connections while reading, they must be able to comprehend the material. Comprehension is the key to proficient reading; readers learn to comprehend material by simultaneously 1) predicting—asking themselves, what do I think is going to happen next?; 2) confirming—was my prediction correct?; and 3) integrating—does this make
sense with regards to what I already know? The reader constantly questions and tries to make sense, to develop meaning from the printed material (M. Atwell, personal communication, December 9, 1992; Goodman and Burke, 1980; Watson, et al. 1989). For students to make meaningful connections in science, they must develop inquiry; scientist do this by learning how to ask and answer questions that develop explanations and understandings of the world (Yager, 1991; Carin, 1993).

A meaning-centered curriculum allows students to make meaningful connections between the content they are studying and relevancy to their lives. Short and Burke (1991) describe the meaning-centered curriculum:

> the function of curriculum is to support us in the inquiry process of searching for questions and ways of looking at those questions. Without inquiry, a sense of purpose and meaning in learning is lost. . . (p. 55).

A meaningful curriculum is focused on inquiry, is built upon prior knowledge, and based on students' interests. The major source of inquiry for students are their interests; these must be considered when designing a meaning-centered curriculum. Well known philosopher John Dewey supports this belief, stating that "... educators should be aware of the interests and motivations of the children" (Ozmon and Craver, 1990, p. 138). Cobb (1991), states that "... connecting (science) with the familiar in a child's life is
the most common way to gain attention" (p.65). Children come to school with questions and personal experiences which comprise their prior knowledge; it is upon these that a meaningful reading curriculum and science curriculum is built (California State Board of Education, 1987; California State Board of Education, 1990).

To learn language and science, one is immersed in an environment enriched with language and scientific thinking. Weaver (1988) talks about the development of oral language and how immersion in a language-rich environment helps the child develop; adults do not "... directly teach children how to talk, they learn to talk by transacting with us in a language-rich environment" (p. 178). This is also true about proficient readers and scientists. Proficient readers develop from a print-rich environment; it is by transacting with this print-rich environment where students learn to read and write (Smith, 1985). Scientists develop from a science-rich environment (an environment filled with many opportunities for inquiry and discovery); it is by transacting in a minds-on/hands-on science environment where students develop scientific thinking (Santa & Alvermann, 1991; Thier, 1986).
REVIEW OF THE LITERATURE

The literature review for this project will support the connection of literature and science from a constructivist approach. Topics include developing a meaning-centered curriculum for science, defining the processes of reading and science, identifying strategies for teaching science, considering cognitive development, making literature and science connections, and evaluation.

Meaning-Centered Curriculum

In general, there are two different approaches to designing curriculum: 1) a segregated approach--each area of curriculum taught in isolation, detached from other content areas, and 2) a meaning-centered approach--an integration of curriculum, content areas are connected to present an overall concept.

In a segregated approach, curriculum has been designated from outside influences with each area to be taught in isolation. Outside influences include the state frameworks, district curriculum guides, school plans, textbooks, teacher’s guides, and scope and sequence charts. Goodlad, in Kronowitz (1992), describes a modified view of how this type of curriculum is developed. There are five curriculum
parts which overlap: 1) the ideal curriculum--from scholars and "experts", 2) the formal curriculum--from state printed documents and publishers, 3) the instructional curriculum--the teacher modifying the formal and ideal curriculum to meet student needs, 4) the operational curriculum--what actually happens in the classroom, and 5) the experiential curriculum--what the students actually learn.

Unlike the segregated approach described above, a meaning-centered curriculum develops as a result of a joint effort of the teacher, the student, and the ideal and formal curriculum described by Goodlad; all three work together to create a meaning-centered curriculum. (Short and Burke, 1991; Goodman, 1986; Watson, Burke & Harste, 1989). The teacher inquires from the students about their interests, then finds what part of the ideal or formal curriculum that can be taught through their interests. This meaning-centered curriculum is founded in the constructivist philosophy; the belief is that all learning is a creative process and constructed by the learner and based on personal life experiences. Teachers must make the connection to the students' prior knowledge so the learner can identify what is being learned, relate to it, and be able to recognize the value of the information--Caine and Caine (1991) call this "brained-based" learning.

In this meaning-centered constructivist approach,
learning is the focus of attention--not the teacher. Students are active learners generating new knowledge--not passive recipients of knowledge, and "experts" and others are only one part of the curriculum program--not the driving force (Yager, 1991; Routman, 1991).

In a segregated approach, a thematic unit ties the content areas together with some sort of meaningless focal point, such as "bears". A unit may include anything that has bears on it; this is used to teach all curriculum areas--addition and subtraction worksheets for math might have pictures of bears on them; fiction and non-fiction stories about bears are read; artwork consists of coloring bears; and science includes talking about bears in their habitat. Even though there is a general focal point, all curriculum is taught separately; it lacks an overall concept which joins the various content areas together into a meaningful curriculum.

In a meaning-centered approach, teachers and students organize curriculum around topics or themes called "Theme Cycles" (Routman, 1991) and do not attempt to isolate the various curriculum areas. The unit provides an overall concept as a focal point for inquiry, for using language, and for content development. It involves students in planning and giving choices of authentic and relevant activities within a productive study. In a theme cycle,
students are asked about their interests and it is on these interests that a unit is developed; it may be developed around any content area topic (Goodman, 1986). According to Routman, the typical unit begins by asking students what they already know about the student selected topic, asking students what they want to know about the topic; then, the teacher and students work together constructing knowledge. If a particular area of curriculum is not relevant in regards to the area of study, it is postponed until later when a meaningful connection can be established--there is no attempt to create artificial connections between the content areas (such as drawing bears on an unrelated math worksheet) which might occur in a segregated approach. Upon conclusion of the theme cycle, students and teacher discuss what learning has taken place and decide the next area of inquiry.

The Science Framework for California Public Schools (1990) calls for a "... thematic presentation of science". This presentation is very different from the traditional thematic approach discussed above; it is an overall conceptual approach, beginning with a concept statement. The science concept is taught using a variety of materials and reinforced through other relevant content areas, such as language arts, social studies and math. There is a conscious attempt to making meaningful connections and build
upon prior science learning (California State Department of Education, 1990; Carin, 1993). To help the young learner (ages five to seven) develop a clearer understanding of science concepts, it is suggested to focus on one area of science (life, physical, or earth) for a length of time rather than simultaneously (J. Woerner, personal conversation, February 8, 1993).

In the meaning-centered theme cycle and science thematic units described above, the role of the student and the teacher in the classroom is very different from the traditional approach. In the traditional approach, the teacher is the giver of knowledge and the student is to absorb the knowledge given. In contrast, the teacher’s role in the meaning-centered theme cycle and science thematic units as described above is that of facilitator—to facilitate students learning and the students’ role is to construct knowledge; the teacher facilitates that construction of knowledge by tying students’ relevant prior knowledge to the curriculum. In this way the teacher helps students make meaningful connections. (Yager, 1991; Routman, 1991; Caine and Caine, 1991).

Reading and Science as Processes

Goodman (1986) takes the stance that the only reason for
reading is comprehension—to get meaning from the print. Reading is not segmenting language into bits of sound, nor is it drilling isolated "reading skills" (Smith, 1985).

Reading is comprehension. The proficient reader reads for meaning by simultaneously doing three things: predicting, confirming, and integrating (Goodman and Burke, 1980; Weaver, 1988).

Before a book is even opened, students make predictions, based on the title and illustration, as to what the content will be about. Students use their prior experiences, or background knowledge, to help make sense of what is being read. As the student reads, the predictions are confirmed or disconfirmed—again, based on their prior knowledge. A proficient reader does all three aspects simultaneously to gain meaning from reading (Busch, 1992; Goodman and Burke, 1980).

Before students come to school, they have developed a natural curiosity and scientific concepts about the world based on their experiences; students use these experiences to help them make sense of the world. As students assimilate knowledge, hypothesizes are confirmed or disconfirmed based on their prior knowledge. Scientists are constantly inquiring, asking questions, in attempt to make sense of the world (Yager, 1991; Carin, 1993; Driver 1983).

Using this natural curiosity as a base, Carin (1993)
describes a four-step format in which science professionals learn and apply new skills and information in their field:

1) accept an initiation to learn; 2) explore, discover, and create; 3) propose explanations and solutions; and 4) take action on what they learned (p.89).

Strategies for Teaching Science

Textbooks

Science can be (and is) an exciting, aesthetically pleasing, problem-solving adventure and reading science textbooks ought to reflect that fact. Instead science textbooks are dull, boring, and for the most part, pedestrian (Anderson, 1992, p.173-174).

