Feature

Connecting Science Notebooking to the Elementary Library Media Center

by Kristin Fontichiaro and Sandy Buczynski

The *Standards for the 21st-Century Learner* paints a vibrant image of motivated, student-driven work (AASL 2007). The Common Beliefs in this document state, "Inquiry provides a framework for learning," and Standard One articulates that students will "Inquire, think critically, and gain knowledge." As the standards unfold, they further define the inquiry process: activating students' prior knowledge, connecting the process to real-world applications, reviewing and evaluating information, and synthesizing new understandings into a final work product. Inquiry, rather than information literacy, is the term at the core of the new *Standards*. This nomenclature change connects library-based work more strongly to the teaching strategies of classroom teachers.

What Is Inquiry?

The term "inquiry" can be viewed from two perspectives. Inquiry refers to the abilities students develop when designing and conducting investigations and the understanding they gain through this process about the nature of science. Inquiry also refers to teaching and learning strategies that enable students to master content concepts (NRC 2000).

Young children are innate inquirers as they explore the world around them. Capturing this sense of wonder in a structured approach to problem solving is the essence of inquiry-based instruction. Rather than following a prescribed series of steps and arriving at "the correct answer," students develop, carry out, and reflect on their own processes to arrive at understanding. Through inquiry, students view the problem through multiple lenses, develop understanding from multiple perspectives, and deepen collective class understanding.

Knowledge is in the head of the learner who can only construct what he or she knows on the basis of his or her own experience. Inquiry-based instruction provides that experience.

Science Inquiry

Library media specialists are not the sole standard-bearers for inquiry; science teachers are deeply committed to inquiry as well. Guided by the National Science Education Standards, science teachers are charged with providing three kinds of scientific skills and understandings. Students need to:

- ►Learn the principles and concepts of science,
- ►Acquire reasoning and procedural kills of scientists, and
- ►Understand the nature of science as a particular form of human endeavor (NRC 2000).

Inquiry pedagogy helps science teachers achieve these goals. Teachers build science lessons on the principle that learners do not enter classrooms as blank slates; rather, they bring with them preconceived ideas about how the world works. To provide learners with constructivist experiences that place them in the center of their learning, encouraging them to explore and relate concepts to their own experiences, science teachers routinely design lesson plans using the 5E model (Ansberry and Morgan 2005). Developed by the Biological Sciences Curriculum Study (BSCS), 5E lesson design is in five phases:

- ►Engage (capture student interest)
- ►Explore (through common concrete experiences)
- ►Explain (students articulate ideas in their own words and listen to each other)
- ►Elaborate (address misconceptions and generalize concepts to a broader context)
- ►Evaluate (self-evaluation and summative assessment) (BSCS 2006).

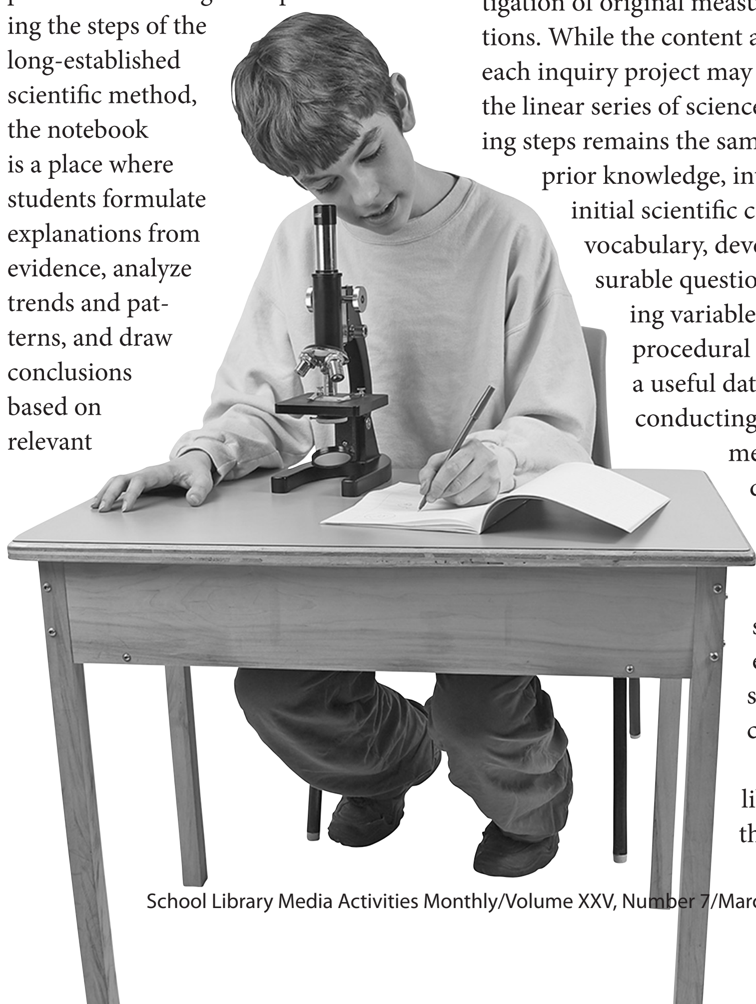
In the 5E model, the student takes on much of the responsibility for asking questions, thinking creatively, explaining possible solutions, and applying new vocabulary. The teacher is a facilitator, providing time for students to observe and investigate, asking for evidence and clarification from students, and encouraging students to self-assess their own learning.

