Resource List on Literacy and Science

Literacy in Science Resources

Barton, Mary Lee, and Jordan, Deborah L. (2001). Teaching Reading in Science. Mid-continent Research for Education and Learning, Aurora, CO.

Science teachers often feel unprepared or too pressured for time to teach skills typically associated with reading classrooms. However, in order for students to fully comprehend science texts and other written materials dealing with science content, students need some specific strategies for engaging and constructing meaning from those materials. This 'teacher's guide' provides a wealth of strategies to improve reading, writing, and communicating within the natural context of the science classroom.

Breger, D.C. (1995). The inquiry paper. Science Scope. 18(11). 27-32.

Breger discusses using inquiry papers, short weekly papers based on independent readings, to help students understand what they have read. In writing these papers, students learn to organize and respond to scientific text as well as learning skills that promote life-long learning. Breger explains that modeling the process for the students is necessary, reading first a reading log, leading to an inquiry paper. A scoring rubric is provided for the assessment of the inquiry papers. As well, a list of sources on which students can base their papers is included.

Casteel, C.P., & Isom, B.A. (1994). Reciprocal processes in science and literacy learning. The Reading Teacher. 47(7). 538-544.

Casteel and Isom examine the parallel processes at work between literacy and science. They maintain that many of the process skills inherent in literacy are also an integral part of science and that these similarities can be used to help students in their learning. The authors also point out the value of using literature in the science program to make the unfamiliar more familiar. As well, Casteel and Isom advocate having students write and reflect about their experiences in science in order to foster further learning and understanding.

Center for Applied Linguistics. (1993). Integrating math and science with language instruction. Washington, DC: Author.

This document describes a program established by the Center for Applied Linguistics to improve math and science education for language minority students. To do this, two in-service training sessions were initiated for a number of classroom teachers. The goals of the in-services were to introduce teachers to the communicative approach to math and science, to develop instructional materials which aid in the integration of these subjects, to develop appropriate instructional and assessment practices, and to train teachers to train others in these methods. According to this report, the program was successful in attaining these goals.

Charron, E. & De Onis, A. (1993). More complementary than contrary. Science Activities. 30 (1). 13-17.

Charron and De Onis suggested that the gap between teachers who teach a "read the chapter and answer the questions" science lesson, and those who provide hands-on experiences is narrowing. A re-examination of the role of reading in science, and the need to include real-life experiences are two reasons for this changing view. Teachers are realizing that children need to create their own ideas about new concepts through self-exploration. An integrated teaching approach has also given teachers more time to facilitate this type of learning. Charron and De Onis believed that reading cannot take the place of doing science, but that the use of multiple information sources enhances learning. Charron and De Onis discussed how two teachers combine their interests to develop collaboratively a four step program that includes brainstorming sessions, activities, and reading. Both teachers believed that science should be taught using an equal combination of reading and doing and not used in isolation.

Cwiklinski, Ann, Czapla, Beth, and Stern, Luli (1996). Books to help teachers achieve science literacy. American Association for the Advancement of Science. (ERIC Document Reproduction Service No. EDO-SE-9)

Project 2061, the American Association for the Advancement of Science's (AAAS) K-12 education reform effort, has created a database of 120 nonfiction science books, essays, philosophical works, and fiction books which are likely to enrich the reader's understanding of important ideas in science, mathematics, and technology. The books in the database meet 3 criteria: (1) match content in the Benchmarks, (2) come highly rated from a reliable source, and (3) be of interest to a general audience. Most have been published within the last 15 years.

Dickinson, Valarie L, and Young, Terrell A. (1998). Elementary science and language arts: should we blur the boundaries? School Science and Mathematics, 98(6), 334-340.

Many elementary teachers feel unprepared to teach science, and thus often put off teaching science because they feel that developing reading and writing is more important. These teachers often do not see the connection between developing literacy through science. Helping teachers see, understand, and implement instructional practices which rely on the teachers' strengths in language arts instruction to improve their teaching of science content could be a solution to the lack of confidence in science instruction. The authors discuss thematic interdisciplinary instruction as a remedy, while highlighting some key considerations for maintaining the integrity of each discipline.