Lightening, thunder, and pounding rain--an exciting science experience; in attempts to use this teachable moment, the science text is often quickly referenced and read. Although students have many exciting questions, the science text is unable to expand upon students' inquires because of its simplistic and superficial information (Dempster, 1993; Ornstein, 1992).

Holliday (1991) found many criticisms of science texts. Not only do they lack the depth with regards to specific topics, but students also have difficulty relating to the information--there may be little or no relevance to the local community, and much of the information is simply facts to present and assess.
Despite the criticisms, dependance on the textbook for curriculum remains high. Roth (1991) and Finley (1991) found the science textbook as the base of science instruction in many elementary schools, with the teacher and the text presenting facts, concepts, and simple explanations for children. McCutcheon, in Kronowitz (1991), found "elementary teachers specifically rely on textbooks for the content of what to teach and how to teach it (p.13)."

Perhaps this occurs because it is the way many teachers themselves were educated, or perhaps teachers lack the knowledge of how to teach science without the text (Ornstein, 1992).

The benefits of using the textbook approach is that it outlines the planning of units and lessons, summarizes information, and relieves the teacher of preparing their own curriculum--allowing more time to prepare the lessons. Many good textbooks are well organized, coherent, and an easily accessible tool of instruction (Ornstein, 1992; Holliday, 1991).

Difficulties in learning occur for the student who is educated by the textbook method alone. Finley (1991) found students usually do not understand the meaning of the terms and concepts in the text; they are unable to identify the inconsistency of text information verses their expectations. Therefore, students lack the development of critical
thinking skills. Information presented is very general, and students are unable to relate the information to their own lives—which is necessary in a meaning-centered curriculum.

Because of the high use of the textbook in the elementary science curriculum, several recommendations are made to the classroom teacher and to the publishers. The teacher should introduce technical words before reading takes place—to facilitate comprehension and there should be activities that engage students in active learning which reinforce concepts read in the text. Publishers should provide students and teachers with rich descriptions and explanations of natural phenomena, adequately define terminology, present science concepts more clearly, consider students background knowledge, account for and be aware of potential misconceptions, and write from a critical thinking perspective—not from the perspective of making it simple for students to understand (Holliday, 1991; Finley, 1991; Konopak, 1991).

**Hands-on/Heads-on Science**

In the 1960’s, a popular movement came about called "hands-on science". This involves the students using materials and discovering science concepts on their own, otherwise known as the discovery approach. Students who
learn with this hands-on method of science instruction scored 62% higher than in the traditional textbook format in all performance criteria; students hypothesize, control variables, collect data, make inferences, and come to a conclusion (Their, 1986). Even though this is true, a problem develops by using hands-on science only; students begin to explore materials and processes and not guided through the concepts encountered during the experiments. As a result, misconceptions about science begin to develop (Their, 1986; Yager, 1991).

Their (1986) addresses the problem by suggesting that along with the hands-on experiences, students need a "heads-on" approach. In a heads-on approach, the science concepts learned are tied to the students’ lives through follow-up materials such as pictures, videos, and other media-based experiences; students develop critical thinking skills and use them for decision making that will empower them with qualities to become a contributing member of society (Their, 1986; Holliday 1991; Carin, 1993).

In Carin (1993), Karplus and Thier describe the stages of an ideal science lesson based on the constructivist learning model which combines the hands-on and heads-on approach. These stages are 1) exploration--students are allowed a time to explore and perform experiments in a hands-on environment, 2) concept introduction--using the
same materials students have explored, teachers demonstrate the experiment and introduces science vocabulary while explaining the concepts learned, and 3) concept application-the teacher presents a new situation or problem for possible solution using the information from the previous stages.

Similar to Karplus and Their's lesson model, Biological Sciences Curriculum Study--BSCS, (1992) uses a specific instructional model. H. Brunkhorst (personal communication, February 15, 1993) describes this model as the "Five E's": 1) engage--the learner’s interest and background experience is connected, 2) explore--the learner is allowed to explore the materials free of teacher directed lessons, 3) explain--the teacher guides student’s thoughts toward the concept which is being taught, 4) extend--the teacher expands the concept learned into a new situation, and 5) evaluate--the learner evaluates their own progress and develops future areas of inquiry.

Cognitive Development

Aldridge, in Andersen (1992) suggests to teach all sciences every year--K-12, and arrange instruction systematically, from concrete-phenomenological through semi-quantitative, and to be consistent with the developmental
level of the learner.

This developmental level comes from the studies of Piaget (Fitzgerald, Strommen, and McKinney, 1982; Charles, 1974). Piaget studied the ways children grow to understand concepts about the world and found three basic cognitive levels or stages of development:

1) Preoperational thought, ages approximately 2-6—children organize speech, language, social behaviors, primarily egocentric reasoning, and the acquisition of representational symbolism.

2) Concrete Operations, ages approximately 6-11—organization of flexible and systematic thought, initial classification and grouping of objects, development of conservation and the ability to reserve mental operations.


In this brief discussion, Piaget notes that one assimilates experiences with their own knowledge based upon their cognitive level; learning occurs when one interacts with the environment and attempts to resolve the cognitive conflict that may occur between expectations and observations (Driver, 1983).
Literature and Science

Making literature and science connections is based on the parallel relationships that exist in learning to read and learning science; much of the successes of students learning to read has come from the use of trade books in the curriculum. Miller and Milligan (1989) found the use of trade books to teach the language arts curriculum to be popular among teachers and beneficial for students learning reading comprehension strategies. With the use of trade books in science, reading material is available for all students--regardless of reading ability levels, concepts and thinking skills are reinforced, and students construct new scientific knowledge (Carin, 1993; Gee and Olson, 1992). Literature has been shown to increase motivation and involvement of students in science curriculum; it makes science interesting and relevant to students lives (Carin, 1993; Butzow and Butzow, 1989; Anderson, 1982).

Cobb (1991), an author of science tradebooks, surveyed teachers at a science workshop. She found that elementary teachers needed many things; they wanted to know how to motivate students, science fair ideas, ways to integrate science concepts into other areas, practical hands-on activities, and, "... reassurance that someone without an academic background in science can teach it effectively"
To meet these needs, Cobb suggested to begin teaching science with literature;

Quality children’s literature can easily contribute to solving the problems facing classroom teachers. . . using good books taps the strengths of most elementary school teachers" (Cobb, 1991, p.62).

Quality literature allows teachers and student to make meaningful connections with science. Through fiction and non-fiction stories, adults and children make sense of the world. If children can learn about science through the literature, children may visualize the concepts and recognize them in their own lives. Children understand stories and science is stories; through studying good literature and science, children can get a sense of how the world works and create their own stories--constructing meaning, making sense of the world (Shannon, 1993; George, 1991; Martin and Miller, 1991; Butzow and Butzow 1988; Manning, 1991).

Armbruster (1993) and Butzow and Butzow (1988) point out the great need for aligning trade books with science concepts. Since the science text no longer runs the science curriculum, teachers need other resources to enhance instruction; trade books aligned with the various subjects to be covered is needed.
Evaluation

In a segregated designed curriculum, evaluation of an effective program within the classroom usually consists of scores from national standardized achievement tests and end-of-the-chapter tests. Students are tested on knowledge on isolated skills and rote memorization of facts.

The Science Frameworks for California Public Schools (1990) notes that "what you test is what you get" (p.176). Because of accountability purposes and personal goals, students often focus attention on activities that determine their grades and career opportunities, and teachers guide instruction toward criteria by which they and their students are evaluated. The national standardized achievement tests and end-of-the-chapter tests are not adequate tools of assessment for evaluation in a meaning-centered approach to curriculum. Fortunately there are many other methods of evaluating student performance.

Goodman (1986) talks about "kid-watching". This is an informal evaluation in which the teacher evaluates by carefully watching students as they write, listening to group discussions, or even during casual conversations. Teachers evaluate and revise their plans based on "kid-watching"; "The key is that it happens in the course of ongoing classroom activities" (p.41). Teachers record these
observations using anecdotal records--dated notations that describe the strengths, needs, progress, learning style, or any other relevant observation.

Using a portfolio is another method of gathering information for assessment and evaluation. Routman (1991) describes portfolios as an ongoing, changing collection of student work samples. Ideally, students help select the pieces of work that go into the portfolio which are used for discussion with the student, examination, reflection, and evaluation.

For science assessment, Carin (1993) describes the "practical assessment". This type of assessment is aligned with the goals and methods used to teach science in a hands-on/heads-on approach, and most appropriate for assessing scientific processes and problem-solving skills. It usually involves manipulative activities where directions are administered either individually or in a group, and responses may be oral or written. Students perform a specific task, then record and interpret results in a test booklet. In addition to anecdotal notes, other ways of recording the assessment may include audiotape or videotape recordings, teacher conversations, and teacher-pupil interviews.

