STC® Curriculum and the Role of Notebooks and Writing

Importance of Science Notebooks

Writing is one of the ways that children learn in science…When children explain what they have seen and why they think this occurs in writing, they are forced to clarify their thoughts and organize these ideas in a way that others can understand.

Jenny Feely
"Writing in Science"
Science & Language Links

Why is a science notebook important?

Science notebooks are important for many reasons. The first reason is that writing is an integral part of the process of learning science. By using notebooks, students model one of the most vital and enduring functions of scientists in all disciplines—recording data. Scientists across the world record their observations and conclusions, as well as comments on their readings and reflections. They rely on their notes when sharing their findings with peers and when preparing the papers in which they share their work with the broader scientific community. The notebooks of famous scientists such as Galileo and Albert Einstein have become part of the world's cultural heritage.

A second reason for maintaining a science notebook is that it provides the student with a ready reference during the unit as well as a resource to consult when reviewing materials at the end of the unit. The notebook is also a means of communicating with other students and with the teacher.

A science notebook encourages the students' creativity. Students are encouraged to draw as well as to write in their notebooks. Keeping a notebook also enhances students' writing skills. It gives them practice in organizing materials and in expressing themselves clearly. At the same time, notebook writing can encourage students to connect science with other areas of the curriculum. Extensions in the STC units, for example, ask students to write poems, stories, or songs, or to do research in related areas such as history and geography.

Another important aspect of students using notebooks is that the books provide a sense of accomplishment in the work they are doing on a daily basis. Most students take ownership of their notebooks in communicating what they have learned. Their confidence in learning science will be represented through their drawings, data, and written conclusions and reflections.

Finally, the science notebook offers both the students and the teacher a unique means of assessing their progress in science learning. The notebook, ideally begun during the first lesson of the unit and continued to its conclusion, is a tool that can be used to assess the growth in students' understanding of science as well as in their ability to summarize and capture their findings.

Science notebooks are tools for inquiry that allow children to frame questions and seek answers…They are to be used to identify student understanding and misconceptions about science concepts and to inform further practice.

Science Notebook Guidebook
Cambridge Public Schools
Cambridge, Massachusetts

Planning for Students Using Notebooks

What types of notebooks can students use?

Student notebook materials are diverse. Students may use a bound composition book or a loose-leaf notebook. Many teachers prefer composition books because they are similar to those notebooks used by scientists. Also, this format deters students from removing or deleting past records. Students can glue or tape their record sheets into the composition books. Other teachers prefer loose-leaf notebooks because they are more flexible. Folders with pockets and fasteners for three-hole paper also work well because they provide storage space for record sheets, graph paper, and other materials. If notebooks are not available, students can staple construction paper around blank or lined paper to create a notebook.

How should notebooks be formatted and organized?

You need to establish guidelines for ensuring a level of consistency with the format of and nature of entries in student notebooks to include the entries of date and time. Consideration should be given to including a table of contents. Students can allow several pages for this at the beginning of the unit. As students begin each lesson, they can then add the title of each lesson to their table of contents. Students also should number the pages consecutively throughout the notebook. For students using loose-leaf notebooks, tabs can help students organize their notebooks and locate specific sections more easily.

When talking about a good way to organize the notebooks, it is important to guide students in developing strategies that will result in a record of the basic components of their scientific inquiries. The components include

- question that is being investigated
- prior knowledge about the area of science
- predictions
- plan for conducting the investigation and the materials to be used
- record of observations and data (words, tables, graphs, illustrations, etc.)
- conclusions
- new questions
- reflections of what new ideas have been learned and what challenges exist

STC lessons generally end with a discussion, during which students share their findings and suggest additional questions to explore. When the discussion ends, you may ask students to return to their notebooks and to summarize, in their own words, the major ideas that have emerged during this discussion. Have students separate these final comments from their previous notes by a horizontal line, which is called the "line of learning."

When should writing in notebooks be incorporated into science lessons?

The times at which students record data and write in notebooks depend upon the expectations that have been established for students along with the nature of the investigations that are being conducted. When students are using their notebooks, it is critical that they be given sufficient time to write, and to make entries in conjunction with their science investigations and discussions.

As students conduct investigations, time needs to be established for them to record their observations and data, and to record their conclusions based on evidence. Students also should be given time to share and discuss their work with their peers. In addition, students can add their reflections at the end of each lesson and the entire unit in order to communicate what new ideas they have learned and what additional questions they would like to investigate.

