# a MENU of options

## *Strategies for success with science notebooks in the primary grades*

*By Valerie Joyner*

Many challenges face primary teachers as they consider using notebooks with young scientists. "How do I start?" "What can I expect from students this young?" "Are they really capable of writing and recording data?" "How do I assess their learning?" Armed with a few topical and organizational strategies, primary grade teachers can successfully introduce their young scientists to science notebooks. I know—I did it myself! I developed creative and meaningful science notebook experiences for my second-grade students. The following overview of notebook methods offers a menu of options. Choose and customize what works for your classroom to provide students with the background and skills necessary to inquire, observe, test, and report.

## Organizational Strategies

### *Notebook Structure*

The first step is to determine what the science notebook will look like. I prefer to use three-ring binders for flexibility because students can add and move both teacher-created materials and workbook pages as needed. I have found that using bound notebooks requires the students to glue or staple in extra pages or tear out mistakes, leading to bulky and messy results. Instead, the young scientists add each new page to the back of the binder, allowing them to create a chronology of their science experiences and rearrange pages when necessary. At the end of the year, I spiral-bind the pages for each child to keep as a record of the science they have learned.

Other important early steps are to set goals to be met through the notebook activities and plan how the results will be assessed. By first identifying instructional goals, we can develop meaningful notebook experiences tied to desired outcomes. The most important goals I set for my students involve content and organization. These two goals are closely aligned. I expect each student to include all the content required for each lesson: their name, the date, and the specifics needed for the current activity (e.g., focus question, drawing, or whatever the day's lesson demands). I also require them to keep their pages in order in the binders and put sticky notes or flags at the beginning of each activity for easy reference. When students participate in activities and record their results and conclusions in an organized fashion, it is easier to check for meaningful understanding and determine whether there is a need for a concept to be revisited. Young scientists also experience how good organization makes it easy for them to locate their data for later use. For example, when recording and comparing monthly rainfall amounts throughout the year, students can compare totals at the end of the year by creating a graph. They see firsthand how keeping their data organized makes the comparison possible. This organizational aspect is also in play when students make predictions and follow up with procedures, results, and conclusions.

### *Scaffolding*

In the beginning, students feel more confident with a guide, so I scaffold their entries for the first few months. At this time of the year, I'm more interested in cultivating students' observation skills than in their developmental ability to write long or complex sentences. Early scaffolding helps students develop skills in recording observations. Sentence structures provided by scaffolding also help English language learners and students with special needs formulate their responses by giving them a pattern to follow.

I often start the school year with the life cycle of a monarch butterfly using a fill-in-the-blank approach for the first few entries. For example, the worksheets I create ask the students to provide detailed observations and written descriptions and drawings. This raises their awareness of these aspects of their experiences and allows them to spend more time on observations and to communicate accurately through writing, measuring, and drawing (Figure 1). Over the course of a few weeks, the children are given more opportunity to describe and record their observations. After group observations and discussion, we list keywords on the board, encouraging the children to master science terms and incorporate them into their writing.

Another strategy I use is incorporating word banks (including cognates) and graphic organizers into the beginning of the lesson. As the unit and year progresses, the students write more independently about their experiences with less scaffolding. Later worksheets feature open-ended questions and direct the students to create their own drawings, graphs, and data records.

### *Drawing, Dating, and Labeling*

Young scientists need to practice the critical skills of drawing and labeling scientific subjects. It's important to work closely with students to help them understand that science notebooks are a time for accuracy, not inventiveness. Students must date all of their work and draw accurate pictures with labels. A larva that is 1 cm should be represented and labeled as 1 cm (Figure 2). Initially, I model the process with them. For example, I show them how to measure a larva, draw a larva of the correct size, draw an arrow to the larva, and record the measurement at the arrow. The students copy my model as a notebook entry. Later, they learn to draw what they observe and record important data about their observations independently. They get accustomed to adding specific dates, names, and measurements. With practice and guidance, they begin to observe, report, and strive for scientific accuracy. For students who are unable to draw accurate detailed illustrations, support can be given with precut objects or templates. In some cases, I hold the ruler for the student and let them measure and then draw their subject with my help.