Because of the time constraints, an evaluation of this project is not available. In addition to being evaluated
based on the above mentioned assessment tools, student involvement and teacher implementation of the curriculum will show the successes of the program and areas which need to be revised.
DESCRIPTION OF THE PROJECT

Summary

This year-long science plan aligns appropriate science concepts with Houghton-Mifflin literature series (first grade), other related literature, and science experiments and activities. A year-long theme joins three units, focusing on physical, earth, and life sciences. Each unit has three sections. The sections last about a month, depending on students' needs and interests. Each unit contains these six elements: a unifying concept, a first grade subconcept, section focus, science vocabulary, literature, activities and related literature or other resources in an annotated bibliography form. Information about how to implement the units as well as a model science lesson involving BSCS's "Five E's" is included. The final part consists of other resources available for the teacher, publications and professional organizations.

Goals

The goals of this project are very specific to the grade level and to the specific school site. The goals are to:

1) design a meaningful science curriculum for first
2) define the processes and content as designated by the frameworks,
3) identify and define science concepts to be taught,
4) align literature which can introduce, restate, or enhance the concepts,
5) provide for additional teacher resources,
6) outline a science lesson format which can serve as a guide in planning science lessons.

Literature used will include the Houghton Mifflin Language Arts Series (1989) for first grade, core literature designated to be taught by Colton Joint Unified School District, and other fine pieces of literature.

This project is different from other programs in that it not only provides literature to go along with the science experiments but will also identify the science concepts to be taught. The focus is on helping students and teachers to make connections across the curriculum areas of language arts and science.

The goal is for this project to fulfill the science requirements designated by the state, district, and school site curriculum guides using good literature and based on student interests; thus allowing students access to a meaningful science curriculum at all times.
Limitations

This project focuses on two areas of curriculum: science and literature. Because of this, no other content areas are developed. Reading and writing activities, as well as other content areas, need to be included in order to have a fully developed meaning-centered curriculum.

The limitations of this project are:
1) it is specific to the needs of one teacher--although others may find the information useful,
2) it is specific to the state of California, Colton Joint Unified School district, and Walter-Zimmerman elementary school curriculum expectations for the first grade only,
3) availability of literature may not be accessible to all teachers, and
4) like all on-going curriculum projects, this is not complete and will continually evaluated, eliminated, and updated.
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APPENDIX:

A YEAR-LONG CONCEPTUALLY-BASED SCIENCE PROGRAM

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INTRODUCTION

During my teaching career, my language arts program has grown from strictly following the district adopted language arts text and workbooks to integrating students' interests and needs into the curriculum. Unlike my language arts program, my science program has remained focused on the textbook. This project is designed to integrate literature used for language arts with science concepts and experiments which support the concepts.

COMPONENTS OF THIS SCIENCE PROGRAM

This project aligns appropriate science concepts with literature and science activities specifically for the first grade. A year-long conceptually based, meaning-centered science program is developed which consists of three units based on physical, earth, and life sciences. Each unit has three sections identifying a unifying concept (which ties the entire school district together), a first grade subconcept (which all first grade students are to construct), a piece of literature (which begins the topic of study), a science focus (a specific area of concentration), some science vocabulary (language which dominates the section), some science related activities (15 to 20), and other pieces of fine literature related to the topic.
This program is built from a constructivist philosophy using the state frameworks, district expectations, school site science content matrix, student interests, student needs, and literature. This program is designed to serve as a guide. Activities are arranged in such a sequence that new knowledge is built on past experiences. When implementing this program, students' interests and needs are to be the core of the program--not the activities themselves. Like all on-going curriculum projects, this is not complete and will continue to change as the students and I grow in knowledge about science.
TERMS AND DEFINITIONS

This section contains terms and definitions necessary to understand while implementing this science program. All this information is designated by Colton Joint Unified School District (CJUSD) or Walter Zimmerman Elementary School for first grade. Definitions are based on information from the New Merriam-Webster Dictionary (1989) and the California State Board of Education (1990) Science Framework for California Public Schools.

Science Working Themes

In the science framework, there are science themes. The framework states that these themes are necessary in teaching science because not only do scientists collect facts and categorize them, but they also study the usefulness of the information of how something works and how it fits in the "whole picture".

"A thematic basis (of science)... is what scientists really do, and what science really is..." (California State Board of Education, 1990, p.28). Connecting the realms of science as students learn, themes provide guidance for teachers in developing instructional units. The instructional focus themes chosen for first grade at Walter
Zimmerman Elementary school are systems and interactions, and scale and structure.

**Systems and Interactions**

**Systems**

A system is a group of units combined to form a whole. In science, the study of systems may include solar systems, individual organisms, chemical systems, and physical systems.

**Interactions**

An interaction is a mutual or reciprocal action or influence. In science, there are many types of interactions and ways systems can be studied. For example, a deer can be studied as a plant eater, an item of prey, or a living system itself. When studying the interactions in a system, aspects of the interaction can be studied like input and output of technology. For example: fruits, seeds, and oxygen are products (output) of flowering plants and are eaten or used by (input) animals.

**Scale and Structure**

**Scale**

A scale is defined as a graduated series. In science, it is used to show the hierarchical component levels of structure.
For example, the hierarchy of atoms to molecules.

**Structure**

Structure is something made up of interdependent parts in a definite pattern of organization. In science, there are many kinds of structures; they include diversity of life, geological forms, chemical structure, and physical structure. To study matter, there are three basic approaches: 1) reductionist--searching for the smallest levels of operations; 2) synthetic--all levels in a system are examined to see what role each play in an overall behavior of a system; and 3) observations of an individual organism--interactions with other organisms and/or their own internal metabolic workings.

**Summary**

Scale and structure and systems and interactions are closely tied together. Most systems are studied at some scale, such as one part of an ecosystem, and there is an interplay between structure and function because structure shows how parts function and how their actions work to support the whole system. For example, deers have long legs (scale and structure) for running which important for the deer's survival (systems and interactions).
Science Processes

This section identifies the science thinking processes. All processes are to be reviewed at in first grade, but observing and communicating are emphasized in CJUSD.

1. **Observing**—looking, touching, tasting, smelling, and listening, identifying such concepts as size, shape, color, texture, and other observable properties.

2. **Communicating**—conveys ideas through social interaction, possibly through published works, lectures, and conferences.

3. **Comparing**—deals with concepts on similarities and differences, using something known to compare to something unknown—scientific measures include length, mass, temperature, volume, and time.

4. **Ordering**—deals with patterns of sequence, putting objects or events in order. Two types: linear stories—show growth and decay, motion of an object, or cause and effect, and cyclical stories—recurring events, such as the water cycle.

5. **Categorizing**—deals with putting objects together with regards to patterns, groups and/or classes. Two basic types: grouping and classifying.

6. **Inferring**—deals with ideas remote in time and space;
logical conclusions are made from a chain of reasoning.

7. **Applying**—scientific process by which we use knowledge; sometimes used to elaborate upon a theory.
This plan is designed with a year-round school schedule in mind. Units last approximately 12 week units each, with one overall theme for the year.

Yearly Overall Theme: "What’s Different in the World?"

Unit 1--"Kinds of Energy"--physical science focus,
Unit 2--"Elements of Change"--earth science focus, and
Unit 3--"Diversity of Life"--life science focus.

The units are designed to include the following information: content area, unifying concept, first grade subconcept, literature, science focus, vocabulary, activities and other related literature; page numbers refer to location of concept in the Science Framework and stories contained in the Houghton Mifflin Literary Readers for grade one are indicated with H/M. Other content areas are integrated in the activities, but specific concepts are not addressed. It should be noted that the units are flexible as to presentation, student interest, and "teachable moments" are always utilized.
YEAR-LONG PROGRAM OVERVIEW

YEAR-LONG THEME: WHAT'S DIFFERENT IN THE WORLD?

Unit 1 -- "Kinds of Energy"
Content: Physical Science
Concepts: Energy causes change in matter; energy comes in different forms.
Section 1--The Five Senses
Section 2--Properties of matter
Section 3--Forms of Energy

Unit 2 -- "Elements of Change"
Content: Earth Science
Concepts: The earth with it’s universe is constantly changing; sun, air, water, are important elements of change on the earth.
Section 1--The Sun
Section 2--The Weather
Section 3--The Earth

Unit 3 -- "Diversity of Life"
Content: Life Science
Concepts: Life is diverse; there are similarities and differences in living things.
Section 1--Plants
Section 2--Insects
Section 3--Animals

Each unit lasts about 12 weeks. Each section lasts about a month, depending upon students’ needs and students’ interests, and all are flexible with regards to real-world happenings. For example, if an earthquake should occur, a brief study of earthquakes should take place immediately following the event.
IMPLEMENTING THE PROGRAM

How to Begin

To begin a unit, students discuss what they already know about the suggested topic of study. This information is recorded by the teacher on chart paper and displayed in the classroom.