What are some first steps in getting started?

Students who have not used science notebooks may need some initial guidance on how to use them effectively. You might want to begin by facilitating a brainstorming session designed to increase students' awareness of the importance of maintaining a notebook. Then present some guidelines such as those noted earlier.

Remind students that you will be reviewing their notebooks frequently to monitor their progress. At the same time, emphasize that the notebook is primarily for their own benefit. Stress that they should record not only observations and data but also questions and ideas they want to further explore.

Help them to understand that they should use their notebooks in two major ways. First, they should "take notes" on what they have seen, experienced, and concluded. These notes will include drawings, data tables, graphs, and other forms of recording observations as well as their

conclusions. As they work through the different investigations contained in each unit, students also should "make notes"—that is, ask questions and pose comments. Emphasize the importance of always writing clearly and of expressing thoughts in an organized way.

Explain that when you look at the notebooks, you will consider many things. You will look at how complete their entries are. You will also try to determine how much effort they have put into their answers and questions. For a science notebook, this is more important than the "right" answers. Students should think of the information in their notebooks as a rough draft; therefore, you will not assess them on the basis of style, correct spelling, or word usage. The notebooks should, however, be neat and clearly written. The notes that scientists keep must be readable by other scientists, and students' notebooks should meet this same standard.

Recording and Organizing Data

What does recording and organizing data look like?

In science, the need arises for students to record and organize the information they are gathering. Whether it is observing the weather or measuring plant growth, there is a variety of data involved in student investigations. In working with this data, there is a wide array of recording and organizational methods available to students. Some of those methods are

- notes and lists
- technical drawings and diagrams with labels
- charts
- tables
- graphs
- written observations

The most common methods are probably lists or quick notes that students record in their notebooks in order to capture the work they are doing. It is important for teachers to remember that these are the students' notes and they should not be subjected to the same criteria put upon other student writing. In real-world note taking, capitalization, punctuation, and grammar are not the focus, the content is; however, notes must be taken in a manner that makes sense. With this in mind, it is reasonable for teachers to expect students to make sense of their notes as well.

Thinking point: What organizational expectations will you have for your students as they record? How will your expectations change over time?

Figures 1 through 3 demonstrate three different ways students recorded and organized the same data.

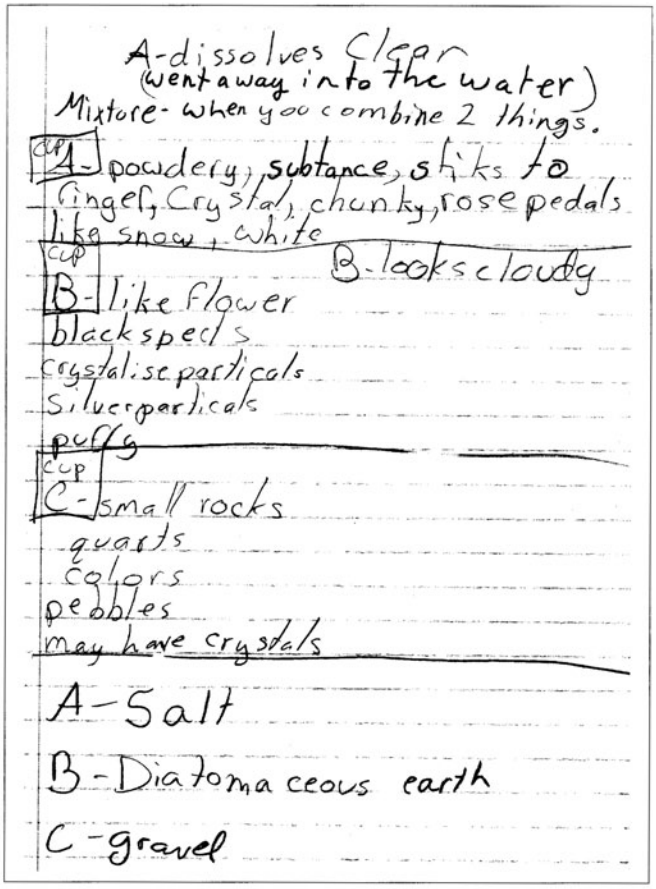

Figure 1 Three fifth-grade students represented observations on unknown materials in unique ways (see Figures 2 and 3).

