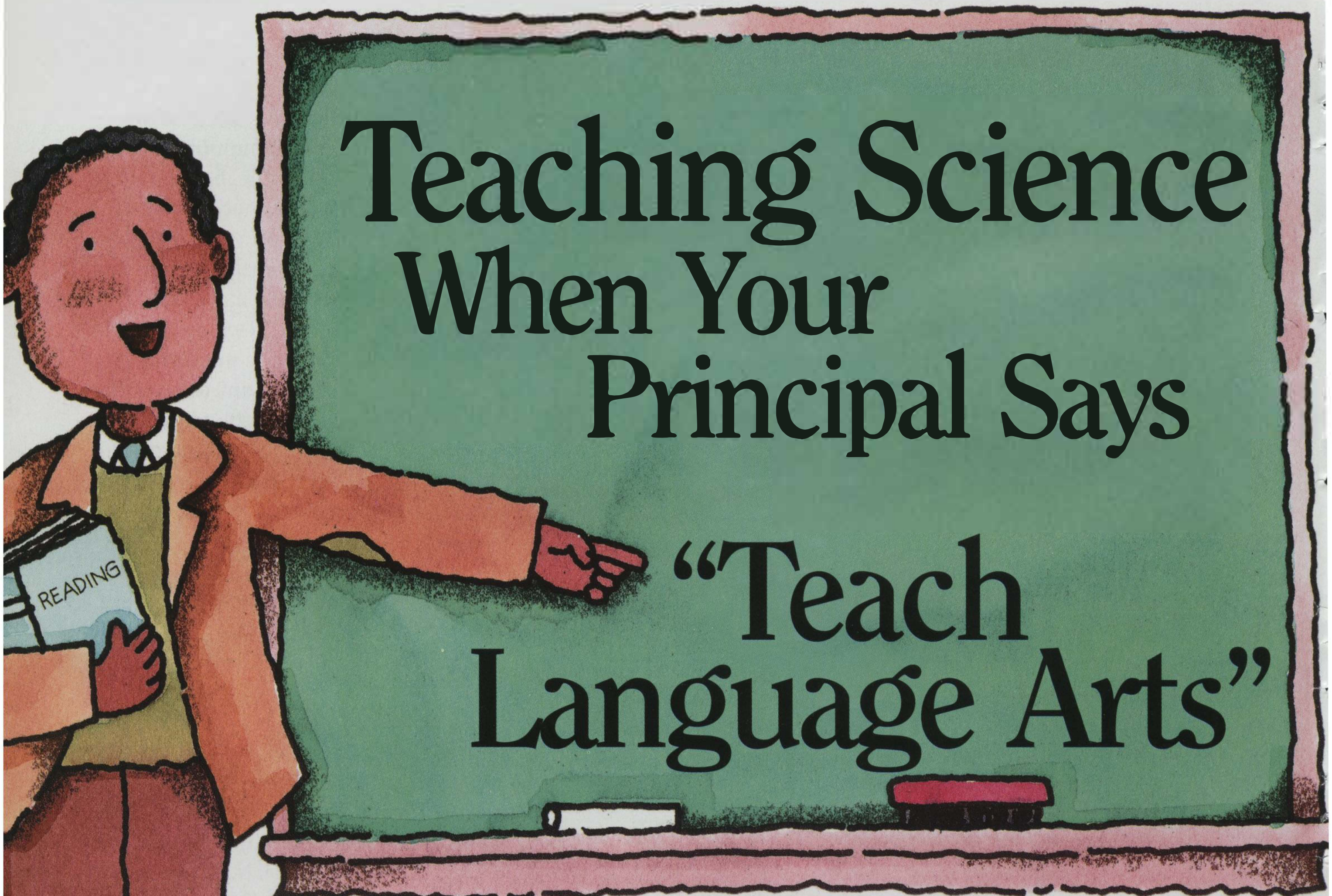


Teaching Science When Your Principal Says "Teach Language Arts"

SHIRLEY V. BECKES

By Valarie L. Akerson

Interdisciplinary teaching can help teachers meet the needs of students and state and national standards.

