Learning to Read and Reading to Learn, pp. 48-58.

6 Reading About Science While Learning to Read

Ginny Muller[1] and Anne Tapp

Introduction

Science is what children do every day as they ask questions, make observations, examine unfamiliar objects, examine familiar objects in a new way, and try to figure out how things work. There are hundreds of motivating, engaging educational activities that support science learning. Children learn concepts best when they actively experience science, and children learn to read best when they are actively engaged in reading connected text.

A Curriculum Gap Revealed

This science experience cycle was developed as a result of an American university graduate class assignment. Both authors charged separate curriculum classes with the task of surveying in-service teachers to discover if a gap existed between the formal, printed science curriculum and the implemented curriculum. The graduate students reported a substantial gap within their local school districts. While the printed, school board-mandated curriculum articulated a well-designed program, skillfully aligned to the standards and benchmarks, very little science was actually being taught. Students reported curricular pressure to teach literacy as the high-frequency reason for abandoning science. In addition, many teachers reported their knowledge base as inadequate for the task, making them uncomfortable, and thus more inclined to cancel science lessons than other subjects.

Science Instruction Can Create Engagement in Literacy Instruction

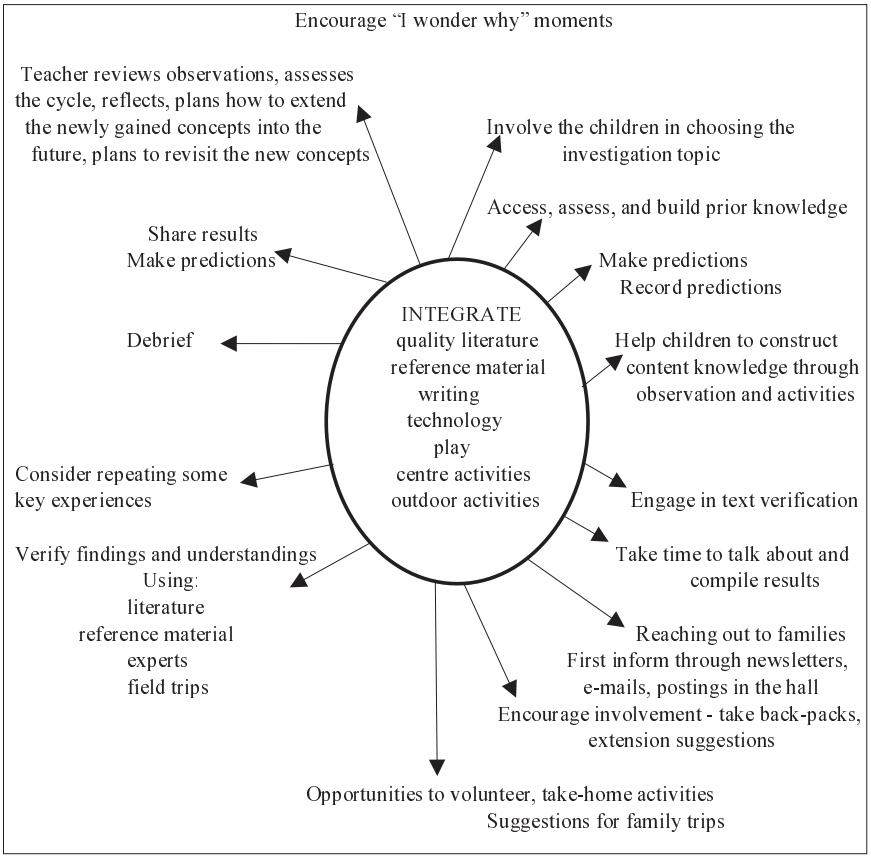
The *Quality Science Experience Cycle* was created to demonstrate the successful co-existence of science and literacy. Most young children have a genuine interest in the area of science, and this interest may transfer to the

---

1 Address for correspondence: Saginaw Valley State University 7400 Bay Road, University Center, MI, 48710. Email: *muller@svsu.edu.*

area of literacy, as children read text that holds their interest more successfully (Gabay, 1991, p. 7). See Table 1.

TABLE 1: ELEMENTARY QUALITY SCIENCE EXPERIENCE



Encourage 'I Wonder Why' Moments

Children also experience more reading and comprehension success when they have established some degree of prior knowledge within the content area. Much of the learning experiences for young children are rooted in oral language. Successful elementary teachers encourage those 'I wonder why?' moments. Successful teachers help children see everyday

events through a new lens. The teacher does not need any background in science to accomplish this; simply a willingness to listen.