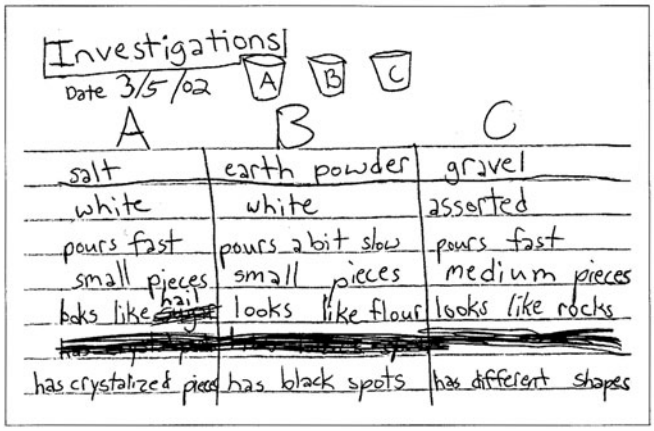

Figure 2 Three fifth-grade students represented observations on unknown materials in unique ways (see Figures 1 and 3).

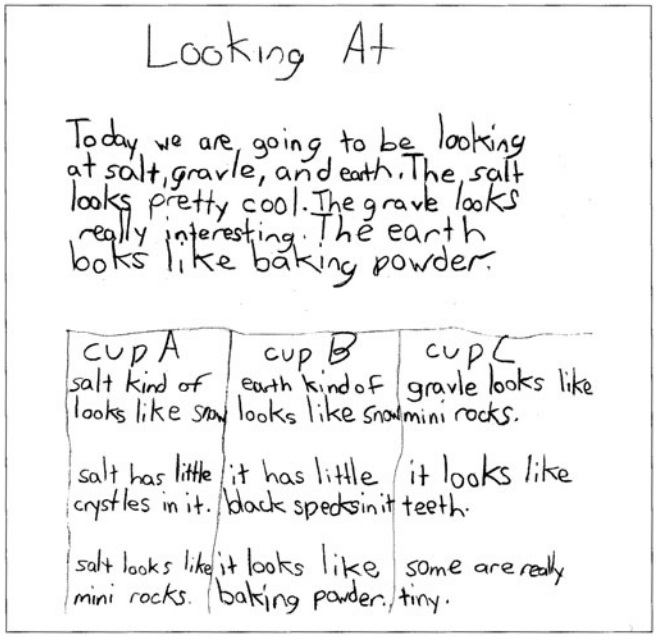

Figure 3 Three fifth-grade students represented observations on unknown materials in unique ways (see Figures 1 and 2).

How do students begin recording and organizing data?

Like scientists, it is important that students become comfortable recording during the science investigation—recording their observations and data while they work in order to reference the information later as they organize and analyze their results. To accomplish this, it is important that notebooks be available during an investigation. This means notebooks may get dirty, wrinkled, and wet; however, this creates the ability to record important information as it is being learned.

When students are first introduced to a material or to science notebooks, they may find it difficult to focus on recording. Therefore, it is important for teachers to provide students with time to experience and explore the material and then encourage recording. The following vignette examines the method one teacher used to introduce notebooks to his second-grade students.

Getting my second graders to record data was something that I knew was going to be a pretty hefty time investment; however, it was one that I considered to be worthwhile. It seemed that there were two ways to approach this task: (1) I could focus on the students and allow their ideas to guide the lesson or (2) I could build the lesson around my ideas and hope the students understood the concept. I decided I would place the focus on the students by watching their actions, listening to their conversations and questions, noticing what they chose to record, and helping them make sense of it.

On the first day of school, my class and I investigated insects, an area typically of interest for the students as well as myself. Before we started looking at the mealworm larva, I introduced the notebooks and set my expectations: students needed to record the date and any information they felt was important. I did not set requirements for recording; their instructions were to record anything they found important. Upon receiving the mealworms, their interest shifted from the notebooks to the mealworm; this I expected. I walked around, listening and discussing with them what they were seeing. They were all actively engaged in observing the mealworms. However, very few recorded their observations. I made a mental note at that time to provide them with time to record.