DiGisi, Lori Lyman (1998). Summary of CUSER Institute on Science and Literacy: November 12-14, 1998. Center for Urban Science Education Reform (CUSER), New York City, New York.

This report is a synthesis of the Center for Urban Science Education Reform (CUSER) Institute on Science and Literacy. Beginning with the assumption that literacy supports science and science fosters literacy through interest, the institute provided a forum to present current research and an impetus for instructional reform. National experts on reading, writing, and language in science were convened to explore the connections between literacy and science in the classroom. Several recommendations were concluded based on discussions among participants. These included specific strategies to foster skilled science communicators, suggestions for assessing student learning and using that information to drive classroom practice, creating time for collaboration among literacy specialists and science teachers to plan and assess student work, and strategic ideas for the leadership of science and literacy programs.

Donahue, David M. (2000). Experimenting with texts: new science teachers' experience and practice as readers and teachers of reading. Journal of Adolescent and Adult Literacy, 43(8), 728-736.

Reading should be viewed as a "social activity of constructing meaning from prior knowledge, current experience, and information from a variety of texts," suggests the author, who teaches a course on reading in the content areas. Focusing on one's own reading in science may help them better understand how students' reading influences their understandings and assumptions about science. 10 preservice teachers were involved in a study that examined their own beliefs about science and literacy by having them read outside of their required course texts for 3 hours per week. The only requirement was that it be connected to their subject matter, thus it could consist of popular books, journals, essays, etc. The teachers had to write about their reading each week and respond to someone else's journal (within the same content area as their own) every other week.

The author examined the journals and drew conclusions as to the preservice teachers' beliefs about reading and writing in their content areas, particularly science. Results, conclusions, and implications of the findings are presented.

Drake, S.M., Hemphill, B. & Chappel, R. (1996) A novel approach. Science Teacher. 63 (7), 36-39.

This article describes how a grade nine class connected the novel Ring Rise, Ring Set to science. The novel had a heavy science content which the teacher used to pique students curiosity. The question asked was: were the scientific concepts encountered in the novel just science fiction or sound scientific thinking? This central issue served as a springboard for inquiry. The students went through several different scientific experiments to explore science and science-like ideas. The authors claim that the scientific content resembled a traditional ninth-grade program but in this approach the content was set in a more relevant context and therefore sparked the students' curiosity.

Ebbers, Margaretha (2002). Science text sets: using various genres to promote literacy and inquiry. Language Arts, 80(2), 40-50.

Inquiry requires that students examine information and resources, plan and conduct experiments and investigations, compare their findings to others, and to communicate their results and conclusions. In order to develop these essential skills in students, teachers must often think about teaching and learning science differently than they themselves learned. The use of a variety of non-fiction genres (reference, explanation, field guides, how-to guides, narrative expository, biography, and journals) enables teachers to expose students to scientific thinking and communicating. Through these models, students can increase their own literacy competencies in the science classroom. The author provides specific instructional strategies to use with the non-fiction genres mentioned, and illustrates how the formation of a 'text set,' or a collection of a variety of genres centered around a common theme, can be used to enhance both literacy and science content learning in the classroom.

Eggerton, S. (1996). Balancing science and sentiment: The portrayal of nature and the environment in children's literature. Science and Children. 33(6). 20-23.

Eggerton examines the on-going controversy of scientific accuracy versus sentiment in children's literature. There are those who argue that imagination and real world overlapping create for children curiosity and interest. However, others argue that this overlap leads to the development of misconceptions in children's thinking. Eggerton explains that critical assessments must be made when choosing books on nature and the

environment. Furthermore, it is essential that real life connections are made when using literature.

Farris, P.J. & Fuhler, C.J. (1994). Developing social studies concepts through picture books. The Reading Teacher. 47(5). 380-387.

In their article, Farris and Fuhler advocate the use of picture books in the classroom to teach concepts to students. They explain that picture books add detailed information which is lacking in many traditional textbooks. Picture books also lend themselves to the exploration of sensitive or controversial issues. Furthermore, picture books provoke curiosity and questions from students. Picture books can be used to make the abstract more real to students. The authors provide more in depth analysis of how picture books can be used in each of the following areas: anthropology, geography, history, and sociology.

