

# Project NOTEBOOK

By Ellen Mintz and Jeri Calhoun

**I**n a climate where language arts instruction and mathematics are clearly educational priorities, how do you build an effective inquiry-based science program? Sometimes, changes in belief systems are necessary: Teachers need to see the value and benefits of teaching science.

Teachers also need to see a clear purpose for the lessons they are teaching by identifying the content and processes contained in science investigations. If connections across the curriculum are made, then teachers may be more likely to embrace the science curriculum.

Believing that science could be used as a vehicle for increasing student achievement across the curriculum, seven science resource teachers in the South Carolina Lowcountry designed a professional development program funded through a Local Systemic Change grant from the National Science Foundation called Project Inquiry.

We'd like to share our experiences in creating this program, in which science notebooks, used in conjunction with an inquiry-based science curriculum, emerged as the natural vehicle for helping to create an effective science program.

## Project Inquiry Background

Two of us had the opportunity to learn about science notebooks while participating in professional development with science resource teachers from El Centro, California, at the Exploratorium in San Francisco. We reviewed data collected in a study by the Valle Imperial Project of the El Centro School District (Klentschy, Garrison, and Amaral 2001), which supported combining effective inquiry-based science instruction and science notebooks as a means of increasing student achievement across the curriculum. Further investigation showed that other school districts across the country were implementing science notebooks and getting positive results and feedback from students and teachers.

We felt this strategy would enable our teachers to view science as a means of supporting and enhancing language arts and mathematics instruction without compromising the integrity of the science content being taught. This would, in turn, allow us to get our "foot in the door" at schools who were resisting the implementation of our district's newly adopted science materials.

Science notebooks emerge as a means of supporting and enhancing instruction across the curriculum.



## Customizing the Workshops

When we began planning workshops, we realized it would not be advantageous to replicate someone else's science notebook program. We would need to create one of our own to meet the diverse needs of our student and teacher populations, which included a large proportion of first-year teachers.

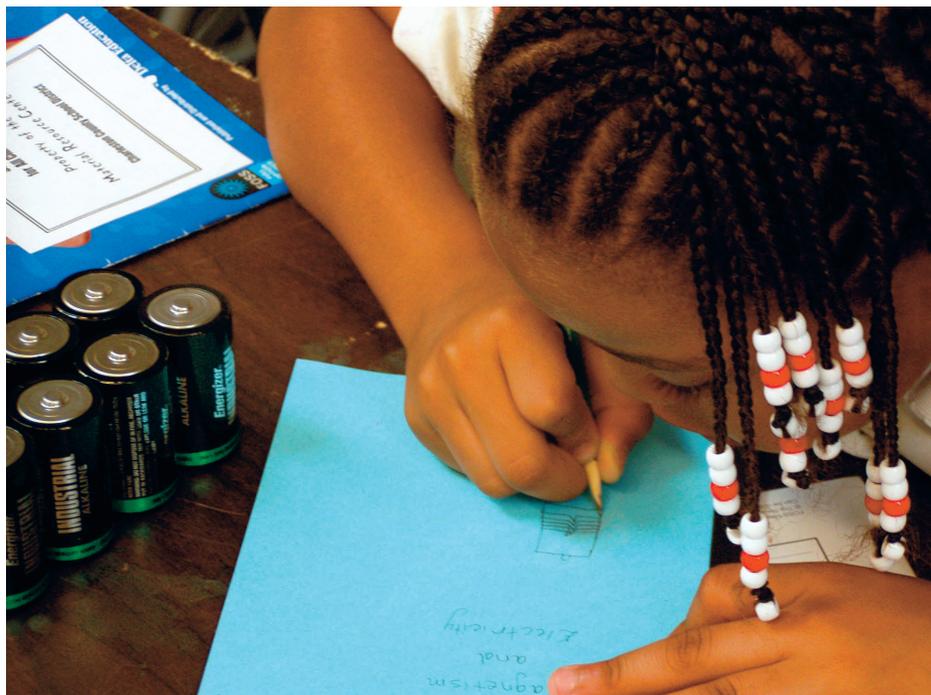
In designing the professional development, we felt sharing the El Centro data would convince teachers that notebooks would increase student achievement. We knew teachers would want to see what science notebooks looked like, so we also secured samples of student work. Finally, we knew that teachers would need to experience creating a notebook entry just as their students would.

Initially, we designed a three-hour workshop. We were aware that follow-up professional development

workshops would be necessary after we had a chance to evaluate the initial implementation. We anticipated that the most experienced teachers and those most comfortable with the topic would be the first to use it. Over time, we hoped to draw more teachers into the process.