While new materials may pose a distraction to students, for many notebooks are new and students may struggle with ideas of how and what to record, students can be excellent resources for one another in this area. One way of exposing students to recording methods is to have students talk with a partner using their notebooks as references. This allows students to see other methods of recording and organizing information in a very informal way. Inviting different students to share provides opportunities for others to see

that a variety of techniques can be used effectively. The following classroom vignette describes this type of sharing and the impact it had upon the class.

After looking at the mealworms, the class met in a circle on the floor to discuss what they observed. A few students brought their notebooks. They started by talking with each other about what they noticed while observing the mealworms. The few that brought their notebooks shared with a fellow classmate what they recorded. When we began to share as a group, one of the students who brought their notebooks read directly from it. This sharing probably served as a stimulus for many of my students who had not recorded anything. I remember hearing one girl say, "Oh, I should have written that down."

As we finished our first day with the mealworms, I began to think about what may have prevented my students from writing in their notebooks.

- Did they have enough time to write?
- Did they know how to write in this context?
- Did they know what to write?

On the second day, we followed the same cycle of observation, followed by sharing. I noticed more notebooks being utilized to record observations and as a reference during discussions. I noticed, during partner discussions, that a couple of students recorded their observations using a list format, while others drew pictures. During the whole-group sharing, I asked for volunteers to show how they had recorded and organized their observations. As students shared, others observed how they recorded. I responded to each student by simply saying, "Thank you for sharing," avoiding any judgments.

Over the next few days, I noticed more and more students recording observations in their notebooks. The students who had trouble writing recorded with pictures. I began a word bank for commonly used words and placed it in the front of the room for students to refer to when they wrote. By the end of the first week, most students had recorded some information about their mealworms. My role was to take them further.

Thinking point: How do your instructional decisions impact what your students view as important?

When does the teacher actually teach recording strategies?

Getting students to record observations is the initial step; helping them expand upon the depth of their recording is the larger task. To take students beyond the initial stage, it will be important to model a variety of recording and organizational strategies. Students serve as excellent models for one another for methods with which they may have experience; however, additional methods can be provided through teacher modeling. This modeling provides students with resources to draw upon during future investigations. The minilesson, a short ten-minute lesson structured around a recording method that would be appropriate to use with the investigation, is useful here. An organizational tool, such as a table or chart, can be introduced to students by collecting class results and organizing them on the board. For example, while investigating properties of liquids, students recognize the need for an organizational tool. The teacher may choose to introduce a new strategy such as a chart in order to compare the properties of each liquid. After compiling data as a class, the teacher introduces the chart as one way to organize the data. Next, the teacher provides a skeleton of a chart, allowing students to determine the heading for each category. Once headings are in place, the teacher may model one or two examples of data entry before providing time for students to complete the chart with guidance.

What about the materials provided in the adopted program?

Still another way to share recording methods with students is to access resources available in an adopted program. Some programs provide student sheets to go along with activities; some of these sheets introduce students to new methods for organizing their data. Teachers may utilize these sheets rather than having students reconstruct a chart or table in their notebooks. Students use the sheets to record their data and insert them by folding the sheet in half and stapling it into their science notebooks. Some teachers reduce these sheets on the copier so

students can paste them on the pages of their notebooks. Others have made overheads of student sheets to provide those in need of a starting point an idea of one way to organize information without limiting their recording.

Technical Drawings

Technical drawings are "text elements that communicate meaning; they refine, clarify, and extend" student entries (Moline 1995, 16).

What are technical drawings?

Students are so accustomed to writing, often narrative text, that they do not think of drawing as a way to communicate their understandings. One method of recording that is often overlooked by both teachers and students is the technical drawing. Technical drawings are a powerful way to record observations and share information with others; they include more attention to detail than typical drawings. In order to draw something well, individuals must observe it closely, noting every small feature and fine line; capturing this type of detail in technical drawings enhances observation skills. The next three vignettes share a second-grade teacher's experience with technical drawings.

> While working with insects my students had spent some time observing wax worms. However, some of them were experiencing difficulty recording their observations for different reasons; some of them, being ESL learners or beginning writers, were limited in the words they had available to them. I realized my students were in need of another tool they could use to record their observations with more detail. We began to explore various drawing techniques.

What is the first step?

Many teachers believe they are not artists and do not feel they can use technical drawings to record their own observations, let alone help their students record observations with technical drawings. When drawing, many people use symbols, such as stick people or the circle flower, to represent an object rather than closely observing that object and drawing exactly what they see. Figures 4 and 5 show the difference between a symbol and a technical drawing. However, with a little practice and guidance, everyone can experience success with technical drawings and go beyond recording a symbol to recording a detailed drawing.