Guthrie, J. T., Anderson, E., Alao, S., & Rinehart J. (1999). Influences of concept-oriented reading instruction on strategy use and conceptual learning from text. The Elementary School Journal, 99(4), 343-366.

3rd and 5th-grade students participated in a year-long integrated reading/language arts and science program called Concept-Oriented Reading Instruction (CORI). The purpose of the program was to increase reading engagement, which is associated with the acquisition of knowledge represented in a text. The experimental groups began an instructional unit with hands-on activities followed by library research on the topic they had explored. Instruction focused on how to integrate information across sources and included storied, folklore, novels, and poetry. At the end of the unit students communicated what they had learned to others through speaking and writing. Control group teachers used their usual McGraw-Hill basal readers for reading instruction and Addison-Wesley textbooks and materials for science. Students in the experimental group demonstrated higher achievement on an assessment of the conceptual knowledge contained in the unit and increased their reading engagement.

Harvey, Stephanie (2002). Nonfiction inquiry: using real reading and writing to explore the world. Language Arts, 80(1), 12-22.

Nonfiction books can be used to engage students in true inquiry. In order to encourage and foster reading, writing and thinking skills, students must have interesting topics to learn about. Utilizing high interest texts about the real world allows students to

go beyond surface knowledge and understandings. The author provides a research base for integrating content and developing students' sense of wonder as a mechanism to increase competencies in science, as well as reading and writing. Resources and practical classroom implementation strategies that are intended to spur enthusiasm among students are presented.

Holliday, W. G. (2001). Critically considering science inquiry. Science Scope 24(7), 54-57.

Holliday, W. G. (2001). Assessing visuals in science textbooks and trade books. Science Scope 24(4), 62-66.

Holliday, W. G. (October 1999). Integrating reading and science. Science Scope 23(2), 12-13.

Holliday, W. G., Yore, L., & Alvermann, D. E. (1994). The reading-science learning-writing connection: Breakthroughs, barriers, and promises. Journal of Research in Science Teaching, 31, 877-894.

Holliday, W. G. & Benson, G. (1991). Enhancing learning using questions adjunct to science charts. Journal of Research in Science Teaching, 28, 523-535.

Holliday, W. G. (1981). Selective attentional effects of textbook study questions on student learning in science. Journal of Research in Science Teaching, 18, 283-290.

Huber, R.A.& Walker, B.L. (1996). Science reading dos and don'ts. Science Scope. 20(1), 22-23.

Huber and Walker suggest that students must read about science in order to gain more information in addition to doing science. They explain that this provides the opportunity to teach students about science as well as improve their science reading skills. They provide a list of suggestions that can help science teachers support their students' growth in science knowledge and as readers. The list consists of the dos and don'ts involved when teaching science reading skills that promote a positive self-concept, attitude toward science reading and strategic approach to science reading.

Klentschy, M. P. (2001, August). The Science – Literacy Connection: A Case Study of the Valle Imperial Project in Science, 1995-1999. Paper presented at the Connecting Science and Literacy Conference, Baltimore, MD.

As part of a NSF-funded Local Systemic Initiative, a high-poverty California school district used an inquiry-based science program including research-based modules and science kits in grades K-6. Students' "real world" science experiences were supplemented with readings from children's books to provide a context for those experiences. Students also kept journals for each of the inquiry units. SAT-9 achievement test scores in science showed increases for all subgroups of students with a positive correlation to the number of years they were exposed to the program. Furthermore, the longer students had been exposed to the program, the higher their reading achievement scores. Limited English Proficient students experienced a strong carry-over effect in which their reading achievement improved along with their science achievement scores. 89% of 6th-graders who participated in the program passed a writing proficiency assessment compared to only 58% of the control group.

Mayer, D.A. (1995). How can we best use children's literature in teaching science concepts? Science and Children. 32 (6). 16-19.

Mayer examines the use of children's literature in science programs. Using a variety of literature which is used in teaching science, the author set out to determine what students learn from the use of fiction (a checklist was developed to determine the suitability of the book). In the study, Mayer discovered that fiction may interfere with the acquisition of knowledge. It was further expressed that when choosing literature in the classroom, care should be taken to ensure accuracy of information in both the text and the illustrations to reduce possible misconceptions which may ensue.