Next

Students and the teacher brainstorm possible areas of inquiry, what they want to know more about. Again, the information is recorded by the teacher on chart paper and displayed in the classroom.

Planning

The teacher chooses from the variety of activities which provide learning into the areas of inquiry. Activities should be chosen with regards to students’ needs and interests. In these units, activities are sequenced in an order which helps to build knowledge based on prior experiences throughout the entire year.

How to Finish

At the end of a unit, students present information they have learned in a culminating activity--either through writing, drama, art, music, or any method of communication. Events may include a presentation to the school, making a class book, or a drama presentation for the parents.
MODEL SCIENCE LESSON

The science lesson design here is based on the "Five E’s" designed in 1992 by Biological Sciences Curriculum Study (BSCS). Not all activities will fit this model, but this should serve as a guide while helping students focus on specific science concepts to be learned.

1. Engage.

Provide an activity or discussion which grabs students' interests. Previous experiences, with the topic and concept, need to be informally assessed at this time.

2. Explore.

Allow the students to explore materials used in the lesson free of teacher directed lessons. Students make a lot of discovery learning at this time.

3. Explain.

The teacher guides the students' thoughts toward the concepts which is the focus of the lesson. This is done using the same materials the students used to explore.

4. Extend.

The teacher extends or expands the new concept learned into a new situation using different materials. The students identify aspects of the recently learned concept in the new situation.

5. Evaluate.

The students evaluate their own progress and develops future areas of inquiry, while the teachers evaluate each student’s progress.
SAMPLE SCIENCE LESSON

Concept: There are similarities and differences in living things.

Focus: Insects and their basic needs.

1. Engage: Through discussion, remind students of the similar basic needs of plants--soil (nutrients), air, and water. Pull out a ladybug puppet. Exchange dialogue with the puppet and the students, asking questions such as what am I, where have you seen me before, what was I doing, what do I eat, do I breathe. Read the chapter on ladybugs in *Insects do the strangest things*.

2. Explore: Have students go on the playground with a hand lens and look for insects and bugs. Return to class and write down their observations on chart paper--have columns with headings such as what the ladybug asked.

3. Explain: The teacher helps guide discussion of about the similarities and differences between the various insects, such as they all have six legs, they all breathe, and they all need water. This information should be included in the chart from step 2. If necessary, have students return outside and look for the information to complete the chart, searching for answers to the remaining questions.

4. Extend: Have lots of real or plastic insects to look at. Establish an ant farm and observe it. List differences and similarities between the animals.

5. Evaluate: Students write in their science journal what they learned about the similarities among insects and other living things. Discussion may include the basic needs--nutrition, air, and water. Then, students write other questions about the topic that interests them--further areas of inquiry. The teacher read the entries and responds, while evaluating the student’s understanding of the concept.
While doing science, there are thinking processes that need to be reinforced. In reading and in science, these processes are similar. Since many primary teachers are confident in their ability to teach reading, I took the processes of reading and paralleled them with science thinking processes. Throughout the many activities that students will be doing, these thinking processes must be developed.

**Predicting**

Students predict what is going to come next while reading. In science, have students predict (or hypothesize) what is going to happen.

**Confirming**

Students confirm their predictions while reading, asking themselves is this what I thought--why or what's different. In science, have students confirm their prediction (test their hypothesis) and ask themselves--why or what’s different.

**Integrating**

Students use their background knowledge of the content and what they know about language to understand what is happening, to get meaning from reading. In science, have students use their background knowledge or the content and what they know about science and what they have just learned in science to develop a new hypothesis or understanding about science.
EVALUATION

This section describes the types of assessments to be used for evaluation in this program. The focus of this science program is on thinking processes and it's assessment is an on-going process throughout the school year.

Kid-watching

As students are working on assignments, the teacher observes what is happening. The teacher records this information using anecdotal records--dated notations that describe any strengths, needs, progress, learning style or any other relevant observation.

Portfolio/Journal

This is an on-going collection of student work sample. Each student has a folder or journal in which work samples are placed or written down. Ideally, students help select pieces of work that go into the portfolio which are used for examination, reflection and evaluation. It may include polaroid pictures of actual completed science projects.

Practical Assessment

This type of assessment usually involves manipulative activities where directions are given, either individually or in a cooperative group, and responses may be oral or written. Students perform a specific task, then record and interpret results in a test booklet. Other ways of recording the assessment may include check sheets for the science process skills, audiotape recordings, videotape recordings, teacher conversations, and teacher-pupil interviews.
UNIT 1

PHYSICAL SCIENCE
KINDS OF ENERGY

Unifying concept: Energy causes change in matter.

First grade subconcept: Energy comes in different forms.

Although the unifying theme is "Kinds of Energy", one needs to build on or develop students' background knowledge about the five senses which helps to identify the characteristics of matter. Students are briefly exposed to the three forms of matter (solid, liquid, and gas) in order to identify some of the effects of energy on matter. Building upon this knowledge, various forms of energy—wind, heat, light, magnetism, and electricity—and their uses will be explored.

Section 1--Five Senses.

This section focuses on identifying matter through seeing, smelling, tasting, feeling, and hearing.

Section 2--Forms of matter.

This section focuses on measurement, relative sizes, shapes, and forms of matter: solid, liquid, and gas.

Section 3--Forms of energy.

This section focuses on energy, its characteristics, and its effects on matter. The forms of energy explored include wind, heat, light, magnetism, and electricity.
Section 1--The Five Senses

Section focus: This unit focuses on identifying matter through seeing, smelling, tasting, feeling, and hearing.

Literature:


This predictable and patterned text is easy for students to read. Illustrations reinforce the text with colors identified on the appropriate clothing items mentioned. All readers, regardless of ability, can be successful.

Science vocabulary: eyes, sight, colors, skin, touch, texture, hard, soft, nose, smell, ears, hear, tongue, and taste.

Activities:

1. Students observe the colors in the text and try to locate someone else who is wearing the same color in the classroom.

2. Have students categorize themselves by the color of a particular article of clothing. Put color words on the walls in various corners of the classroom, students go and stand in the category in which they belong.

3. Make a class book. Students draw a picture of themselves wearing a specific color. Students write or dictate their lines similar to the text in "Mary wore her red dress and Henry wore his green sneakers".

4. To reinforce listening skills and color word identification, students learn to act out and sing Hap Palmer’s "Parade of Colors".

5. Talk about the characteristics of clothing. Students can feel the various textures, and whether or not it is hard or soft and the reason for its construction.
Students can learn the word "cotton"—which appears on most labels of shirts.

6. Make a bar graph. Students choose their favorite color and write it on a post it note, then they place it on a bar graph.

7. While reading the story *Brown Bear, Brown Bear* student predict what color and animal will come next.

8. Mixing Colors. Students can experiment with mixing paint colors to form new colors. Student can predict what color will appear, confirm their predictions, and record their results in their personal science journal through pictures and writing.

9. Each student writes four color words on four different post it notes and walks around and places them on items of the same color.

10. Students predict what smells and tastes they might encounter while at a birthday party.

11. Blind fold students and have them smell various items and classify them as something pleasant or unpleasant.

12. Have a taste test. Make two pitcher of lemonade, one with sugar and one without—students taste to identify sweet or sour.

13. Classify fruits and vegetables. Students use all their senses, including taste, and in small groups categorize the various fruits and vegetables. Categories may include hard or soft, juicy or dry, sweet or sour, rough or smooth.

14. Work in partners. One partner is blind folded and the other holds his/her arm and tells the partner how to move while going on a short walk around the playground.

15. Students can feel what braille is like with the use of McDonald’s Braille menus.

16. Using a hand magnifying lens, students can look at various items at a larger than normal scale.

17. Watch T.V. without the sound and write down what the show is about. Then, watch the show with the sound to check your predictions.
18. Using a 3x5 card, cut a small square in the middle. Students go outside and look through the square and draw a picture of what they see.

19. Have a walking field trip, students go outside and listen to the sounds. After returning to the classroom, students draw or write about the sounds they heard.

20. While listening to music, have students identify the concepts of loud and soft, fast and slow, and high and low pitches.

21. A guessing game. Students write down clues which contain the various senses used to identify matter and the other students get to guess what the item is.

22. Students walk by a neighborhood farm and listen to the farm animal sounds.

23. Learn to sing "Cat goes fiddle-e-fee" by McCracken and read the story Cat goes fiddle-i-fee in H/M. Students identify the similarities and differences between the two versions.