In order to help students be successful with technical drawings, teachers need to offer them support. A guided drawing is a process in which the teacher and students look at an object together and discuss what they see. The teacher draws the object on the board and encourages students to draw along on their own papers. At this beginning point, many of the drawings will look similar; that is fine. Through guided drawings students are gaining experience with the tools of drawing as well as realizing the observational skills needed to draw an object accurately. This initial support is crucial. If teachers simply ask students to draw technically without providing them with the tools, the outcome will be frustration for both the teacher and the students.

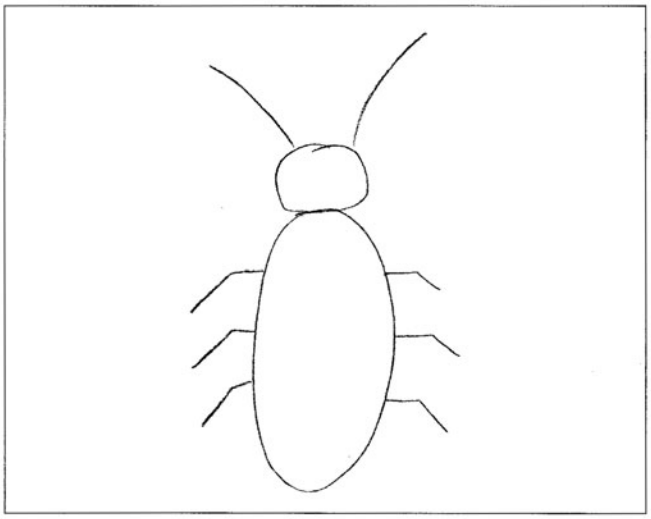

Figure 4 Symbol of an insect

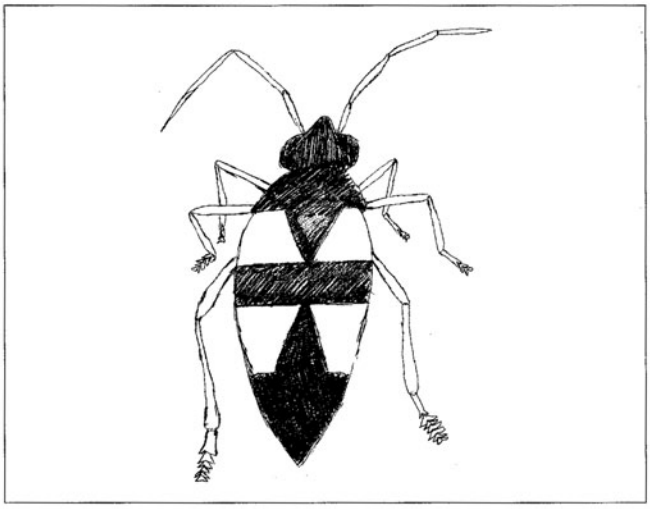

Figure 5 Technical drawing of a milkweed bug

To begin guided drawings, the teacher and the students look closely at the object that is to be drawn. They notice how parts of the object (a head, a wing, etc.) resemble basic shapes (square, rectangle, circle, oval, triangle, rhombus). They examine the entire object, noting the various shapes that are present, and choose the largest or main shape of the object and draw that on the paper. Once it is down on the paper, the teacher and students soften the sides or reconfigure it slightly so the appearance matches that of the object more closely. They then continue to add to their drawings by using basic shapes that are modified slightly to more closely match the object. This process, or the stages of a technical drawing, is shown in Figure 6.

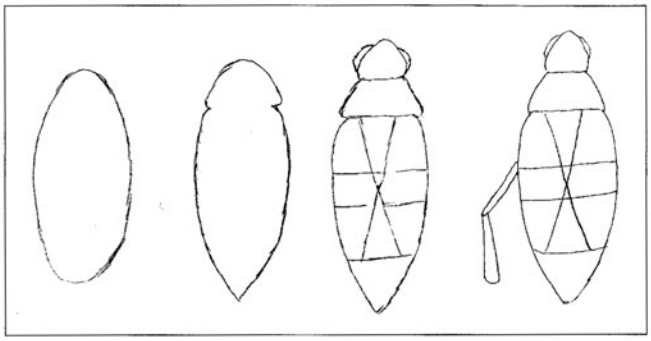

Figure 6 Beginning stages for technical drawing of a milkweed bug

What other types of support do students need?