As an assistant professor of elementary science education, I teach many practicing teachers in graduate courses and teacher institutes. While some elementary teachers may avoid teaching science (Borko 1992; Enochs and Riggs 1990; Smith and Neale 1989), the elementary teachers who take my courses are generally very enthusiastic about teaching science and want to learn strategies to help them become better science teachers. These teachers believe that language arts are important and that science and other important disciplines can be supported by language arts, even with a reciprocal relationship (Akerson and Flanigan 2000; Dickinson, Burns, Hagen, and Locker 1997; Dickinson and Young 1998). Recently, however, several teachers have commented that principals tell them to focus on language arts and mathematics because those subject areas are being tested. While some teachers may be specifically told *not* to teach science, most are being asked only to *emphasize* language arts. This can make it difficult to satisfactorily meet state and national recommendations that indicate science content should be learned in kindergarten through high school. To help address this problem, teachers are seeking strategies that can help them focus on language arts while continuing to do a good job teaching science.

Why Use Interdisciplinary Instruction?

How do teachers respond when principals tell them to emphasize language arts? Teachers who are committed to meeting state and national standards of all curricular areas are bound to state the importance of teaching science just to help students meet those science standards. However, there are other important reasons.

First, learning science and language is reciprocal (Casteel and Isom 1994). Proponents claim that learning science can be described as a process similar to learning language, from questioning and setting a purpose to analyzing and drawing conclusions, and reporting/communicating results. Thus, processes of science and literacy learning are similar and may help the development of each discipline if the teacher is explicit in helping students note the similarities. Second, elementary students need to read, write, and communicate about something; science can provide that purpose. Finally, the most pragmatic response may be that science will soon be tested as well (in some locales it already *is* tested), using the same high-stakes examinations that language arts and mathematics enjoy at this time. Do we really want to start at a disadvantage with science? Using an interdisciplinary strategy can help us meet those state and national science objectives in a way that supports language arts.

Connecting language arts to science makes sense because many elementary teachers' strengths are in language arts (Akerson et al. 2000; Dickinson et al. 1997). Additionally, there are similarities in national reform goals for both science and language arts. Use of language arts to promote literacy and support learning in other content areas is recommended and encouraged by the International Reading Association (IRA) and the National Council of Teachers of English (NCTE). The *Standards for the English Language Arts* recommend that language arts serve the goals of purposeful communication through reading, writing, speaking, and listening (IRA/NCTE 1996). In addition, recent reforms in science education recommend that students communicate ideas through written and oral interactions, which are applications of language arts (National Research Council 1996).

It is possible to use language arts to support science learning and to use science as a purpose for learning language arts. Interdisciplinary teaching can help teachers meet objectives for both language arts and science and still prepare our elementary students for the tests they must take.

Successful Interdisciplinary Instruction

The following suggestions offer various teacher-tested ways to include science in a language arts curriculum. The subsections range from ideas to consider to specific strategies particularly suited for interdisciplinary science and language arts instruction.

Choose a Meaningful Theme. Elementary curricula often follows themes that do not meet both science and language arts objectives. For example, thematic instruction based on topics such as teddy bears or apples may lend itself to language arts instruction using reading and writing, but offer little to focus on with science instruction. A meaningful theme, however, promotes for discussion of big ideas and offers a greater likelihood that science objectives can also be met. For example, common themes from the *National Benchmarks for Science Literacy* (AAAS 1993)—such as systems, models, constancy and change, or scale—enable teachers and students to explore a wide variety of science concepts. Language arts skills can be incorporated in the same way as in the study of other, less scientific themes. Adams and Hamm (1998) recommend that selection of thematic big ideas meet the following criteria:

- the big idea is constant over space and time,
- the big idea broadens students' understanding of the world or what it means to be human,
- the big idea is interdisciplinary,
- the theme relates to the genuine interests of the students,
- and the interdisciplinary work lends itself to student science inquiry.