Bringing Science and the Library Media Center Together

To maximize students' learning, science teachers and library media specialists can work together to pursue quality cognitive experiences for elementary students via inquiry and science skills. The two share a deep responsibility for promoting reasoning skills, content acquisition, and curiosity in students. Realizing that students must have a deep foundation of factual knowledge and a means to organize that knowledge in ways that allow retrieval and application, science notebooking represents an ideal method for capturing mutual educational objectives.

What Is Science Notebooking?

Science notebooking is a process tool used to scaffold inquiry as well as provide an ongoing record of the students' procedural and cognitive processes. Using the steps of the long-established scientific method, the notebook is a place where students formulate explanations from evidence, analyze trends and patterns, and draw conclusions based on relevant evidence. These science notebooks facilitate inductive thinking through a series of sense-making strategies. The use of multiple modalities—text, graphs, charts, scientific drawings, procedural lists, sketches, and observations—gives students the opportunity to think through ideas and data in many ways. This approach facilitates differentiation for English Language Learners and for students with special needs (Klentschy 2008). In addition, repeated use of science notebooking develops many types of writing: expository, procedural, and reflective. In a science notebook, students write for themselves, rather than for an instructor audience. By doing so, science notebooks empower students and give them ownership; they recognize their notebooks as a place to record their own processes and discoveries in their own voices. This is a significant shift away from extrinsically-motivated, teacher-assigned tasks.



Science notebooking is not a curriculum; its process can be used with existing science kits (Campbell and Fulton 2003) or to document the investigation of original measurable questions. While the content and design of each inquiry project may be different, the linear series of science notebooking steps remains the same: awakening prior knowledge, introducing initial scientific concepts and vocabulary, developing measurable questions, identifying variables, drafting procedural steps, creating a useful data organizer, conducting the experiment, recording data, processing the data to establish a claim with supporting evidence, and synthesizing a conclusion.

As in quality library inquiry, the instructor's role is not to give out worksheets or predetermined procedures; instead, they provide overarching scaffolding via the notebooking process and support students' efforts to organize and make sense of their work. Throughout the notebooking process, instructors are actively involved in formative assessment. Rather than assigning grades to the notebooking process, instructors give feedback via conferencing, constructive comments, and reflective opportunities for students. In this application of science notebooking, the summative assessment is in the form of an authentic, real-world product (such as a brochure, letter, podcast, or monologue) that brings the thinking process full-circle and demonstrates the students' level of applied conceptual understanding.

A simple, marble-covered composition notebook is ideal for science notebooking. Because the stitched binding keeps papers in a fixed order, the notebook is an enduring record of current understanding and past thinking, becoming a cognitive portfolio that can span many projects over multiple grade levels.

How Can the Library Media Specialist Be Involved?

When library media specialists become partners in science inquiry, they have new opportunities for reinforcing the values found in the AASL Standards. The correlation is remarkably strong, and Table 1: Using Science Notebooking to meet the AASL Standards (see page 27) shows how closely science notebooking supports the inquiry process outlined in the AASL Standards. Co-teaching halves the student-to-teacher ratio and facilitates greater levels of student support via feedback, conferencing, and personalized, differentiated instruction. Library media specialists can share their expertise in designing meaningful questions and provide companion resources. Those students who have developed new questions or further interest in a topic can work intensively with the library media specialist to pursue these interests. For some inquiry projects, specifically those dealing with physical science (e.g., motion and design and physics), the larger tables of the library media center create a wonderful ad hoc laboratory.

Lesson Plans with Science Notebooking

Check out the two lesson plans related to science notebooking in this issue of *SLMAM*. One lesson plan was developed from a perspective of hands-on science, "Science Notebooking in Action: Where Does Condensation Come From?" (pages 12-14) and one was developed from the perspective of library media research, "Science Notebooking in the Library Media Center: Alternative Energy" (pages 14-16). These lesson plans show the strong correlation between science inquiry and the AASL Standards and demonstrate how working with hands-on science can develop the skills needed for research.

Conclusion: Joining Forces

In the transition from *Information Power* to AASL's *Standards for the 21st-Century Learner*, library media specialists are changing from instructors who focus on finding information to guides who help students make meaning from and enhance conceptual understanding. When library media specialists step outside the traditional confines of the library media center, they can find a dynamic partnership with science teachers and co-create active learning environments. Science notebooking encourages authentic engagement that reinforces the nature of science and results in more resonant student learning. Hands-on inquiry, like quality library inquiry, strengthens students' cognitive toolkit, brings new knowledge, and develops lifelong habits of mind.