Involve Children in Choosing the Topic

The role of the teacher is to "bridge the gap between what the reader already knows and what the reader needs to know before he or she can meaningfully learn the task at hand" (Ausubel, 1968, p.148). Science lessons may build prior knowledge and awaken interest in the assigned text. Science is all around us, and content-ready texts are readily available. Varying-level books exist within the same area of science benefiting all ability readers within a classroom. But with so much available, teachers and children need to differentiate between a topic that might be an entertaining chat on the playground and a topic that might be worth a sustainable scientific inquiry. A conversation during a class meeting allows students to think critically about the topic. Even if the large topic is mandated, the children can still engage in a critical conversation about sub-topics worthy of investigation. "Real science begins with childhood curiosity, which leads to discovery and exploration with teachers' help and encouragement. It involves three major components: content, processes, and attitude" (Conezio & French, 2002, p 2). Some teachers use a grid as an aid to decision making, such as the one in Table 2.

TABLE 2: DECISION MAKING GRID

Topic: _____

Idea	Might be Interesting	Involves Travel	Could be Dangerous	Part of the Curriculum	I know Someone
Idea 1					
Idea 2					
Idea 3					

Access, Assess, and Build Prior Knowledge

Once the decision has been reached to pursue a particular topic, it is important to access prior knowledge. This helps the teacher to decide the starting point for instruction, and points out misconceptions. Many able

teachers use the K-W-L strategy, developed by Donna Ogle (1986). This is illustrated in Table 3.

TABLE 3: KWL

Topic_____

What Do I Know?	What Do I Want to Learn?	What Have I Learned?

The Letters represent three headers: *What Do I Know, What Do I Want to Know,* and *What Did I Learn.* The first step of the strategy is simply to ask the students to share what they know about the topic. The teacher then records each statement without comment. The children are assigned a homework task: ask about the topic at home, and make a three item list of what they would like to learn.

After the children go home, it is important for the teacher to read the list and reflect. It is very important to identify misconceptions, as children tend to cling to wrong information with great tenacity. Misconceptions can lead to learning difficulties, so this is important. It is through conversations, guided activities, and text verification that correct perceptions and information can be reinforced. With multiple exposures, misinformation can be replaced with scientifically accurate information.

Make Predictions, Record Predictions

This is a good activity for the science journal. It can be accomplished within a large or small group setting or individually. It is important for students to write their predictions. First, this is what scientists do. Second, children learn to write by writing, and they write better if there is an authentic topic about which to write. Sometimes, the process to predict/observe/study/interact/ then predict again needs teacher input. For example, take the topic of studying the mixture of two primary colours to

create a third colour. One way to demonstrate this to a group of children is to place a fairly large clear glass jar on an overhead projector, turn the projector on, and turn the classroom lights off. This creates an interesting glow when adding a bit of vegetable oil to the jar. This gives the teacher time to talk to the children, and it gives the children time to focus attention on the jar. The teacher then adds drops of two different primary colours of food colouring, for example, yellow in one spot and red in another. The colour will sit on top of the oil for a moment and will suddenly fall through the oil. The jar will be filled with growing plumes of colour. Because the jar is sitting on a heat source, there will be a heat rile moving through the water. This motion will cause the two colours to mix, and the water will turn orange. Then the children might write a prediction. Could this experience be repeated with the same results? What will happen if different colours are used?

Help Children Construct Content Knowledge Through Appropriate Activities and Observations

Children need appropriate, motivating reading materials as well as opportunities to investigate, sort, and manipulate within science centres. Children need to step back to observe, speculate, and to reflect. They need the chance to discuss the findings, to engage in text verification, to collaborate, and to engage in personal scholarship. Centre materials, along with related, quality literature may sustain your students' interest for up to two weeks. Students should be closely observed to see how often they visit the centre, how long they stay, and their level of activity while at the centre.

Elementary educators need to allow for teachable moments. Kathleen Conezio and Lucia French, commented that:

> Young children, like all scientists, need to practice the skills of predicting, observing, classifying, hypothesizing, experimenting, and communicating. They also need time to reflect on their findings, how they reached them, and how the findings compare to their previous ideas and the ideas of others. In this way, children are encouraged to continue the discovery process. By building on young children's curiosity about the world around them, families, teachers and other adults can make science come alive, thereby reinforcing science learning. Science provides a rich knowledge base that will become an essential foundation for later reading comprehension. Exploring the

natural world presents authentic opportunities for children to listen and talk (2002, p. 16).

If you were to investigate colour mixing, some of the centre activities might include:

- Mixing yellow and red frosting on a sugar cookie
- Mixing yellow and red clay
- Sprinkling red and yellow sugar on white paper and allowing it to stand in a light rain for a moment. Then putting it on a sheet of newspaper and sprinkling it with salt. Look carefully after it dries to see sparkles.

Each of these activities may become entries in a science journal. Students list the materials, procedure, anticipated outcome, and the actual outcome. This topic lends itself to the children illustrating the activity. Suddenly frosting a cookie is more about colour mixing than it is about frosting. Interesting new words are discussed and can be posted within the classroom.