Using a *Benchmarks*-recommended theme meets those criteria.

For example, teachers in my advanced science methods course used the theme "systems" to explore such topics as electricity, seasons, chemical and physical reactions, and plant growth. Within this theme teachers learned science content as it related to interactions of components of the system, such as components of plant growth, electrical circuitry, and causes of seasonal changes.

By continually focusing teachers' attention to the theme, they were able to recognize that "systems" is a component of all science content, as recommended in the *Benchmarks*. Additionally, they were able to hone language arts skills through their oral and written discussions of the theme in class discussion and reflection paper writings.

Developing Science Skills Through Language

Explore Students' Ideas and Misconceptions. The language arts are well suited to helping teachers identify student science misconceptions. It has been long recommended that teachers of science seek to know children's ideas about a science concept prior to teaching it, so they can build on those understandings rather than teaching past the student (Driver, Guesne, and Tiberghien 1985). By using language arts skills of speaking, listening, and writing, teachers can identify students' scientific understandings.

Teachers can use class discussions to help identify children's ideas about a science topic.One useful language arts technique that lends itself to this purpose is K-W-L. Because it is more effective to identify student ideas by asking what they "think" about science content than what they "know," I've used a modified model with both elementary and adult students, such as a "T-W-L," where students tell what they *think* about the content, what else they *want* to know, and what they *learned*.

By having students write about their understandings, a teacher can track the development of student ideas from misconceptions to better understandings.

For example, in reponse to the question, "How do you think electricity works?" both children and adults shared their ideas in a large-group setting, debating their ideas while I observed their thinking on that topic. Both adults and children answered with similar incomplete conceptions prior to instruction, such as "electricity is lightning" or "electricity is power."

I used the same T-W-L technique after students (both adults and children) were asked to light a bulb using a battery and a wire. The T-W-L enabled students to express their views regarding explanations for phenomena. For the most part, both practicing teachers and elementary students tended to believe prior to experimentation that connecting a wire from one end of a battery to the bottom of a bulb would make the bulb light, but after exploring configurations, they recognized the necessity of a complete circuit. Some ideas shared after exploration included, "you need everything in a circle—that makes a circuit so the electricity can flow." Students developed oral-language skills around a shared experience, as well as developed content knowledge, something many language arts methods texts recommend (Rubin 1995; Templeton 1995; Tomkins and Hoskisson 1995; Tway 1991).

Written language can also help teachers identify students' ideas about a topic and develop profiles of individual student's thinking, particularly through science journals. For example, during a unit on sinking and floating, one elementary student's journal included the following entry, "An anchor keeps a boat floating in the river." When questioned, I found he believed the anchor did not merely hold the boat in place, but held it afloat. Following an activity involving sinkers and toy boats in a tub of water; however, the student's revised entry was, "An anchor holds a boat in place. But why does it keep floating?"

By having students write about their understandings, a teacher can track the development of student ideas from misconceptions to better understandings. The questions that students raise in their journals can also help teachers recognize areas of focus for future instruction (i.e., explore the forces that "keep boats floating").

Another benefit of using writing to elicit student thinking about science concepts is to help students develop their ideas and understand their own thinking. The *National Science Education Standards* (NRC 1996) recommends meaningful written communication of scientific understandings, which could take place in early stages of the writing process, later developing into meaningful reports of scientific investigations.

One way to develop ideas would be

to have students write down observations and inferences during an investigation, such as an investigation exploring magnets. Students could record observations of magnetic items and then make written inferences for why they think certain items are magnetic and others are not. From this simple listing, students could write a formal report based on their scientific investigations of and explanations for magnetism. Students could present the reports orally or make them into books to share with classmates.