Mansukhani, Premlata (2002). The Explorers Club: the sky is no limit for learning. Language Arts, 80(2), 31-39.

When students are allowed to ask their own questions and pursue answers to them, the learning becomes the student's and the motivation is intrinsic. The "Explorers Club" is a model for facilitating inquiry learning in any content area, with any and all students, even ESL students. Students are nurtured by the teacher to pose rich questions and then guided as they pursue answers and/or solutions from a variety of media and sources. Evaluation of the learning, the learner, and the process occurs formatively and summatively.

Martin, George T. (2002). Reading, writing, and comprehending. The Science Teacher, October 2002, 56-59.

A synthesis of strategies learned by the author through a reading course at Shenandoah University in Virginia and a National Science Foundation training focusing on reading and writing in the content areas is presented. Pre-reading, reading, and post-reading strategies are discussed and described, enabling implementation in any classroom. Assessment strategies are presented as well that focus primarily on writing in the content area class.

McMahon, M. M., O'Hara, S. P., Holliday, W. G., McCormack, B. B., Gibson, E. M. (April 2000) Curriculum with a common thread. Science and Children. 37(7): 30-35, 57.

McMahon, M. M., O'Hara, S. P., McCormack, B. B., Gibson, E. M., Holliday, W. G., & Kelly, C. K., (1999). QUINTO: A fifth grade teacher team's electronic professional development tool, Meridian: A Middle School Computer Technologies Journal, 2(1), http://www.ncsu.edu/meridian/ (see http://www.ncsu.edu/meridian/jan99/quinto/index.html)

Moore, Sara Delano, and Bintz, William P. (2002). From Galileo to Snowflake Bentley. Science Scope, September 2002, 10-14.

In order to increase achievement in science educators must find ways, as John Dewey suggested decades ago, to present content in a more engaging context and consider different methods for that presentation. Moore and Bintz present paired texts as a reading strategy that can be used to introduce the concept of inquiry. Ideas for differentiation are presented, as well as the notion of using multiple texts, including literature, to further support student understanding of science and how scientists work.

Olson, M.W. & Gee, T.C. (1991). Content reading instruction in the primary grades: Perceptions and strategies. The Reading Teacher. 45(4). 298-307.

This article examines the need for young children to develop proficiency with expository texts, even in the primary grades. Having completed a survey, Olson and Gee share commonly recommended practices of primary teachers for content reading and also suggest specific strategies which are accompanied with examples to illustrate them. These strategies include: semantic mapping, KWL (what I know, what I want to learn, what I have learned), concrete manipulatives, expository paragraph frames, group summarizing, and visual imagery.

Romance, N.R., & Vitale, M.R. (1992). A curriculum strategy that expands

time for in-depth elementary science instruction by using science-based reading strategies: Effects of a year-long study in grade four. Journal of Research in Science Teaching, 29, 545-554.

Ruiz-Primo, M. A., Li, M., Ayala, C., & Shavelson, R. J. (1999, March). Student Science Journals and the Evidence they Provide: Classroom Learning and Opportunity to Learn. Paper presented at the meeting of the National Association for Research in Science Teaching, Boston, MA.

As part of a study designed to determine how best to assess student achievement on inquiry-based science activities, 163 California 5th-graders kept science journals describing their classroom activities. Teachers scored these journals using specially designed verification lists. Student performance on journal entries was positively correlated with their achievement on inquiry activities in class. Students with low journal scores tended to have a poor understanding of the science concepts in the activities they did. The researchers concluded that writing can be a valid way to demonstrate science achievement.

Schumm, J.S., Vaughn, S., & Leavell, A.G. (1994). Planning pyramid: A framework for planning for diverse student needs during content area instruction. The Reading Teacher. 47(8). 608-615.

The authors explain a framework for planning content area: a planning pyramid. The pyramid allows for inclusionary instruction for children with a broad range of abilities. The three degrees of learning examined are: what all student should know, what most but not all students will learn, and what some students will learn. The five points of entry described are: student, teacher, instructional practices, topic, and context. An example, using simple machines, is provided to illustrate the planning pyramid.