24. Using a story bubble format, students might create their own story or comic which includes the sounds that they have identified. The Boat (H/M) and Splish-Splash Sounds illustrates this format.

25. Place five similar looking items in dishes on a table. Number each dish. Have the students look at them and predict what the item is, then students taste and write their answer. Items might include sugar, powdered sugar, flour, baking soda, and cornstarch.

26. The Mystery Bags. Students are handed a bag with a small hole to reach into and to guess by feeling what the item is, oral descriptive language is encouraged.

27. The Telephone Game. Connect two empty cans with at least fifteen feet of string. Two students talk to each other.

28. Three glasses of clear water. Students stick a finger in each to identify the temperature of the water: warm, cool, and cold.
Related Literature:


The train is labeled with the color, type of car, and is moving down the track. Heavy black smoke pours out of the engine. Very simple text.


A book about the colors in the rainbow. Realistic items are drawn and labeled according to item and color.


This predictable and repetitive text helps with color identification, predictions, and confirmation. All readers can be successful.


This story is a predictable and repetitive text. Students will be successful if paying attention to the printed words and pictures. A boy feeds his animals by a tree. The little boy’s interpretation of many animal sounds is the content of this story. Animals include a cat, dog, horse, cow, pig, sheep, goose, duck, and hen.


Simple text yet descriptive vocabulary are the main attractions to this piece. Most readers will be successful. Concepts such as colors, texture, size, and sounds are covered in this story about a chicken who hatches from an egg and learns about the world in which he lives.


Based on the traditional song, this book is filled with predictable language. Children read the book and predict what is coming next by seeing a part of the next animal and the sound it makes.

This easy is an easy to read book with repetitive phrases and predictable text. The format contains story bubbles, like in comic strips. It is about animals and they are trying to go for a boat ride, but there is one thing they all forgot to do. Through careful observation of the illustrations, students predict what is wrong and what will happen next.


This story is about deception. A fox tries to fool a young rabbit, whom he wants to eat for lunch, by pretending he is a red frog. The young rabbit’s mother feed the fox some soup. After the fox tastes it and says he likes it, he has a big surprise.


Iris gets confused, she sees things differently then everyone else in her house. After a visit to the optician, Iris gets glasses and finally see and understand the world.


Noises are explored through various environments: in a house, in a playground, around a town, at the zoo, in a harbor, at a construction site, on a farm, on the beach, in the mountains, and on a picnic. Illustrations are detailed and contain words that symbolize sounds.


This book covers the fives senses in very simple language.

Music:

Section 2--Properties of Matter

Section focus: This unit focuses on measurement, relative sizes, shapes, and forms of matter: solid, liquid, and gas.

Literature:


This big book is about a boy who compares the size of himself to other things. The illustrations show relative size. Text is repetitive and predictable; all students can be successful. Little books are available for the students to make themselves.

Science vocabulary: relative sizes, shapes, buoyancy, volume, length, space, alike and different, solid, liquid, and gas.

Activities:

1. Have students line up in on a scale from shortest to tallest.

2. Using a pencil and paper, students take off their shoes and trace around the shape of their foot. Using the drawing, students measure the length and width of their foot.

3. Bean Bag Toss. Students estimate the length of their bean bag toss, then toss, and measure actual length.

4. Students write hypotheses on whether or not 10 various items will sink or float in water. Place water in a tub, and in small groups children test their hypothesis.

5. Fill a jar with water to the rim. Ask students to guess how many pennies you can add until the jar overflows with water. Try it.

6. Is air matter? Have a zipper sandwich bag filled with air on the table, ask students to come up and tell you what is in the bag. After someone identifies "air"
have students tell how they know, identifying some of the properties of air.

7. Let students brainstorm how they can demonstrate that air is matter.

8. Bring in a flat bicycle tire, balloon, and deflated beach ball to demonstrate air has volume, pressure, and occupies space.

9. Have students push or pull a filled box over a smooth surface and a rough surface.

10. After reading Much Bigger than Martin, play "Is it bigger than a . . . " game. An object is in a person’s mind, and others guess by asking the question, "Is bigger than a . . . ."

11. Using a balance scale, students predict what items weigh more or less.


13. Change states of matter. Demonstrate how ice can change to water and to steam and back to water again.

14. Add vinegar or lemon juice to milk, students watch what happens to the milk. This is a chemical change.

15. Students can make a plaster footprint to demonstrate matter changing from liquid to solid.

16. To learn the basic shapes, students learn to sing and act out Hap Palmer's song "Triangle, Circle, and Square."

Related Literature:


This story is about a boy who wants to be bigger than his brother. Imagination, height charts, and sympathy are key components; good for studying relative sizes.

This is a teacher resource book. Students can also explore some ideas with adult supervision. It is filled with practical and fun ideas which will intrigue any student. No fancy chemicals are needed to perform most of these experiments. Properties explored include mechanics, fluid dynamics, sound, air pressure and electromagnetism.

Langstaff, J. (1986). Oh, a hunting we will go. Boston: Houghton Mifflin. (H/M)

This is a predictable rhyming silly story about catching animals and then letting them go. Various shapes and sizes of animals contribute to the story line.


Throughout this story, an eeny, meeny, miney, mouse is trying to find a new place to live. The illustrations demonstrate relative sizes. Text is predictable and repetitive.


Full of descriptive words about water.


Being different is not bad. A giraffe, who has an extra long neck, wanted to be like other giraffes until he is able to discover many positive attributes about having this long neck.

Music:

Section 3--Forms of Energy

Section Focus: This section focuses on energy, its characteristics, and its effects on matter. The forms of energy explored include wind, heat, light, magnetism, and electricity.

Literature:


This is a story about a cartoon bear who has a difficult time trying to fly his kite. Many friends offer help, and at last the kite flies. This story illustrates aspects of a windy day. Text is repetitive and fairly predictable.

Science vocabulary: wind, heat, light, magnetism, and electricity.

Activities:

1. Talk about the illustrations in the story and what characteristics make a "good day" to fly a kite.

2. Students brainstorm experiences that have to do with air, including flying kites.

3. Bring in books about kites and their various shapes and designs of kites throughout the various cultures.

4. Students make their own kites, using sticks or straws, paper, string, and cloth for a tail.

5. Make a pinwheel. Use pencils with erasers, straight pins, and a paper pinwheel pattern.

6. Using flex straws and garbanzo beans, students can experiment with moving and controlling air.

7. Students can create their own paper airplanes and see which flies the farthest, and come up with hypothesis.

8. Blow Power game. Students estimate and then count how
many times it takes to blow something across a table. Items may include a marble, styrofoam ball, pencil, and cotton ball. Write the items on the bottom of the graph and graph the results.

9. Study about Benjamin Franklin, how he used wind energy and discovered electricity with a kite, key and lightening.

10. Brainstorm items that run on electricity. Using old magazines, students cut out items and categorize them into using electricity, or not using electricity.

11. Using balloons, students discover some principles of electricity. First, have them rub the balloon on their hair, arms, clothing, etc. and see if there is any reaction. Next, hang a banana from a string. Rub the balloon on an item that generated static electricity and then hold it near the banana--the banana should move in a circle.

12. Electricity--complete the circuit. Given a "D" size battery, a flashlight light bulb, and copper or bell wire, students attempt to make the light bulb light.

13. After reading Mickey's Magnet, students get an opportunity to explore magnets and their properties. Simply put magnets and various items on a table--pins, coins, cans, paper clips and sand.

14. Put a magnetic object on top of a piece of paper. Students move a magnet underneath the paper.

15. Bring a solar cooker to exhibit the power solar energy of the sun.

16. Make caffeine-free sun tea in a large jar with tea bags and water.

17. Brainstorm other sources and uses of heat.

18. Talk about how light from the sun allows us to see various colors. Have students explore prisms or sun catchers which break light into different colors.

19. Using a flashlight and other items, discover the properties of translucent, transparent, and opaque.
Related Literature:


The Berenstain Bears go to the science fair and get to try many different things. Experiments involving energy are included in this book.


This children’s resource is an easy to understand book about electricity. Beginning with a light switch in a child’s bedroom, the author explains energy, electricity, circuits, generator, and connections. A simple electricity generating experiment using a magnet, a compass, and electrical wire, is included.


This story is about a little boy who discovers the properties of magnets.


Originally published in 1939, this story is about Mike Mulligan who owns a steam shovel. As technology develops and the steam shovel ages, it is replaced by faster and more efficient machinery.


The train is labeled with the color, type of car, and is moving down the track. Heavy black smoke pours out of the engine. Very simple text.


A kite gets loose and sails across town. Illustrations are from the kite’s perspective.


This book is designed for children to read. It is filled
with many experiments using household items. Mixtures, food, nature, balloons, and weather are the categories covered. Language in the text is simple.