Colour mixing can be investigated very successfully on the internet. At *http://www.omsi.edu/visit/tech/colourmix.cfm* and *http://www.science netlinks.com/lessons* the children can manipulate both light and ink, and observe how the addition and subtraction of one colour affects the resultant colour. At *http://www.explorelearning.com*, the colours of fireworks are addressed.

Engage in Text Verification

Real scientists look for information in the literature. Young scientists can do the same. At many online book sites there are internal search engines that can be used to find quality books. For example, a search for the term 'colour' at Booksource.com, *http://www.booksource.com*, produced a list of 500 titles.

It is during science time that children can be invited to read books that are well within their reading success level for the scientific content. Children can learn techniques for reading non-fiction materials during this time. Then, during the reading instructional block, the children may read fiction books with the same topic running through them. colour mixing leads to just fun in school as the children read about characters getting in and out of one mess after another. Connections may become apparent and may be recorded in science journals.

Take Time to Talk About and Compile Results

Take time to talk about and compile the results of any explorations and discuss ways real scientists engage in the same behaviors. These conversations lead to more questions; verify the issues through literature, reference materials, visiting experts, and field trips. One noted master teacher writes letters to the immediate world, inviting working professionals into her classroom to help her students to understand science. It is amazing how many people will come to school to talk with children or write a letter explaining their occupation. When the child of the day goes down for the mail, it is an adventure. The notion that real, regular people do science daily is reinforced, as well as the notion that schooling leads to an interesting job in the adult years.

Remember to Reach out to Families

Every parent wants the child to do well in school. Schools need to partner with families to maximize learning opportunities. The home/school learning connection is essential. Many teachers have been successful in reaching families through regular newsletters, science literacy take-home bags that circulate, and bulletin boards in the hall where parents gather to wait for school dismissal. Send home colour mixing homework: drop a single drop of food colour into the bottom of a small paper cup and allow to dry overnight. At the close of the day, each child takes home two cups, fills each half-full with either milk or water, and observes what happens. Next, the child pours both cups into a glass, and observes the results. The child then writes a report about what happened.

Parents are often very willing to provide a real-world context to the unit of study. When there is a study involving colour mixing, consider reaching out to parents and ask them if they work in a job where colour mixing is important, or if colour is important to what they do. Our classroom welcomed a number of parents:

- A lineman who talked about the three colour tests he needed to pass and passed around a thick line of cable so the children could see how lines are colour-coded.
- A lab worker who talked about how poisons are identified through chromatography.
- A cake decorator who brought big cookies and talked about paste colours and colour mixing to order, squeezed lines of primary colours inside a huge pastry tube, filled it with white frosting and allowed

each child to decorate a cookie. No two were the same as the colours mixed.

Verify Findings and Understandings/Debrief

Children who are given the opportunity to make choices at school engage in the learning more whole-heartedly (Robinson, 1999). When this onus is placed on them, students more readily engage in the life of the classroom and enjoy greater benefits from the instruction than children who are just going through the motions. If we want children to take responsibility for their own learning, we must first give them responsibility for their own learning. The way a child learns how to make decisions is by making decisions, not by following directions. As written by Clemens and Battista, "Knowledge is actively created or invented by the child, not passively received from the environment."(1990, p. 34) It is important to realize each child and class has different interests, needs, and prior knowledge, and it is important to celebrate learning in the classroom. This is the place to return to the KWL and complete the last column. Once a teacher is aware that a child does not understand a particular concept, additional, specific lessons may be planned to address that misinformation.

Share Results

Teachers realize that children learn concepts best when they actively engage in hands-on, minds-on learning. However, children need not be taken on an out-of-the-classroom field trip to experience science. What they do need is somebody to listen to them, show an interest, demonstrate that interest by pulling out an appropriate book, and expanding the conversation. Successful elementary teachers ask their students to observe and talk about encounters in their everyday life. Some of these experiences are teacher initiated; others are events that children notice. If a teacher celebrates what the child has noticed, children feel affirmed, take risks, and are more likely to really notice and think about things around them.

Think about how the students could share what has been learned. A colour-mixing event provides an opportunity to review as well as an authentic reason to engage in literacy.

Make Predictions

The cycle begins again. What topic should be the next focus? Sometimes, it is the unplanned lessons that best engage children. Wise teachers involve their students in choosing the investigation topic. Often,

the meatiest, most productive conversations with young children spring from their interests.