A support that many find helpful to use is a blackline master of the object being drawn. It is easier to see lines that have already been drawn than it is to find lines on an object. Many curricula offer drawings of the various materials with which students are working. Using a copier, the teacher enlarges these drawings, if needed, to a point that students can easily see the shapes and lines present. When using a blackline master to guide the drawing, it is important for the teacher to emphasize that this is one interpretation of the way the object looks and that it is only a guide. The students must examine the original object closely, perhaps with the use of a hand lens, and add details that might be different from those included on the blackline copy.

Through close examination of a blackline master, my students began to look at the wax worm differently. Looking for shapes allowed them to describe it more efficiently than their previous description of "round." When comparing the actual wax worm with the blackline representation, the students started to see that different parts of the wax worm were different shades and the different parts had features they had not noticed. Using hand lenses, they saw hair extending from the wax worm's body. They noticed "holes" on the sides of the wax worms. These features were then incorporated into their drawings.

Figure 7 shows one student's drawing from this lesson.

Proportion is another important factor to examine. In order to draw an object accurately, students need to pay attention to the proportions of the object. When drawing an insect, students look closely at the size of the head in comparison with the body. Then they examine where the legs are attached to the body. Teachers can ask questions to focus students and help them to record their observations more accurately. For example: "Are there markings on the body that would help in placing the legs? How far apart are the legs? Where does one leg end in relationship to another?"

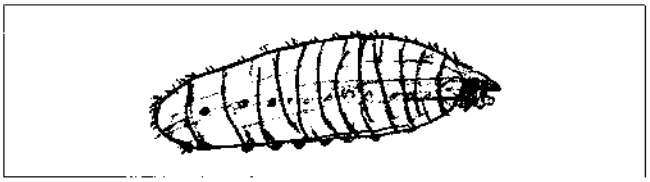

Figure 7 A second grader's technical drawing of a wax worm

Thinking point: What opportunities within your curriculum allow students to use technical drawings?

Once students understand the techniques of technical drawings, it is important that the teacher builds the opportunities for practice. Many students find it easy to communicate with drawings, but those who may still not consider

themselves artists may forgo technical drawings unless encouraged to include them in their notebooks. Later, when students are comfortable with drawing, they will begin to freely include technical drawings in their notebook entries. They will use the tools mentioned earlier (proportion, shapes, blackline masters) to create original drawings. As teachers, it is important to be patient and understand that completing technical drawings is worth the time they take. It is important that students be provided with the time to record their observations by drawing and that they are sometimes asked to represent their thinking using drawings.

Although some students (as well as myself) could not draw very well, I noticed that looking at the details and attempting to recreate them on paper brought forth new ideas and concepts, such as spiracles. Throughout the year, my students had many opportunities to draw many different things. Often they asked if they could draw the details like they did with the wax worms. They did not always include such details, but when they had the time, they did. They noticed more and more details and recorded more and more details, not just with words, but also with drawings.

Thinking point: How do technical drawings fit in with how you teach science?

What other ways are technical drawings used to enhance understanding?

Technical drawings provide a wealth of information to the readers. Drawings can be enhanced through the use of labels. "Labeled diagrams work like glossaries and they can be a more powerful tool than vocabulary lists…the words are supported by the pictures which help to define or explain the meanings of the words especially for very young students or those students who are learning English as a second language" (Moline 1995, 23). By asking students to draw and label an object rather than label a worksheet, teachers gain a better idea of the students' understanding and of what they are able to do independently. The components students include in their drawings, or those components they leave out, provide the teacher with a window into what children see as important. Creating their own drawings with labels is by far more challenging and worthwhile than labeling existing diagrams and allows students to utilize informal terms or formal vocabulary.

Students' Questions

When we interact with the materials, there are inherent questions in our actions with those materials. (Dyasi 2002)

What are students' questions?

In science, students raise different types of questions; some questions are about directions or procedures, while others capture a curiosity—a need to know why something is the way it is. Questioning takes place between students as well as between the students and the teacher. There are also times when the questions students ask are never spoken nor documented in writing. Obviously, some students' questions lend themselves to science investigation more than others. As teachers of science, it is important to capitalize on this curiosity and students' natural questions, bringing awareness to questions that can be investigated and working with students to recognize and record them.