Their, Marlene (2002). The New Science Literacy. Using Language Skills to Help Students Learn Science, Heinemann Pub.

Unlike other books that concentrate on reading and writing, this book defines "literacy in science" as more encompassing: it includes speaking, listening, and media analysis. In chapters devoted to each of these literacy skills, authors Marlene Thier and Bennett Daviss detail specific metacognitive techniques that teachers can use to coach students to become independent learners. By combining science, language, and guided inquiry, teachers can empower students to think and express themselves about science more effectively, improving their learning and retention. To this end, the authors provide lists of explicit performance expectations in each of the five areas of literacy for learning science. Reproducible pages including these performance expectations, graphics, and

other metacognitive aids can be used by teachers and students alike to guide and assess growth in the use of language through science activities.

Walker, Bradford, and Huber, Richard A. (2002). Helping students read science textbooks. Science Scope, September 2002, 39-40.

Textbook reading can enhance both students comprehension of scientific texts and their interest in and knowledge of science concepts. However, textbook reading is often ineffective as students struggle more to decode than to actually comprehend the science content. Specific instructional strategies are highlighted which have proven effective in engaging students and increasing comprehension of text.

Current Articles on Writing in Science

Clidas, J. (1996). Personal plot journals. Science and Children. 33(6), 22-25.

In this article Clidas describes how she organized and implemented 3m by 3m environmental study areas for her fourth-grade class. She goes on to describe the journals her students kept while visiting their plots twice monthly. These journals supported her students' science inquiry and learning and documented change over time. The field journals encourage her students to write like scientists, which in turn encourage them to observe, and think like scientists.

Ediger, M. (1994/1995). Writing in the science curriculum. Catalyst. 38(2). 36-41.

Ediger strongly advocates the use of writing in the science curriculum. He explains that clear communication of thoughts and ideas is imperative. As well, he demonstrates that writing does, in fact, aid students in learning and reflecting. Ediger recommends writing be used in the following forms: experience charts, outlining content, experiments, book reports, journals, diaries, and logs in order to provide optimal learning and understanding for students.

Holliday, W. G. (Sept 2000). Integrating writing with science. Science Scope 24(1), 72-74.

Holliday, W. G. (September 1999). Teaching note-taking. Science Scope 23(1), 16.

Johnson, T, Hawe, M. & Burkimar, J. (1995/1996). Augmentation: Extending ideas in report writing. Prime Areas. 38(3), 41-45.

Johnson, Hawe and Burkimar advocate the augmentation of a core text as a way for students to write reports. To augment a core text the students take a normal text and surround it with factual and fictional information. The original text is referred to as the core text. The additions represent the augmentation. They claim that by using augmentation, instead of copying, there is a significant increase in the quality of children's engagement and understanding of the source materials, and their written reports. These important cognitive activities happen because augmentation requires transformation of information and ideas encountered in the text. Augmentation also gives the students experience in writing expository texts. Johnson and Hawe give clear example of students' augmented reports, and how they are done in a classroom setting.

Ogens, E.M. (1996). The write stuff. Science Scope. 20(1), 15-17.

Ogens examines the use of journal writing in science class in this article. She describes how she uses journals in her classroom which include: to close a unit with a rough summary of ideas learned, setting goals, recording progress, and posing further questions. She also uses journal writing to determine the level of understanding of the concepts taught and to help her identify the areas chat need more clarification. As well, Ogens advocates journals as an invaluable instrument for promoting student-teacher dialogue -- conduit for learning.

Reif, R.Ji& Rauch, K. (1994). Science in their own words. Science and Children. 31(4).

Reif and Rauch outline the value of students creating their own science books. This activity allows students to design, to write, and to illustrate their own books, making science learning relevant to them. Students are able to share their books with their class and with other students in the school. It is also explained chat this project is ideal as it can be adapted to the level at which the children are working. The authors suggest three formats the books may take: alphabet book, concept book, or science narrative. The further offer a variety of suggestions for illustration.