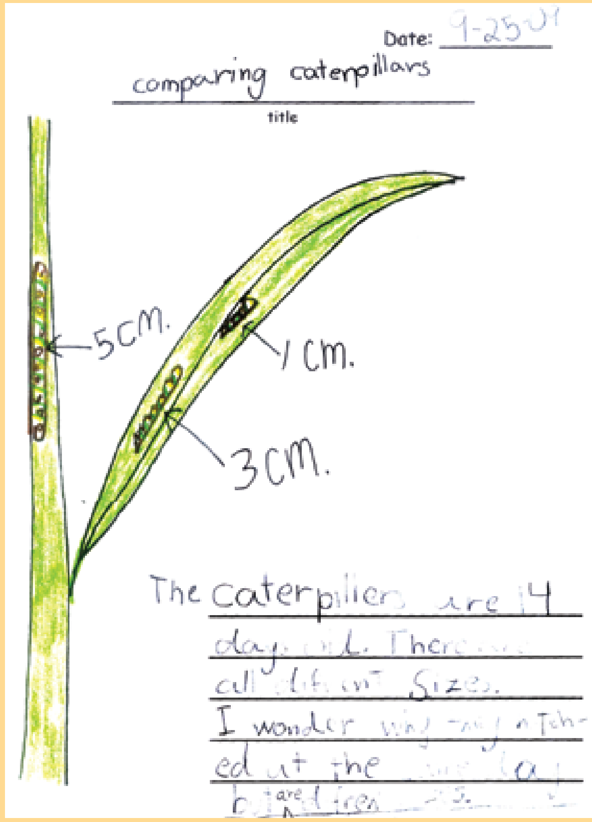
**Figure 1.**
An initial notebook entry showing fill-in-the-blank style scaffolding.

### *Table of Contents and Glossary*

It's easy to overlook the importance of organizational components, such as the table of contents and glossary, but both elements enhance cross-curriculum learning and save classroom time. With regards to the table of contents, have students create it as they proceed through each assignment or save that task for later in the school year. A third option is to have students create their table of contents during a language arts period. Another path would be for teachers to create strips with activity titles and space to record the page numbers. The students in turn glue the strip into their table of contents and fill in the page numbers.

A glossary is also an important element of an active science notebook. It's essential for students to record science vocabulary as it is uncovered in lessons and refer back to the words in an organized manner. I put the key vocabulary terms on a sentence strip prior to teaching a science activity. During the activity, as the students experience these new concepts, we post the written terms on the board. Throughout the activity, we develop the meaning of the new terms in group discussions. The children then write definitions in their own words and post the glossary terms at the back of their notebooks. Composing their own definitions after the hands-on experience encourages better understanding and retention of the newly introduced vocabulary. By the end of the school year, each student should have a usable glossary in their notebooks. These standard elements of published books tend to give the students a sense that their science notebooks are important, useful, and real.

**Figure 2.**
A later notebook entry showing accurate measurement, labeling, and use of an "I wonder" question.




## Topical Strategies

### *Focus Questions*

Before students begin a science experience, it's important for them to focus on a question. First we talk together as a group to develop a focus question. A good focus question narrows the scientific experience into a search for a specific set of conclusions. With a tight focus, students can practice collecting and sorting data without being overwhelmed by irrelevant details. At this age, guided by their teacher, students develop a focus question such as, "What do you notice about the monarch butterfly life cycle?" Then the young scientists record the focus question in their notebooks to guide their work.

It's critical to systematically talk through the focus question in a debriefing session after all science activities. This is when I work with the class to reflect on their observations, ideas, and experiences and determine a well thought-out response to the focus question. This vital task develops students' understanding of the focus question and ability to relate that to both the science experience and their conclusions.