Getting the Most Out of Nonfiction Books

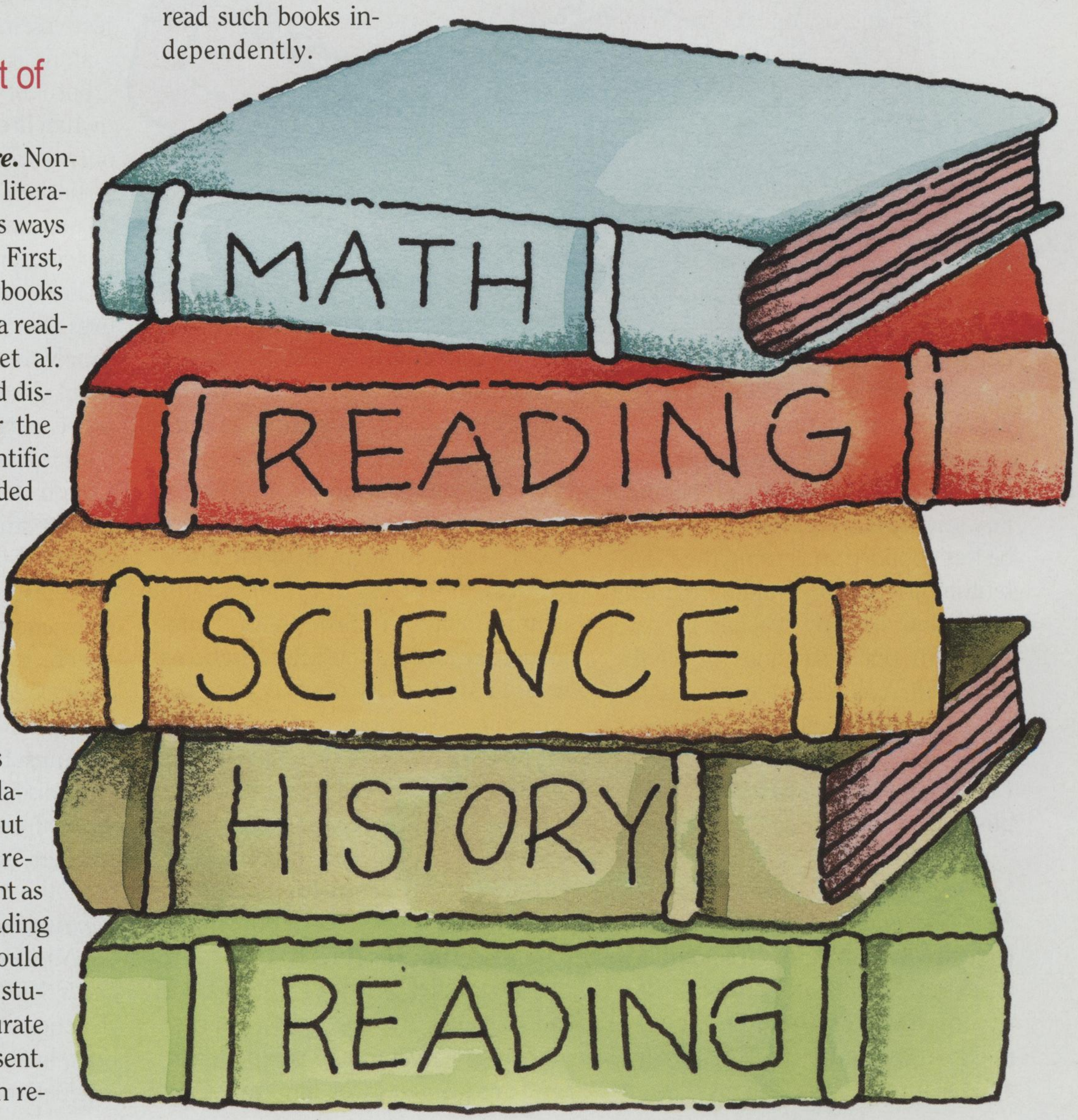
Share Nonfiction Literature. Nonfiction children's science literature can be used in various ways in the science classroom. First, teachers can share these books with their students during a read-aloud time (Dickinson, et al. 1997). The teacher can lead discussions during and after the reading related to the scientific accuracy of what is included in the book.