This short informative story has pictures about the solid and liquid forms of water and its uses. Student develop descriptive vocabulary associated with water.

The following is a series of small books.


All types of cars, trucks, fire engines, etc. are identified.


Includes kites, hot air balloons, biplanes, jests, propeller plans, blimps and parachutes.


Freight, passenger, steam powered, electric powered and more.


A variety of boats and how they are powered, types include a paddle, motor, sail, fishing, tug, ships, fire, and house.
UNIT 2

EARTH SCIENCE
ELEMENTS OF CHANGE

Unifying Concept: The earth with its universe is constantly changing.

First grade subconcept: Sun, air, water are important elements of change on the earth.

The unifying theme for this section is "Elements of Change". Picking up from the physical science unit about energy and the sun, this unit begins with the sun and moves into learning about the solar system, the earth's rotation, and other aspects of the universe and the changes that occur within. Tying in the yearly rotation around the sun with the seasons, the next section helps construct knowledge about the weather and how the elements of sun, air, and water effect these changes. The final section is about the changes within or on the earth and how the elements (sun, air, and water) create or effect these changes.

Section 1--The Sun

This section begins by learning about the sun, the earth, and the surrounding universe. The rotation of the earth around the sun is introduced and the changes that occur as a result.

Section 2--The Weather

Rain, snow, hail, and sleet all come from clouds, which are made of water. In this section, students learn about the changes that occur in the seasons, the weather, and the water cycle.

Section 3--The Earth

Mountains, valleys, plains, deserts, rivers, lakes and oceans are all features of the surface of the earth. Students learn about the changes on the earth by studying the construction of the earth and the processes of wind, water, and ice that cause change in features over time.
Section 1--The Sun

Section focus: This section begins by learning about the sun, the earth, and the surrounding universe. The rotation of the earth around the sun is introduced and the changes that occur as a result.

Science vocabulary: time, rotation, axis, changes, solar system, and motion.

Literature:


Illustrated by Mark Graham, this book follows shadows throughout the day. Beginning with sunrise and ending with sunset, one can see how the shadows change places.

Activities:

1. Discuss and identify properties of night and day.
2. Students learn about the composition of the sun--gases.
3. Learn the song, "One Light, One Sun" from Raffi.
4. Demonstrate and have students act out how the earth turns on it’s axis using two balls, one yellow and one earth ball.
5. Shadows. Have students work in partners and go outside and draw their shadows with chalk on the sidewalk or use butcher paper. Students return to the exact location 3 or 4 more times during the day and continue to trace their shadow and note the differences between the drawings.
6. Reread Shadows are about and observe light and shadows in art.
7. Demonstrate how the moon reflects the sunlight using a flashlight and a mirror.
8. Shadow puppet show. Using a sheet and a light source,
create a shadow puppet stage.

9. Have students take the temperature at four different points of the day, noting the cooler times are in the morning and the evening--when the earth is rotating towards and away from the sun.

10. Create a solar system mobile.

11. Students role play being the planets. Give 9 children names of the planets and have them rotate one child who is the sun, make sure they are in their correct orbit.

12. Students note that the sun is one star of many. Have them discover why it is so big to us.

13. Study the constellations. Have children make drawings connecting the stars.

14. Homework idea. Students draw a picture of the night sky, including the moon and stars. Do this once a week for a month or more, or return to this several times during the year and compare the illustrations.

15. Study the seasons and how they relate to the earth revolving around the sun.

Related Literature:


This comical story is filled with facts about the solar system. The schoolbus goes into the solar system and the children go to all nine planets, the sun, and the moon; they describe the characteristics of every stop.


This book talks about Christopher Columbus’ voyages, the different lands he went to, using the stars to find his way, the maps he used, and how the weather affected his trip.

Western.

A book about the stars, constellations, galaxies, telescopes, solar system, planets and the sun. A lot of facts but in simple to understand language.


This is about a young fox who dreams about becoming an explorer.


This is a very simple story about the sun and how it helps things grow, how the world revolves around the sun, and how it effects the weather.

Music:


This cassette contains the song, "One Light, One Sun" which talks about the earth revolving around the sun and the light it gives to the earth.
Section 2--The Weather

Section focus: Rain, snow, hail, and sleet all come from clouds, which are made of water. In this section, students learn about the changes that occur in the seasons, the weather, and the water cycle.

Science Vocabulary: weather, rain, snow, hail, sleet, ocean, evaporation, hurricanes, tornados, and flooding.

Literature:


This pattern book covers various weather conditions associated with the four seasons: rain, wind, snow, hail, and heat. Illustrations show the colors and conditions. A musical version of the story is available on tape. A successful read for all students.

Activities:

1. Students read and sing I like the rain. Children identify characteristics of the different kinds of weather through the pictures and life experiences.

2. After reading a story about rain, students observe the processes of changing water to the three forms of matter. Use a pan with a clear lid, melt ice--let students observe the water in the pan, then the steam, last, put the lid on and turn off the heat--children can observe it 'raining' in the pan.

3. Put a cup of water in the sun and the shade. Throughout the day, students measure and record the level of the water.

4. Using two-liter bottles and a tornado ring, students shake the bottle and observe the "tornado" like action developing inside the bottles.

5. Show a recording of the T.V. weather report. Identify and discuss the various items they reported and why the information is important (air quality, high and low temperatures, movement of clouds, clothing suggestions, weather predictions).
6. Bring in a newspaper weather report and talk about it’s information.

7. Read Cloudy with a chance of meatballs. Students write their own silly weather report. Be sure to emphasize how weather really does not do this.

8. Make a weather collage. Students cut pictures from various magazines or draw pictures of various weather conditions and things associated with it.

9. Create a weather bulletin board. Include information similar to the T.V. or newspaper report. Students make predictions for the next day. Have students make clothing suggestions appropriate for their weather prediction.

10. Students use a line graph and record the temperatures (high and low) from the day before. Students connect the previous day’s results and visualize if the temperature was higher or lower.

11. On interesting weather days, go on a walk. When students return, have them write what they saw and how they felt--relative to the weather.

12. During the rainy season, record the number of inches of rain and compare it to the weather reports.

13. Show pictures or bring in news reports on the destructive forces of weather. Have students look for changes caused by the weather.

14. Using a pencil, straight pen, straw and a small streamer, students can make their own weather vane.

15. Students write a book about the weather they experienced or learned about during this study.

Related Literature:


In a town called Chewandswallow, it had unusual weather--instead of raining water, it rained food. This text provides a sample of the usefulness of weather forecasts.

There is a snowstorm and all the roads are blocked. It is up to Katy, a tractor converted to a snowplow, to clear the streets.


Illustrations and texts show the various clouds. Different types of clouds are identified and labeled.


A fox is very thirsty on a very fine day and goes looking for a drink. He drinks a lady's milk, who takes his tail, and the fox hunts to find some more milk to return to the lady--it is a long journey.


This is a comical look at the wind and what happened to various people’s items. A man looses his wig, someone else looses their umbrella, and many other things. The people run to try and grab their belongings.


A little boy has difficulty mailing a letter to his friend. The weather created a slight delay.


A tale about a young boy who is sent by his mother to get flour. On the way home, the north wind blows it away. The boy goes to the north wind for help and gets a magic blanket, and that is where the troubles begin.


Two cats explore the country during at the first signs of spring. Very simple text.

Two feet going for a walk in the rain. No one knows if they belong to boy or a girl. All students can be successful readers. Small books are available for the students to make on their own copy.


This is a Russian story based on the family history of the author. A little girl was visiting her grandma and a thunderstorm broke out. She was a scared little girl. Her grandmother and her made "Thundercake" to help calm the storm.


A boy goes and plays in the snow. He looses a mitten which becomes a home for many small animals that live in the cold snowy mountain.


Originally published in 1947, this book contains unique drawings, possibly charcoal and watercolor. The story is about people who live in a town and what they do during the snow season.


This book illustrates different parts of the country and what people are doing before, during, and after a huge storm.
Section 3--The Earth

Section focus: Mountains, valleys, plains, deserts, rivers, lakes and oceans are all features of the surface of the earth. Students learn about the changes on the earth by studying the construction of the earth and the processes of wind, water, and ice that cause change in the earth’s features over time.

Science vocabulary: layers, inner core, outer core, mantle, crust, rock, eruption, erosion, and soil.

Literature:


This texts illustrates the effects of the wind, sun, and rain on the earth. There are two factful stories going on at one time, paralleling the effects of the elements on the earth.

Activities:

1. Students draw and label the layers of the earth.

2. Using different colored playdough, students create the earth’s layers. Then cut the earth in half.

3. Watch a video about volcanic eruption. Discuss what the volcano is made of and how it works. Identify changes to the earth’s surface because of the eruption.