Two different methods of introducing science notebooks were presented. We offered the workshop as part of our district professional development opportunities that allowed teachers from any school to register and attend the workshop. We also offered training at individual elementary schools, which allowed entire faculties to begin the journey together and kept implementation consistent schoolwide. Many schools took us up on the offer and science notebook workshops were presented during schoolwide professional development days and after school.

Science notebooks provide students with meaningful reasons for expository writing, give students time to reflect on what they're learning, and create useful references for class projects and future investigations.



PHOTOGRAPH COURTESY OF THE AUTHORS

## And We're Off!

At the workshops, teachers viewed a PowerPoint presentation on the benefits for students and teachers of using science notebooks. Commonly cited benefits are: providing students with meaningful reasons for expository writing; giving them time to reflect on what they're learning before classroom discussions; and creating a useful reference source for class projects and future investigations. We then discussed how notebooks could be used as a formative assessment tool for teachers. For example, teachers can use notebook entries to spot developing student misconceptions, find evidence of student learning, and plan future instruction based on what they find students know and don't know.

Next, we reviewed the suggested components of science notebooks:

- **Purpose/Question**—This is the question posed by the teacher based on the purpose of the lesson and the learning standard being addressed. It allows students to focus on what they will be investigating.
- **Predictions**—These are based on students' prior knowledge.
- **Planning/Procedures**—This describes the materials needed for the experience and steps needed to complete the investigation.
- **Observations/Data**—This is what students record during the investigation. Students might draw as well as write what they are observing.
- **Student Reflection/Summary**—Reflections are written by the student after completing the investigation. The data and observations are used as the basis for a summary of what the student learned from the investigation. An answer to the initial question should be found in the summary.

- **“I Wonder” Questions**—Students record additional questions that can be used as the basis for future investigations.

We reminded teachers that not all components would be used during every investigation. Teachers were shown ways to identify which component best fits a given investigation. For example, if specific steps that needed to be followed were provided in a teacher's manual, the steps could be pasted in the students' science notebooks, which would take the place of the “planning/procedures” notebook entry. Or, if students did not have the necessary prior knowledge for making legitimate predictions, it would be inappropriate to ask them to predict.

After the introduction to notebooks, we viewed and discussed student notebook samples that we had gathered from other areas of the country where science notebook programs were already in place. These were gathered from classes with new teachers and from classes with veteran teachers. Teachers were asked to examine the entries to determine which components were evident in the sample. We hoped teachers would see the evidence of science content and process as well as the richness of the writing the students were producing.

Next, teachers created their own notebook entry. We felt it was important for teachers to experience the same process that their students would experience. This was done using an investigation from the FOSS Magnetism and Electricity module, a kit from our adopted curriculum. Teachers were asked to identify “what sticks to a magnet” using test items provided in the kit. No specific instructions were given to the teachers as to what should be included in the response.

Teachers were merely asked to find a way to record their data and to make sure they included a place for recording predictions before actually testing any items to see if they would stick to the magnet.

Teachers compared their entries in groups to identify the different components. They also looked for evidence of science content and process skills included in their responses. In every group, the teachers acknowledged the many opportunities for assessing other types of skills provided in the activity. Teachers noted that graphic organizers could be created, predictions could be made, procedures could be written, and summarization could be practiced. Enthusiasm for the process was evident in each workshop delivered.

## Connecting Standards to Investigations

Over time, it became apparent that teachers were not making strong enough connections between science standards and their notebook prompts. As a result, we made adjustments to show teachers some specific strategies for establishing the relationship between their grade level science content and inquiry standards and the investigation they are preparing to teach.

For example, teachers examined the national and state science standards, the lesson itself (in this case the FOSS Earth Materials kit), and any duplication masters that accompanied the lesson. They then identified a question to be used as a prompt, such as “Describe the properties of a mock rock,” based on the third-grade South Carolina standard: “Varied Earth materials have different physical properties and uses.” This type of request gives students a clear focus while helping teachers focus on the purpose of the lesson.

It also shows teachers how they can support mathematics and language arts instruction while teaching science. For example, while responding to this kind of question, students would have the opportunity to use measurement skills to describe the properties of their mock rock, such as finding the circumference of the rock and measuring its mass.

To support language arts instruction, students could generate a list of descriptors for their rock, such as “shiny,” “hard,” etc. We also recommend teachers have students create a table of contents at the beginning of their science notebooks. Students can also create a glossary at the back of their notebooks as another opportunity to further practice language arts skills.

In addition, teachers were shown tools for using science notebooks for instructional purposes. An example is a strategy called the “Line of Learning,” which takes place while conducting a whole-class discussion after students have written a reflection or summary of an investigation. Students draw a line under their reflection to indicate where their initial summary ends. They then

add new information they hear from the discussion below the line they have drawn. This requires students to actively listen to the discussion to ensure that any information they initially omitted is added below the line of learning. The discussion is richer when students are required to become more active listeners and participants by adding what they learn from their peers or have forgotten to record in their notebooks.