What can be done to help students recognize their questions?

Often, students don't recognize that they have a question they are exploring; rather, they see it simply as an attempt to determine how something works. When students are manipulating materials, the teacher can help students recognize the questions they are asking. By talking with them, the teacher can discover what their students are thinking and help them reword their thoughts as questions. The following vignette describes how a fifth-grade teacher guided a group of students to recognize their questions.

As my students were exploring pendulums, I noticed a group that was changing the height from which the pendulum was dropped. I went over to their table and asked them what they were investigating. The students responded, "We want to see if it will swing longer if we drop it from up here" (indicating a higher location than the original starting point).

"Oh, so you want to see how changing the starting position affects the length of time the pendulum swings?" By rephrasing the question in this way, I changed it from a yes or no question to an open-ended question.

How do I help students record questions that are worthy of investigation?

Once students begin to ask their own questions, the teacher should model the importance of capturing these questions for future reference. A class "research board" serves as a place to capture students' questions. During the early stages of forming questions, students often create queries that can be answered with yes or no. It is important to call their attention to this and begin to work at rephrasing these questions in order to make them more open-ended because open-ended questions allow thinking to be extended beyond the initial question. If a child asks, "Do turtles like lettuce?" the teacher may rephrase it as "What food does the turtle prefer?"

As students become comfortable asking open-ended questions, they then begin to explore the difference between questions for investigation and research questions. One way to do this is to have the students record their questions on sentence strips. The teacher then categorizes the questions with the class according to those that can be answered by further work with the materials versus those that require consulting an expert (book, person, Internet, etc.). Once students have an idea of the two categories, they can continue to sort their questions. It is important for students to understand the difference between the two types of questions in order for them to continue to investigate independently. The following vignette shares how a teacher worked with third-grade students to sort their questions.

After providing students with opportunities to develop questions, the teacher asked them to share their questions with one or two of their peers. This sharing time allowed students to hear what others were exploring while exposing them to various questioning styles. As other students' questions sparked their interest, students began recording them in their own notebooks. The teacher then asked students to select two or three questions from their notebooks to record on sentence strips, which they hung around the room. Together they sorted the questions into the teacher-selected categories of "can be answered by working with the materials," "must be answered by an expert or book," and "not sure." The teacher and the students reworded those questions that were placed in the "not sure" category and then added them to one of the two other columns. At this point, students had created questions they could investigate.

Thinking point: What are reasonable expectations for your students in terms of developing and recording questions that can be investigated?

What do students do with their questions once they are recorded?

Questions are the heart of a scientific investigation. The investigation may actually begin with a teacher- or program-generated question, but it is the students' questions that fuel the desire to know more and do more with their investigations. Students may come to the end of an investigation to find that they are only just beginning and that the work they have done has actually generated more questions than it answered. By keeping those questions in their notebooks, students are able to refer back to them during future investigations, as scientists do. Figure 8 shows how one student recorded questions within the notebook.

The following vignette explains a teacher's thinking on the importance of students' questions.

> One of the biggest motivators for my students in recording questions was the opportunity to investigate their own questions. After the first investigation based upon their own questions, students began recording more questions in hopes of being able to investigate them.

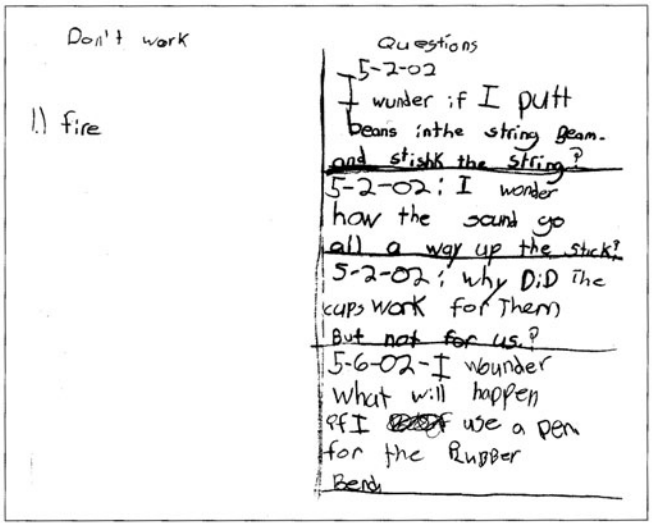

Figure 8 A sample of recorded questions in a fourth grader's notebook

Recording Thinking

What does it mean to record thinking?