4. Build your own volcano. Use either mud or plaster of paris, mix, fill a cone-shaped paper cup, allow to partially dry, turn on a piece of foil, cut tip off cup, insert pencil to make a hole, remove pencil before plaster dries. Allow it to dry completely, fill crater with baking soda, add food coloring to vinegar, add vinegar mix to baking soda.

5. Explain at one time there was one giant land mass. Cut out continents and make a puzzle.
6. Have students identify the continents and oceans on the globe. Compare the globe to a world map.

7. Make a paper mache globe with a balloon. Students paint the globe representing oceans and continents.

8. With egg carton for each student, make a rock collection. Working in groups, students note similarities and differences among the rocks.

9. Using the rocks from number 8, create categories for rocks. Examples may be texture, hardness, color, size, and weight.

10. Using a balance scale, students weigh their rocks and place them in a scale of lightest to heaviest.

11. Place the rocks in a glass of water, discuss the changes in color that occur.

12. Grow a crystal garden. In a bowl, mix 1/4 cup salt, 1/4 cup water, 1/4 laundry blueing, and 1/2 cup ammonia. In a glass or ceramic dish, put several lumps of soft coal then pour on liquid mix. Add a few drops of food coloring on top. Crystals will form and last for several days.

13. Analyze a rock, figure out its components. Using a chocolate chip cookie, students dissect particles to find the chips--breaking down the rock into pieces.


15. Look at some fossils. Try and figure out what animal might have made the fossils.

16. Working in small groups, with dirt and sand in a large plastic tub, make earth layers, including hills and valleys. Use various forces of water to change the surface.

17. To demonstrate the concept of wind and erosion on the surface of the earth, use the earth layers created in number 16 and use a fan to show how moving air can cause change on the earth's surface.
Related Literature:


Topics include erosion, eruption, the layers of the earth, rocks, minerals, gems, sandstone, fossils, coal, and more.


A young girl talks about what to look for to find a special rock. Location, size, and texture are just some of the things to think about.


Sylvester finds a magic pebble and wishes for many things. One day, he accidentally wishes he was the pebble—and there he remained until someone picked him up.


This is a teacher resource as well as a child’s. Beginning with how mountains are formed, to the shaping of the earth, rocks and minerals, oceans, and weather. Beautiful illustrations.


Supported by the EarthWorks Group, there are experiments, facts, and other things children do to learn about how to help keep the earth a safe and healthy place to live.


A through reference. Topics include cosmic darwin, milkey way, the sun and the solar system, land mass changes, study of rocks, fossils, dinosaurs, glaciers, and predictions of the future.


Includes information about what rocks are make of and how
they are formed by weathering and erosion. Includes maps, pictures and diagrams.
UNIT 3

LIFE SCIENCE
DIVERSITY OF LIFE

Unifying concept: Life is diverse.

First grade subconcept: There are observable similarities and differences in living things.

This unit is divided into three sections. Building on the previous unit, ending with the study of rocks and soil, this unit begins with the study of life that comes from the soil (plants), moves into the life cycle of insects and bugs, and culminates with the study of animals and the environments in which they live.

Section 1--Plants

This section begins by students developing knowledge about living things as compared to non-living things and moves into learning about a variety of plants and their basic needs in order to sustain life and help them grow.

Section 2--Insects

As seasons change, living things also change. Each species has its own life cycle. Through the study of insects, students learn about life cycles.

Section 3--Animals

Living things have particular kinds of environments in which they live because these are where they find the things and the conditions that they need to survive.
Section 1--Plants

Section focus: This section begins by students developing knowledge about living things as compared to non-living things and moves into learning about a variety of plants and their basic needs in order to sustain life and help them grow.

Science Vocabulary: living, non-living, basic needs, growth, soil, roots, stem, flowers, and leaves.

Literature:


This story is about a flower seed which grows into a beautiful flower. Then, as the seasons change, the seeds blow to other areas and remain dormant until spring, where once again the flower grows and blossoms.

Activities:

1. From a collection of living and non-living things, students identify characteristics and classify living and non-living things.

2. Go on a walking field trip. Have students identify life that comes out of the soil.

3. Have students go on the playground and gather a variety of leaves. Using the five senses, students identify similarities and differences and maybe categorize the leaves.

4. Using a typical house plant, remove the plant from the soil, displaying all the parts of the plant. Using their senses, students examine each of the parts.

5. Students can grow plants from seeds. Using clear plastic cups, students put in soil and water it. Push a finger down the side of the cup and place a seed in that hole. As the seed grows, students will be able to see the roots forming.
6. In small groups, students can set up science experiments to observe the effects of using various elements on plants. Each group choose an element to vary, such as soil, water, temperature, and light. Each group should have four plants with four different variables. One plant in the class should be cared for normally. Students record observations daily.

7. Have students cut out magazine pictures of plants. Students develop categories to classify these pictures.

8. Classify a variety of seeds. Put together some items that look like seeds with seeds. Students have to sort between the seeds and nonseeds.

9. Grow grass seed, alfalfa, or bird seed on a sponge or bed of moist cotton on a cottage cheese lid. Should be grown within five days.

10. Make a seed poster. Buy packages of seeds and open them carefully. On a large piece of tagboard, place the empty seed wrapper and glue a small sample of the seed next to it.

12. Dissect fruit to find seeds. Count them, graph them. Identify which fruit has more seeds inside.

13. Make a terrarium of plants. 1/2 inch of gravel, 3-4 inches of black magic soil, make a slop toward the front, add seeds, water, and cover.

14. Display food products or process that comes from plants. Example: wheat flour.

15. Celery experiment—or white flower. Put in food coloring and water mix, celery or flower will change color.

16. Make a non-fiction class big book which includes information learned during this science unit. Diagrams and pictures should be labeled and explained.

Related Literature:


This resource offers 12 activities that encourages
classification, prediction, and communication of discoveries through picture or written records while observing seed growth.


A pop-up book, this tale includes a hen that lays a golden egg and a singing harp. Jack is sent by his mother to the market to sell the family cow, instead he trades it for magic beans. His mom gets upset and throws them out the window. The next day, Jack climbs the beanstalk and steals the hen and harp from the giant, slides down the beanstalk and the giant is never heard from again.


Illustrated by Crockett Johnson, the simple pictures and repetitive text will allow any reader to be successful. Basic care of a plant is included in the story.


A classic tale, a mother and daughter go out to a field and gather blueberries to be canned to eat later during winter. At the same time, a mother bear and daughter bear go out into the same blueberry field to eat and get fat, also storing up food for winter.


Students learn about prior experiences with seeds, specific characteristics of seeds, and composition of seeds. Illustrated by Susan Swan.


Peter Rabbit disobeys his mother and goes to visit Mr. McGregor’s garden. He eats many vegetables. He returns home safely, but in trouble and goes to bed early with a stomachache.

An old man plants a turnip and it grow so big, everyone in his family has to pull to get it out of the ground.
Section 2--Insects

Section focus: As seasons change, living things also change. Each species has its own life cycle. Through the study of insects, students learn about the life cycle.

Science Vocabulary: metamorphosis, change, similarities, differences, insects, and arachnids.

Literature:


Illustrated by Ralph Masiello, realistic drawings of bugs and insects are the highlights of this book. Starting with the letter A through the letter Z, each page includes some characteristic about the bug or insect.

Activities:

1. Create a chart for the wall with these headings: name, how it looks, what it eats, what it does, and how it moves. As the insects are being studied, fill in the appropriate spaces.

2. Observe and chart the metamorphosis of a caterpillar changing into a butterfly. Include dates and children's descriptions. Post the information near the caterpillar jar.

3. Have a bug jar for an insect collection. Have students work in partners. They are in charge of finding an insect or bug for the students to observe for the day and then return to it's natural habitat. Make sure they collect something for the insect to eat.

4. Create an ant farm. Shift dirt into a large pickle jar. Put in a small wet sponge for water and dried bread crumbs for food. Gather ants on paper with honey and place ants in the jar. Put jar in a dark place to simulate being underground, give the ants time to make tunnels.

5. Students select an insect or small animal to study and watch grow. Set up an observation jar for each group.
Students log observations in a science journal daily. Students compare and contrast the physical changes.

6. Using observations from number 5, students study the various environmental needs of insects or small animals.

7. Categorize harmful and unharmful insects with regards to humans.

8. Identify ways in which insects are helpful to humans and the environment. Read Be nice to spiders.

9. Study the life cycle typical of all insects. Have students sequence events in writing or through pictures or both.

10. Visit a local museum and note the insect collections, pay attention to categories and varieties, similarities and differences.

