

SCIENCE AND LITERACY

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"Words are small shapes in the gorgeous chaos of the world.

But they are shapes.

They bring the world into focus.

They corral ideas.

They hone thoughts.

They paint watercolors of perception."

Diane Ackerman, *A Natural History of the Senses*

Howard Gardner, eminent Harvard psychologist, said, "For me, the purpose of education is to enhance understanding." Teachers work to produce understanding in their students—whether the topic is literature, social studies, math, or science. For young people to be literate, the written word needs to bring the world into focus for them.

To be literate is to be able to read and write. Additionally, however, it means having or showing extensive knowledge and learning. When we speak of science and literacy, two interpretations arise. The first relates to being able to read and write about science. The second refers to having a knowledge of science.

George D. Nelson, director of Project 2061 for the American Association for the Advancement of Science defines science literacy more extensively as "having a knowledge of certain important scientific facts, concepts, and theories; the exercise of scientific habits of mind; and an understanding of the nature of science, its connections to mathematics and technology, its impact on individuals, and its role in society."

Stephanie Harvey, in *Nonfiction Matters*, said, "Inquiry requires that we dig beneath the surface to explore a topic, dwell in it, wonder about it, and find out information. This is active learning whereby students explore their passions and curiosity, pursue topics of interest, ask questions, conduct primary and secondary research, read for meaningful content, organize and synthesize information, craft authentic reports, and present and report findings—and gain new understanding in the process." All of these processes Harvey mentions depend upon literacy that extends across the curriculum. If students are engaged in learning, then the processes necessary to facilitate this learning will be engaged in gladly with enthusiasm once the students are taught how to use them.

Great concern is being expressed throughout the United States about the falling test scores of American students. Are our students less literate than those of five or even ten years ago? This concern has created a greater pressure on teachers and schools to focus on the primary definition of literacy—being able to read and write. Many teachers are finding themselves mandated to spend more time during the school day on teaching reading as a separate skill in an effort to improve the test scores of their students. This causes teachers to approach other curricular areas such as science and ask how the study of science can improve their students' reading abilities. If they don't find a satisfactory answer, they are cutting the time spent on science each week to focus more on reading.

As science educators, we should provide reasonable responses to these concerns so that science is not relegated to a smaller portion of the school day or week. Our science curriculum needs not only to help the students become more science literate, but also better able to read and write about science.

Too many people believe that teaching reading means teaching students how to read and enjoy fiction. Stephanie Harvey suggests that half of what students read in school should be nonfiction. They need to

recognize, read, understand, and synthesize nonfiction as much as they need to fiction. These are skills that can and should be addressed by the Science teacher as well as the English teacher. And they can be.

Another misconception about reading is that people learn to read in the primary grades, then suddenly read to learn in the intermediate grades. Reading is not nearly so simple a process. Teaching reading extends beyond the primary grades and beyond K-3 teachers. People develop strategies to improve reading proficiency well into adulthood.

Classrooms that are being crunched by the cry for improved literacy and the increasingly longer time spent on reading each day, do not need to forgo time spent on science and social studies. It is just as important to include reading literacy in science as it is to understand the scientific process. Students need to be able to read with clarity, understanding and make application of what they read about nonfiction as much as about fiction.

There are several ways to include reading instruction in a science program. Some are as simple as recommending good nonfiction books on topics being studied. This would include reading aloud from nonfiction books as appropriate to the study and doing book talks about exciting nonfiction books that might capture the students' interest. Reading instruction is also about teaching the students how to read nonfiction and how to do research to support the experiments and activities that are the core of the science curriculum. What follows are some suggestions about how to teach reading comprehension as part of a science program.

The following list of nonfiction comprehension strategies comes from researchers like Keene and Zimmerman (1997), P. David Pearson, et. Al., and Stephanie Harvey. They are also based upon a reading project sponsored by Denver's Public Education and Business Coalition that focuses on comprehension

1. *Activating background knowledge.* Readers pay more attention when they relate to the text—text to self, text to text, and text to world. Knowing something about an article's content before reading it gives readers an edge. Part of the meaning breakdown that can occur when reading expository text comes from a lack of prior information. Teachers can help readers build background knowledge where little or none exists.
2. *Questioning.* If confusion disrupts understanding, nonfiction readers need to stop and take stock of why and what they don't understand. Asking questions is at the heart of nonfiction inquiry and often leads to further research.
3. *Determining important ideas.* Reading to learn requires readers to identify essential information. There are many ways to help students do this.
4. *Monitoring and repairing comprehension.* Nonfiction text is often packed with unfamiliar ideas and vocabulary. Cracking these strange words and concepts is crucial to understanding. Knowing how to adjust when meaning breaks down is critical.
5. *Drawing inferences.* Reading between the lines requires inferential thinking. Inferring is particularly helpful when searching for answers to questions that are not answered directly in the text.
6. *Synthesizing information.* Reviewing, sorting, and sifting information are specific skills students should apply to nonfiction reading. These can lead to new insights that change the way readers think.
7. *Visualizing.* Sensory imaging makes reading pleasurable. When readers get pictures in their mind while reading, they are more likely to hang in with the text against difficult odds.

Expository text is often schematically unfamiliar to young readers. The expository text of a textbook may consist of unfamiliar topics, factual material, and uncommon structures. Teachers need to expose students to a variety of expository texts and teach the different strategies for comprehending the

different approaches. Besides the traditional textbook and encyclopedia, students should be exposed to newspapers, magazines, nonfiction books on specific topics, the internet, videos, and more. All of these different forms have their own needs in terms of teaching students how to read them carefully with discernment and how to be able to glean understanding from them.

Can teaching specific nonfiction reading strategies improve reading scores? Science scores? Romance and Vitale (1992) found significant improvement in both science and reading scores of fourth graders when the regular basal reading program was replaced with reading in science that correlated with the science curriculum. They also found an improvement in students' attitudes toward studying science. The only area that didn't improve was students' attitudes toward reading in general. It stayed the same.

Another way of including reading instruction in the science curriculum is through thematic studies. Theme immersion can incorporate all types of skills as students gain understanding and knowledge about a science or social studies theme. One classroom focusing on the environment was able to use not only science time, but reading and writing workshops, math, art, and library time in their study of the environment.

As providers of environmental education, it would enhance your curriculum if you gave a packet of reading materials or suggested resources to teachers that applied to your lessons. This would encourage further follow up activities by the students while allowing teachers the opportunity to include nonfiction reading as part of their regular science or reading curriculum. Supporting students' enthusiasm for both science and reading is an opportunity hard to resist.

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