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Notebooking Stage	What Happens	Role of the Library Media Specialist	AASL Standards Correlation
Planning for Learning	The teacher selects a science concept focus and, optionally, finds a story that introduces students to a content-based problem needing solution. The teacher and library media specialist select an inquiry focus (e.g., questioning, predicting, making meaning of data, conclusion, etc.) that will be especially monitored.	Provides age-appropriate introductory content materials and/or stories related to the scientific problem. Plans co-teaching, formative assessments strategies, project, and rubric with teacher.	Common Belief 8: Learning has a social context. Common Belief 9: School libraries are essential to the development of learning skills.
Story Starter, Connecting to Science, Inventory Walk, Vocabulary	The teacher taps into and strengthens prior knowledge. In Story Starters and Science Notebooking, teachers present a story that introduces students to a science concept and problem to be solved. The teacher introduces basic science concepts, begins vocabulary development, and reveals materials available for students to use in designing an investigation.	Provides cameras so students can create labeled photo display of inventory items as a visual reference throughout inquiry. Recommends books for additional reading. Co-leads discussions.	1.1.2: Use prior and background knowledge as context for new learning. 4.1.5: Connect ideas to own interests and previous knowledge and experience.
Questioning	Students generate an open-ended measurable question. Counting, cause and effect, or comparison questions are effective. Avoid "yes/no" questions.	Guides students in designing open-ended questions that will lead to fruitful exploration.	1.1.3: Develop and refine a range of questions to frame the search for new understanding.
Formulating a Prediction	Based on the measurable question, students determine what they think a logical outcome will be and then make a prediction (via writing or drawing) about the direction of that outcome.	Assists students in creating an "if, then" statement that reflects the student's vision of a possible outcome of the experiment.	1.2.1: Display initiative and engagement by posing questions and investigating the answers beyond the collection of superficial facts.
Identifying Variables	Students identify the experimental elements (variables) that will change, be measured as a result of that change, and remain constant.	Guides students in their efforts to identify variables using word clues such as "if, then."	Belief 7: The continuing expansion of information demands that all individuals acquire the thinking skills that will enable them to learn on their own.
Designing the Procedure	Students further define their experimental process by visualizing the steps they will take to test their prediction. In a sequential manner, students write or sketch steps to be followed during the experiment.	Helps students visualize steps needed to gather data, reviews procedural thinking for thoroughness and materials needed, monitors for gaps.	4.4.3: Recognize how to focus efforts in personal learning.
Creating the Data Organizer	Students reflect on their variables and consider the types of data they will need to collect in order to test their prediction. They create an empty graphic organizer (table, chart, graph, etc.) for use during the experiment.	Provides examples of graphic organizers. Helps students envision data to collect. Monitors that the organizer relates to the procedure and prediction.	2.1.2: Organize knowledge so that it is useful.
Conducting the Experiment, Recording Data and Observations	In groups, students conduct the experiment and record data. In addition, they sketch images of the experiment in progress and record observations.	Circulates throughout groups to monitor progress, discusses progress with students, gives oral feedback, and assists students with accurate measuring.	3.2.2: Show social responsibility by participating actively with others in learning situations… 3.2.3: Demonstrate teamwork by working productively with others.
Claims and Evidence	Students review data, looking for patterns or trends that lead them to make an assertion (claim). Students justify their claim with data (evidence) collected during the experiment. The cognition in this step moves students away from reliance on prior knowledge and into consideration of collected data.	Helps students make meaning of data and distinguish between inference and evidence. Assists with using technology to sort data, calculate, or construct graphs to make patterns/ trends visible.	1.1.6: Read, view, and listen for information… to make inferences & gather meaning. 2.1.4: Use technology and other tools to analyze and organize information.
Conclusion	In their notebooks, students compare their claims and evidence to their original prediction. They determine whether their original prediction was supported and what new scientific knowledge they have gained. Students reflect on possible experimental errors. The notebook will be used in subsequent steps as a reference in creating a work product that demonstrates what has been learned.	Collaboratively guides students through this thinking process. Reminds students that unsupported predictions are not failures and provides examples of "failures" that yielded new discoveries.	2.4.2: Reflect on systematic process, and assess for completeness of investigation. 2.4.3: Recognize new knowledge and understanding. 3.4.1: Assess the process by which learning was achieved in order to revise strategies and learn more effectively in the future.
Project	Students use findings to create an authentic work product (brochure, podcast, monologue, etc.) that requires them to apply content knowledge, interpret results of investigation in context of original problem, take a different perspective (speak from another voice), or use technology to communicate findings. Students receive rubrics in advance to guide them in identifying quality work. Students have opportunities to re-submit final project after constructive feedback.	Provides support or co-teaches necessary writing or technology skills. Supports student work in creating the final product that demonstrates level of conceptual knowledge. Shares in evaluating student work and revising the project for resubmission.	2.1.6: Use the writing process, media and visual literacy, and technology skills to create products that express new understandings. 3.1.1: Conclude an inquiry-based research process by sharing new understandings and reflecting on the learning. 3.4.2: Assess the quality and effectiveness of the learning product.
Next Steps	Like real scientists, students consider what new hands-on or library inquiries they might like to explore next. Future investigations are recorded in the same science notebook, creating a long-term portfolio of student thinking.	Works with groups to pursue new hands-on or library inquiry. Shares evidence of learning with administrators. Plans next inquiry with teacher.	2.4.4: Develop directions for future investigations.