11. Make a bug collection. Have the students develop the categories.

12. Using the terrarium built during the plant study, add live insects to observe.

13. Compare the life needs of plants to insects.

14. Students write an independent or class story about the interdependence of insects and plants.

15. Create a play having students play an insect. Each insect will need to talk about where it lives, what it does all day, what it eats, and where it likes to sleep.

Related Literature:


A folk tale from West Africa. Through a sequence of unexpected events, the mosquito is responsible for the death of an owlet. Illustrations demonstrate scale and structure and text is predictable and repetitive.

While finding something sweet to bring back to the ant colony, two ants stay behind from the group and get into trouble. Illustrations are drawn from the perspective of an ant.


Watch a spider build a web. Color photographs show how a web is built and used to catch the spider's food.


This tale is from a boy's perspective, he catches fireflies and lets them go. The author includes information about the characteristics of fireflies.


Beginning with the egg, Carle presents the metamorphosis of a caterpillar into a butterfly. He also incorporates basic counting skills.


Near a farm, a spider spins a web to catch his food. The colorful illustrations show how webs are designed. It provides a tactile illustrations.


A lady bug is very grouchy and will not share the aphids for breakfast. She picks a fight, but backs down. Every hour, she picks a fight with another insect or animal. There is an analog clock displaying time to the hour on every page.


A spider, named Harry, visits a zoo and helps rid the many flies that bother the animals. It illustrates how spiders make webs.

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Learn many facts about insects. This can be a read aloud or student read. Topics include: dragonfly, walking stick, ant, ladybird, termite, praying mantis, whirligig beetle, grasshopper, water strider, caddisfly, mosquito, housefly, butterfly, silkworm, flea, honeybee, and firefly.


A polliwog and a caterpillar talk to each other about the changes in that are going to occur as they grow older.


Color photographs demonstrate the life of a snail.


Pallotta uses realistic drawings, relative facts, demonstrates animals and their habitats. Numbers 0-26 and number words are displayed in large print for all readers to see.


Everything one would want to know about earthworms: Finding them, raising them, anatomy and physiology, and food. May be used as read aloud book.

**Music:**


This song is about five frogs who fall in a pond after eating too many bugs.


Eency Weency Spider—this is about a spider who gets caught in the rain. Lyrics are available on a poster and in isolated words to be used with a pocket chart.
Section focus: Living things have particular kinds of environments in which they live because these are where they find the things and the conditions that they need to survive.

Literature:


This story contains many unusual types of animals in a pet parade. Animal characteristics are described.

Activities:

1. Observe and identify the basic needs of farm animals while on a walking field trip.

2. After reading Swimmy, students identify the cyclical nature of a food chain.

3. Brainstorm any other food chains the students may be able to identify—how about insects and plants?

4. Go outside and identify animals that live on treetops, their basic needs and salient characteristics (bees and birds).

5. Read Over in the meadow and identify animals that live in a meadow or prairie. Through the illustrations, have students describe this habitat.

6. Take a field trip to the San Bernardino County Museum in Redlands, CA. Study animals that live in the desert—basic needs and salient characteristics (lizards, snakes, and scorpions).

7. On a rainy day, study for animals that live underground their basic needs and salient characteristics (worms and moles). Place worms and dirt in a clear jar to observe. Read the book Earthworms.

8. Study animals that live in the forest—basic needs and salient characteristics (raccoons, squirrels, bears). Plan a field trip to the mountains and visit the Oak
Glen petting zoo in Oak Glen, CA. Students can observe and pet animals that live in the forest.

9. Study animals that live in the water their basic needs and salient characteristics. Go on a fieldtrip to the Laguna Tide Pools in Laguna, CA. Discuss the differences between the ocean, rivers, and ponds as habitats (Oysters, salmon, and frogs).

10. Check out preserved animals and habitat items from the San Bernardino County Museum in Redlands, CA. Compare and contrast the many animals.

11. After reading the book *Pets*, compare the basic needs of wild animals studied above with domesticated animals.

12. After reading *The pet show*, have students discuss the pets they own or would like to own. Have them write how they would take care of their pet’s basic needs.

13. Have parents bring pets to school for a short visit. The students share about the needs of their pet and what they do to help.

14. Talk about what characteristics put us in the animal kingdom. Compare our basic needs with those of other animals.

15. Using three dimensional art, students choose an animal to create along with their environment. Use shoe boxes for panorama or create mobiles.

**Related Literature:**


Sharp quality pictures of a variety of pets are featured. Body parts are identified and labeled. Some characteristics of the animals, as well as the care necessary to maintain a healthy pet, is discussed.


A boy save a crocodile’s life but the crocodile wants to eat him. The boy tries to persuade and a monkey comes to his rescue. In return, the monkey would like more banana plants on the plantation--this is a Philippine folk tale.

A bunny finds and egg and hears a tap coming from inside. He tries to guess the egg contents. While waiting, the bunny falls asleep and the chicken hatches out of the egg. The bunny wakes up and they become friends.


Read aloud book. Students learn all about snakes: eggs, food, enemies, and shedding their skin.


A black fish stands out from the rest of the school of fish, they are all red. One day, a tuna fish came and ate all the red fish and the black fish escaped. He found another school of fish and they devised a plan on how to trick the other big fish, so they will not be eaten.


Beautifully illustrated, children read about the typical day as viewed by a bunny rabbit. The bunny goes in the wilderness, meets other animals, eats, and drinks water; good for studying animal behaviors.

Rigby. (1986). *Who's in the shed?* IL: Rigby

Prediction, scale and structure. A circus wagon puts something in the shed on a farm. The predictable and repetitive text is a good read for all students. In the story, farm animals try to guess what animal is in the shed. The ending surprises almost everyone.


This picture book shows puppies and how they grow.


This book shows the life of a hamster. There are beautiful color photographs depicting a hamster's life, from being newly born to being fully grown. Simple language, bold headings, and details are provided.
OTHER TEACHER AND STUDENT RESOURCES:

The following is a series of small books with many simple activities to do in the classroom. Concepts are developed and build on prior experiences.


This book aligns specific pieces of literature with science activities. Other content areas are included.


This resource tells about the processes, content, cognitive development, and curriculum for grades K-12 in the California Public Schools.


This is a science book for college students. It is very readable and has a lot of information, especially for the teacher who did not major in science.

Publishing.

Filled with practical and fun ideas which will intrigue any student. No fancy chemicals are needed to perform most of these experiments. Properties explored include mechanics, fluid dynamics, sound, and electromagnetism.


This book lists over 320 free or up-to-a-dollar items children (and teachers) can order. Content areas include sports, environment, stickers and stuff, mind over matter--includes reading, music, science, space, history, and business, crafts, safety, health, nutrition, and travel.


This is collection of simple, inexpensive, and practical science experiments.


This was developed through America 2000, a long-term national education strategy designed to increase science and math in education. This is designed as a parent guide, as well as being useful to teachers. Ideas are for children ages 3-10. It includes an introduction to science, many simple experiments, definition of science concepts, and a literature list.

The following three sources are teacher resources filled with inexpensive practical ideas. Strategies to find out what students already know about a subject, laboratory hands-on experiments and curriculum connections across the content areas. Content areas included are writing, drama, cooking, fine arts, social studies and science.


nonfiction to promote literacy across the curriculum.
Carthage, IL: Fearon Teacher Aids.

New York: Prentice Hall

This resource has a lot of outdoor activities.
PUBLICATIONS AND PROFESSIONAL ORGANIZATIONS

Super Science Red
Scholastic Inc.
P.O. Box 3710
Jefferson City, MO 65102-3710

Super Science Red is a scholastic newspaper for students and put out eight times during the traditional school year. It is filled with inexpensive science experiments children can do at school or at home.

Science and Children
National Science Teachers Association (NSTA)
1742 Connecticut Ave. N.W.
Washington, DC. 20009-1171

This professional journal is published eight times a year by the National Science Teachers Association. It is an excellent resource for computer software reviews and practical science activities to use in the classroom. Every year, in the March issue, editors write a review of outstanding science trade books. Many articles are written by classroom teachers.

The Reading Teacher
International Reading Association
800 Barksdale Road
Newark, DE 19714-8139, USA

Published eight times during the traditional school year by the International Reading Association, this journal includes articles about integrating literature throughout the content areas, assessments, technology, and how to teach from a whole language perspective. Many articles are written by classroom teachers, some by professors at the university level.

Language Arts
National Council of Teachers of English
1111 W. Kenyon Road
Urbana, IL 61801-1096

Published eight times a year by the National Council of Teacher of English, this professional journal deals with many topics dealing with literacy. Each journal has a
general theme which includes articles from teachers and professors, research findings, and review of current literature on various topics.
REFERENCES