Rillero, P., Zambo, R., Cleland, J., & Ryan, J. (1996). Write from the start: Writing to learn science. Science Scope. 19(7). 30-32.

In this article, the authors advocate using the first few minutes of class for an activity called "Write Now." Students are asked to respond to a "quasar question"--powerful, open-ended questions which foster reflection and understanding. The teacher can use the questions as a form of daily assessment as well, assessing conceptual knowledge and misconceptions. The class can share responses and a discussion may develop from the varying viewpoints. The authors have provided examples of quasar questions and a variety of classroom strategies for using them.

Ryan, J., Rillero, P., Cleland, J., & Zambo, R. (1996). Writing to learn math and science. Teaching K-8. 27(1), 78-81.

The "Write Now" approach is a writing to learn math and science program [also see Science Scope, 19 (7)]. This is a warm-up approach which includes using an open-ended question posted in the front of the room upon the students arrival. The students answer the question by elaborating on what they learned in the previous days' lesson. This approach provides the teacher with a chance to see whether the students have understood the lesson from the previous day and to assess other prior knowledge related to the topic. The article further explains the types of science and math questions that work for this approach, and they claim that open-ended questions work the best.

Scarnati, J.T. & Weller, C.J. (1992). Write stuff Science and Children. 30(4). 28-29.

Scarnati and Weller advocate the integration of language arts into science. The authors suggest chat narration, description, explanation, and persuasion are the four basic methods of writing. These should be a student's "main purpose in writing" rather than watching for errors, such as "misspellings, grammatical errors, and messy penmanship." Scarnati and Weller believed that there is "no better subject in which to practice these skills than science." By reporting on science activities, and keeping observations, students are in a situation where a need for different writing form exists. "Integrating science and language arts is easy to do as long as you keep in mind the four purposes for writing and recognize the relationship between writing and science inquiry skills. "

Articles on Integrated Reading and Writing in Science

Jaegar, M., Lauritzen, C. & Davenport, M.R. (1996). Integrating curriculum. The Reading Teacher. 50(1), 64-66.

The authors describe an integrated approach to the study of Hot Lake: a local hot springs site with old buildings and ponds. This mysterious environment with steamy waters, ghosts haunting the legendary spa provide a high motivation and interesting focus for experimentation. The students pursued the discipline of science, acted as engineers, and explored folklore and history in this study. The authors also explain the idea that teachers and students who have an understanding of the nature of these disciplines can further use this understanding as a prism for examining contexts, generating inquires, and determining explorations. The oral and print language arts are essential in the construction of understanding and in the sharing of ideas.

Lozauskas, D. & Barell, J. (1992). Reflective reading. The Science Teacher. 59(8). 42-45.

Lozauskas and Barell encourage the use of a "thinking journal" in the science classroom wherein students write their thoughts while they read science materials or perform science experiments. It is important for the teacher to model how to write in these journals using a "think aloud" technique. The authors give a list of "starters" for the journal entries. They further explain the usefulness of journals in the insight they can give regarding the students thought processes and as a means of communicating through a running dialogue.

O'Mallan, R.P., Foley, C.L., & Lewis, C.D. (1993). Effects of the guided reading procedure on fifth graders' summary writing and comprehension of science text. Reading Improvement. 30(4). 194-201.

The authors of this article examine the use of the Guided Reading Procedure (GRP) in writing summaries. Two groups of students participated: the control group was given a traditional science program while the experimental group practiced GRP through a process of gradual release. Through examination of products, including a pre and post test, it was determined that students may initially struggle with comprehension when first learning the GRP strategy; however, it is speculated that this lessens with familiarity. Summary writing improved-evaluators saw increased paraphrasing and decreased reproductions in the students' writing.

Schroder, G. (1996) The elements of story writing: using picturebooks to learn about the elements of chemistry. Language Arts. 73, 412-418.

In this article Schroder writes about how her grade six class wrote and illustrated picture books for younger children to help make abstract and difficult science concepts more understandable. Schroder talks about each step of her project which includes taking students through: research, modeling, developing a plan of action, drafting, final revision and editing, and sharing the finished product: publishing. Schroder claims picture books were the natural bridge that made the study of elements meaningful to sixth grade students.