## Designing Prompts

Novice teachers often begin notebooking by framing their prompts directly from black-line masters. There’s nothing wrong with cutting and pasting—often critical vocabulary, diagrams, detailed drawings, and reference materials needed for completing an investigation are contained on duplication masters. However, we recommend using only the part of the black-line master that addresses the lesson being taught and then having students paste that part in their notebooks. That way, students still have space to add the drawings and reflections that personalize their entries.

As teachers became more proficient in designing prompts and implementing notebooks, they lessen their dependency on the duplication masters and look for additional opportunities to practice other process skills while integrating skills across the curriculum. A duplication master from an investigation that includes a graphic organizer does not give students the opportunity to design their own data collection method. Instead of using that part of the duplication master, the teacher can ask the students to design their own data collection method, which allows the teacher to see how they are progressing in this skill.

## Notebooks and Feedback

In the last segment of our workshop, we explored ways of providing feedback—an integral and necessary part of notebooking. Feedback is supposed to move students’ understanding to a higher level and create opportunities for students to respond to the feedback of the teacher, thereby extending their learning. It is also an opportunity for teachers to pose questions that will compel students to try to clarify their thinking and draw conclusions that will help them make meaning from what they have observed.

In our workshop, we stressed the importance of using science notebooks formatively rather than using them for summative assessment purposes. By reviewing the notebook entries on a regular basis, teachers can note student’s growth over time as well as identify any misconceptions or incomplete learning that needs to be addressed. Without this feedback, students might not view notebooks as a significant part of the instructional process and therefore not display their best efforts.

Feedback needs to be specific in nature and address the purpose of the lesson in order to be beneficial to the students. Once this process is in place and teachers are responding in a purposeful way to students, teachers can use this information to inform their instruction.

We suggested that teachers provide feedback on Post-it notes, which can be removed when the student improves the entry or adds the needed information to make it complete. Because the science notebook is a work in progress, we felt it would be better not to make permanent comments that would imply the information was permanently wrong. Students are encouraged to revise their entries to show that understanding is progressing. Most students like the notes, and many students create a permanent place in their notebooks for them, moving the notes there after adding the requested information.

## Lessons Learned

So far we have seen positive results as a result of this program: More science is being taught using state-adopted instructional materials, and more kits are being distributed from our science resource center. On our classroom and school visits we see science notebooks in use on a regular basis.

With the notebook strategies we taught, teachers are able to focus on the science being taught and see the purpose of the lessons they are teaching, while making connections across the curriculum. Teachers have come to realize that skills are skills regardless of the subject matter they are practiced in. Comparing and contrasting is done in science as well as language arts. Measurement is a tool that is an important skill in science that is taught in mathematics. Making inferences is a skill emphasized in all areas of the curriculum.

Notebooks are giving students real opportunities to apply the skills they are learning in language arts and mathematics in a productive way. Teachers are seeing that science motivates students to read and write. Students are writing about a common experience, which levels the playing field for them; learning styles are more easily addressed; and teachers have a consistent way of providing feedback that students can use to improve and increase their learning.

While we recognize that we are well on our way to seeing the science curriculum implemented on a regular basis, we still have a way to go. Some teachers still see the lessons as language arts lessons rather than opportunities to communicate science findings through an application of language skills.

Science notebooks will continue to be a priority for us because we have seen their benefits for students and teachers. Additional professional development is being designed to address expository reading skills and

## Connecting to the Standards

This article relates to the following *National Science Education Standards* (NRC 1996):

### Teaching Standards

#### Standard B:

Teachers of science guide and facilitate learning.

#### Standard C:

Teachers of science engage in ongoing assessment of their teaching and of student learning.

### Professional Development Standards

#### Standard B:

Professional development for teachers of science requires integrating knowledge of science, learning, pedagogy, and students; it also requires applying that knowledge to science teaching.

### Assessment Standards

#### Standard A:

Assessments must be consistent with the decisions they are designed to inform.

#### Standard B:

Achievement and opportunity to learn science must be assessed.

#### Standard C:

The technical quality of the data collected is well matched to the decisions and actions taken on the basis of their interpretation.

continue to enhance student achievement. Using science as the theme for teaching needed reading strategies works because students genuinely enjoy learning through science.

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## Resources

- Klentschy, M., L. Garrison, and O.M. Amaral. 2001. *Valle Imperial Project in Science: Four-Year Comparison of Student Achievement Data 1995–1999*. Research Report, National Science Foundation Grant #ESI-9731274.
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