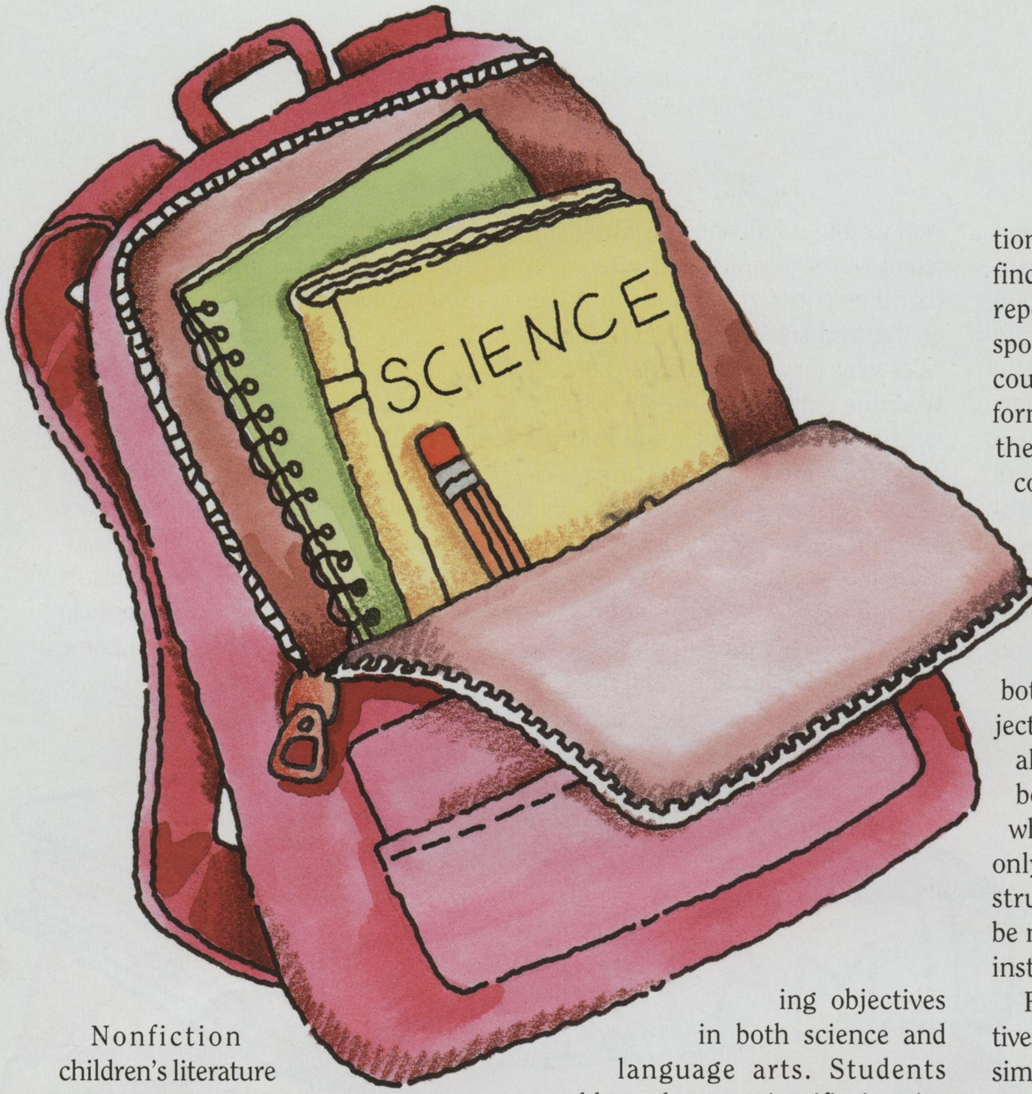
For example, in *The Emperor's Egg* (1999) the reader is left with the idea that penguins "think" as humans do. Similarly, in *Bright Beetle* (2000) the reader is left with the idea that the ladybug purposefully seeks out adventures, rather than responding to its environment as it does in nature. After reading these books, the teacher could discuss these issues with students to address the inaccurate impressions the books present.