The responses to focus questions can often be enhanced with accurate pictorial representations of the results. For

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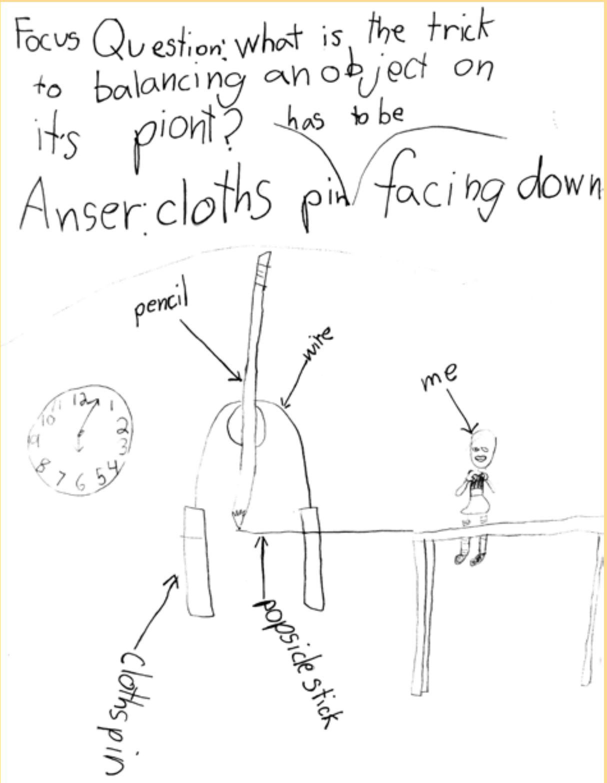
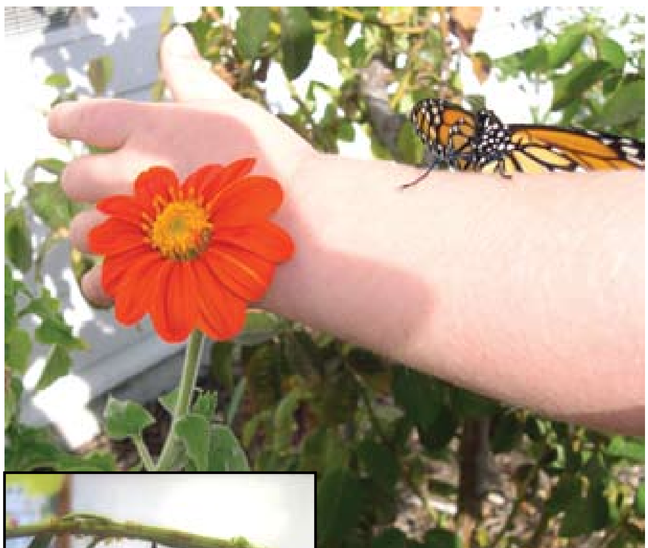
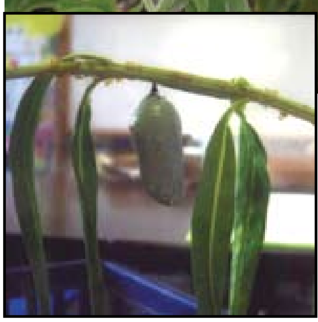
A monarch larva crawls along a plant stem.

**Figure 3.**
A focus question, answer, and detailed drawing.





A monarch butterfly rests on a student's arm. Monarch chrysalis in the classroom.

example, one focus question I use from the Full Option Science Systems (FOSS) Balance and Motion unit is "What is the trick to balancing an object on its point?" After the hands-on activity, the students draw a model representing their actual results (Figure 3). They can then refer to their drawing to answer the focus question. Teaching children to focus on a question helps them succeed as they progress through the grades and are challenged to hypothesize, infer, and generate their own investigable science questions.

### *Making Predictions*

Another essential skill for young scientists to develop is making predictions that relate to the focus questions and reveal key concepts. Predictions ask students to think about their prior knowledge and experiences and formulate in their own minds what they think will happen. Often they make a quick prediction without much thought, but the students' predictions should be followed by "because…" During the monarch butterfly experience, for example, a student made the following prediction after observing the tiny eggs: "I predict the eggs will hatch into aphids because they are so small." When *because* is added to the science writing it forces the students to give rationale to their predictions (even when incorrect), and the predictions become more meaningful. I have my students write their predictions in their notebooks using the "because…" structure at the beginning of science lessons. This gets them thinking about their prior knowledge of the topic and develops their ability to make predictions. After the activities we go back to our notebooks as a group and discuss our predictions and how they compare to the results we observed.