The Centre of the Cycle

The centre of the cycle addresses the classroom environment and the integration of a variety of elements: literature, reference materials, technology, writing, play, centre activities, and outdoor activities. These are both fun and creative elements of the cycle. Use all of those elements to revisit the new knowledge. One way to expand and validate the inquiry is to take photographs of the children's work or allow them to take photographs. For example, the following internet site will show children happily mixing colours at a summer school program: *http://www.dare.k12.nc.us/moxie/schools/FFH/colour-works.shtml*. Pictures can then be used to weave literacy activities through the science inquiry. This provides the children with evidence of the topic they actually want to write about as well as illustrations for journal entries making them more vivid and interesting. As Cynthia Hoisington reported: "... photographs are useful tools not only for literacy learning, social-emotional development, and assessment, but also for science teaching and learning" (2002, p. 27).

Often, an investigation will lead to a desire to write a book. This is a good place to use the photographs taken during the course of the investigation, and reading the class book is a good way to re-visit the inquiry. Plan events that encourage writing, including helping children to develop e-mail relationships. This creates a win-win relationship as young children gain encoding skills while building a knowledge base. If you use undergraduate students for your respondents, they gain a familiarity in reading invented spelling. If you use remedial elementary students as respondents, they gain a reason to read books that are at their success reading level without any social embarrassment.

Skillful teachers know that research suggests that prior knowledge about any given topic is the single biggest predictor of learning success for that topic. So, it is also of great benefit for teachers to talk with their students with great frequency, listen carefully, and pick up on any opportunities to engage in teachable moments. Reflection is important for scientists in the field and is just as important for science students. It is up to the teacher to decide which concepts are key, and revisit them after the actual study has been completed. Likewise, the teacher knows which topics are mandated in the curriculum, and can look for ways to create prior knowledge. Always be on the look-out for ways to re-activate the

knowledge gained in the investigation. How else do colours mix? Could you mix the colours found in spring flowers? Do falling leaves stain the pavement under them? This *Quality Science Experience Cycle* is a guide which can be used to create many authentic literacy experiences. Children need something to read, a reason to read, and a desire to read. Likewise, they need a real reason to write to build the desire to write. Why not read about science?

References

Ausubel, D. (1968). *Educational psychology: A cognitive view.* New York: Holt, Rinehart & Winston.

Camp, D. (2000). It takes two: Teaching with twin sets of fact and fiction. *The Reading Teacher, 54,* 54-63.

Clemens, D. & Battista, M. (1990). Research into practice: Constructivist learning and teaching. *Arithmetic Teacher, 38*(1)*,* 34-35.

Conezio, K. & French, L. (2002). Science in the preschool classroom: Capitalizing on children's fascination with the everyday world to foster language and literacy development. *Young Children. 57,* 12-20.

Harlan, J. & Rizkin, M. (2000). *Science experiences for the early childhood years* (7th Ed.) Columbus, OH: Merrill Prentice Hall.

Gabay, J. (1991). Issue: Motivation. *ASCD Update, 33*, 7.

Goals 2000: *Educate America Act*, Pub. L. No. 103-227. 103rd Cong., 2d session. (March 31, 1994).

Guillaume, A. (1998). Learning with text in primary grades. *The Reading Teacher, 57,* 476-486.

Hoisington, C. (2002). Using photographs to support children's science inquiry. *Young Children. 57,* 26-30.

Jones, M. G., Jones, B. D., Hardin, B., Chapman, L., Yarbrough, T., & Davis, M. (1999). The impact of high-stakes testing on teachers and students in North Carolina. *Phi Delta Kappan, 57,* 191-203.

Lapp, D. & Flood, J.. (1993). Literature in the science program. In B. Cullinam (Ed.), *Fact and fiction: Literature across the curriculum* (68-79) Newark, DE: International Reading Association.

Lerner, L. (2000). Good and bad science in U.S. schools. *Nature, 407,* 287.

Martin, Ralph, Gerlovich, Jack & Sexton, Colleen. (2000). *Teaching science for all children,* Third Ed. Needham Heights: Allyn and Bacon.

Mayer, R.E., Bove, W., Bryman, A., Mars, R., & Tapangco, L. (1996). When less is more: Meaningful learning from visual and verbal summaries of science textbook lessons. *Journal of Educational Psychology, 88,* 64-73.

Michigan Department of Education. (1996). *Michigan curriculum framework.* Lansing, MI.

National Research Council. (1996). *National science education.* Washington, DC: National Academy Press.

Ogle, D. (1986). K-W-L group instructional strategy. In A. Palincsar, D. Ogle, B. Jones, & E. Carr, (Eds.), *Teaching reading as thinking* (Teleconference Resource Guide, pp. 11-17). Alexandria, VA: Association for Supervision and Curriculum Development.

Robinson, L. (2004). *Engaging young children in computer activities.* http://www.wiu.edu/users/mimacp/wiu/articles/engag.html. Retrieved September 2, 2004.

Wilson, R. (2004) Connecting children to nature: Making outdoor play accessible to all children. *Early Childhood News*, October 2002, 15-17.

Yopp, R., & Yopp, H. (2000). Sharing information with young children. *The Reading Teacher, 53*. 410-423.