In addition, students can review various nonfiction books from different years, opening the discussion that different "facts" will be in books on the same subject. Students can consider why they think that is the case. Were the writers of earlier books necessarily wrong? Teachers and students can discuss the tentative nature of science, helping students understand that scientific knowledge changes with new investigations and evidence.

Another way to use nonfiction children's literature in the science classroom is to encourage students to read such books independently. Nonfiction science books can give students background knowledge for future hands-on science investigations. Students can prepare written or oral reports to share the scientific background knowledge they have gathered from nonfiction books.

Students can also read nonfiction biographies about scientists to learn more about what scientists actually do. Reading these biographies can help students understand scientists and perhaps help them recognize that they can become scientists, too.





Nonfiction children's literature can also help teachers develop further understandings of science content (Akerson et al. 2000). As stated earlier, elementary science teachers in particular can be less confident regarding their content knowledge. It would be virtually impossible for any teacher to have thorough understandings of all the many different science concepts. Using children's literature as a means of improving science content knowledge can be a nonintimidating way to explore scientific knowledge.

Using Available Resources

Meet Language Arts and Science Objectives. Educators recommend students experience various information sources including books, magazines, the Internet, field trips, and resource people—to meet learning objectives in both science and language arts. Students could conduct a scientific inquiry exploration—thus meeting science objectives—after researching background information in resources, which meets language arts objectives. They could meet both disciplines' objectives for meaningful communication through oral discourse regarding science content, as well as written records of their inquiry investigation.

For instance, a teacher in my class who was also taking an advanced language arts methods course conducted an investigation on factors that influence plant growth in my science methods course. From this investigation she learned under which conditions her houseplants grew best (i.e., amount of sunlight, water, and soil pH). She prepared a poster of her investigation to communicate her ideas and findings. She also wrote a formal report of her investigation in response to a language arts methods course requirement to write an informational report based on an authentic inquiry. Similar projects could be conducted with elementary students.

Include Disciplinary Instruction. While it is apparent that interdisciplinary instruction can help meet both language arts and science objectives, interdisciplinary instruction alone is not sufficient for meeting both objectives. There are times when literacy objectives can be met only through explicit literacy instruction, and science objectives can be met only through explicit science instruction.

For example, to meet science objectives, teachers cannot have students simply read, write, and share ideas about concepts. Students must also be actively engaged in inquiry investigations and experimentation. Conversely, a language arts teacher would not want to have students reading, writing, and communicating solely about science concepts. Thus, separate disciplinary instruction in both language arts and science is necessary to meet each disciplines' objectives. The goals and objectives of both science and language arts must be considered and assessed if both disciplines are appropriately addressed in elementary schools and teachers hope to help students meet both the *Standards for the English Language Arts* (IRA/NCTE 1996) and the *National Science Education Standards* (NRC 1996). Interdisciplinary instruction can help meet those objectives, but without explicit disciplinary instruction it is possible—and maybe even probable—that some disciplinary goals and objectives are lost. Teachers must balance interdisciplinary instruction with disciplinary instruction.

The Benefits

Science concepts can be explored through literacy in a fashion supported by science and literacy reforms. Although one must balance interdisciplinary with disciplinary instruction, a teacher can often concurrently help students meet both literacy and science objectives with single activities, such as *Benchmarks* (AAAS 1993) and *Standards* (IRA/NCTE 1993) communications objectives with written and oral descriptions of science inquiries. With thoughtful interdisciplinary instruction, teachers will be able to continue to successfully teach science without compromising literacy instruction.

Valarie L. Akerson is an assistant professor of science education at Washington State University in Richland.

Resources

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If you have an idea that you think could benefit your fellow teachers in their understanding of science and/or teaching, send your manuscripts to column editor Michael Kotar, Department of Education, California State University, Chico,CA 95929; mkotar@csu.edu.