### *I Wonder...*

We have all experienced the curious minds of primary students as they ask endless questions. "How big will the caterpillar get?" "How many paper clips will the magnet hold?" "What will the seeds become?" We should capitalize on their curiosity. "I wonder…" questions allow young scientists to take ownership of their work, explore the discovery process, and develop their inquiry skills. Once they have posed their questions and recorded them, they've developed a personal investment and they want to know more.

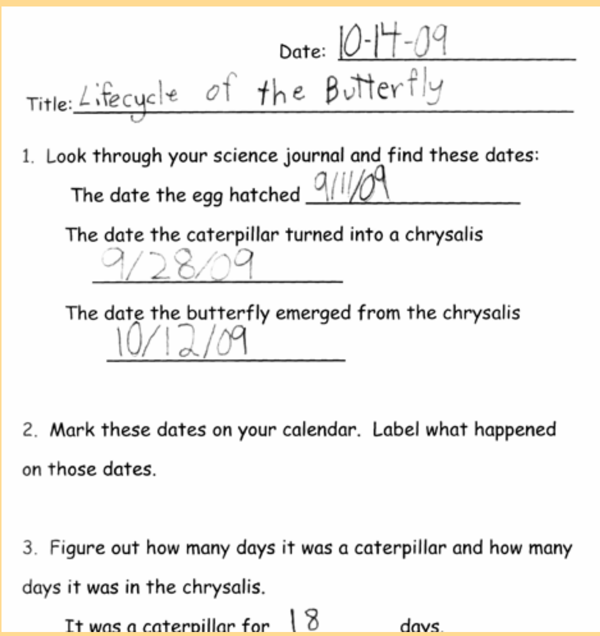
### *Calendars and Graphs*

As our young scientists develop their observation skills and learn to accurately record data, they become ready to work more deeply with their information. Using graphs, charts, and calendars, students plot recorded dates and use their data to answer focus questions, "I wonder" questions, and teacher-asked questions. As an example, after the monarch butterflies hatch in my classroom, students use their science notebooks to find the dates and data they recorded about the different stages of the life cycle (Figure 4, p. 33). They plot the data on a calendar

**Figure 4.**

a. Record of exact dates of the changes in a monarch life cycle.


b. Entries and organizational calendars are used to calculate results.



Date: 10-14-09

Title: Lifecycle of the Butterfly

1. Look through your science journal and find these dates:

The date the egg hatched 9/11/09

The date the caterpillar turned into a chrysalis 9/28/09

The date the butterfly emerged from the chrysalis 10/12/09

2. Mark these dates on your calendar. Label what happened on those dates.

3. Figure out how many days it was a caterpillar and how many days it was in the chrysalis.

It was a caterpillar for 18 days.

and use their calendars to answer questions about the length of each step of the life cycle.

Another class experience is collecting and recording rainfall. We use a class rain gauge to collect data about rainfall amounts. The children use this information to create their own rainfall centimeter rulers and record the amount. They plot the rainfall amounts that occurred throughout the year on a student-made graph. When students create graphs, charts, and calendars from the data they collect in their science notebooks, it deepens their understanding of science and the process scientists routinely follow.

## Start Small, Think Big

Science notebooks give vivid insight into students' learning and allow us to review firsthand their procedures, processes, results, and conclusions. At the end of each science experience, revisit the instructional goals and assess the outcome based on the students' notebooks. If the goal is accuracy in scientific drawings, one has immediate access to their pictures to measure their progress. A teacher can get a sense of their improvement in language skills from their written entries. From their writings and drawings we can shape our further instruction to ensure that student understanding is correct. The possibilities for detailed formative assessments from science notebook results are limitless.

Science notebooks are a comprehensive way to foster interest in learning, progress students in all curricular areas, and assess their multifaceted development. The question remaining is how we, as primary-grade teachers, can find the time to develop and use an active science notebook. Start small. Establish a few goals for the students and their notebooks. Look for interdisciplinary options and take a few steps forward. It's a worthy endeavor to include the use of science notebooks in any primary classroom at whatever level possible, so use and adapt these organizational strategies to customize a science adventure for your young scientists! ■

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## Connecting to the Standards

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

**Content Standards**

**Grades K–4**

Standard A: Science as Inquiry

- Abilities necessary to do scientific inquiry

National Research Council (NRC). 1996. *National science education standards*. Washington, DC: National Academies Press.