As students work in science, they are gathering data that is essential to their work. At some point, it is important that they attempt to make sense of their data, to examine what it means, why their results may differ from others, and how they plan to proceed. By asking students to record their thinking, teachers are asking them to do much more than simply reflect on the activity—they are asking their students to reflect on their thought processes and how they came to their way of thinking, to use data collected as evidence to support or change ideas about concepts, and to share questions they now have.

What does it look like when students record their thinking?

While some students may record their thoughts using complete sentences, most will use fragments. Students' thinking may be recorded as predictions, conjectures, hypotheses, conclusions, or drawings. Some students embed their thinking throughout their work while others synthesize their thoughts at the end. It is important to remember that children are individuals and need to record their thinking in a way that makes sense to them, as shown in Figures 9 and 10.

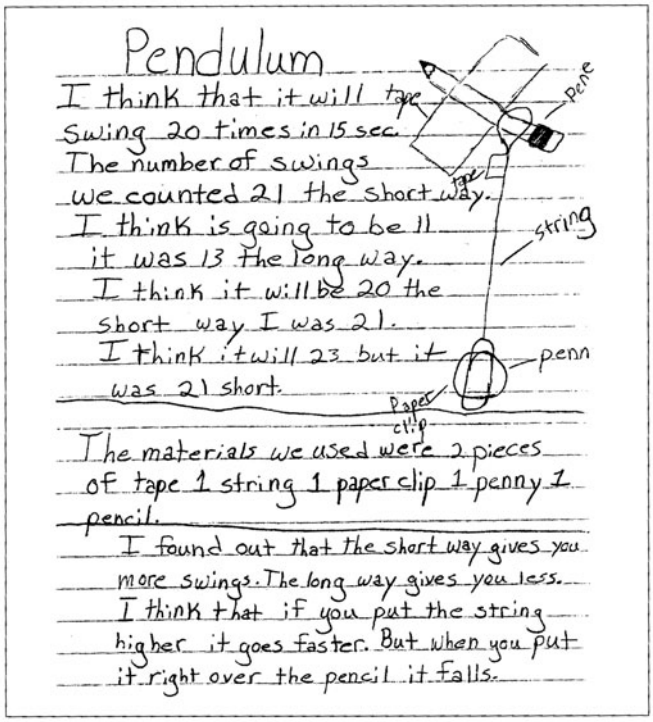

Figure 9 A record of a fifth grader's thoughts while working with a pendulum for the first time

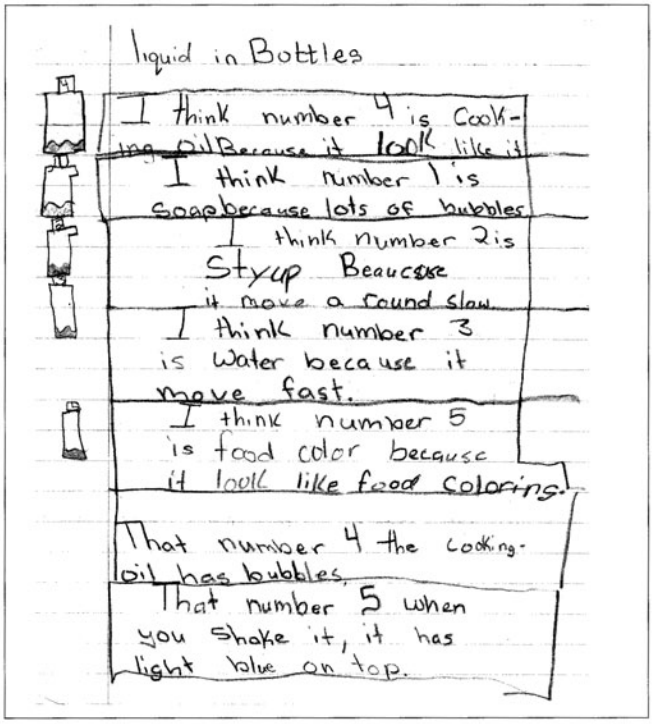

Figure 10 A record of a fourth grader's thoughts while working with bottles of various liquids

Thinking takes place before, during, and after an investigation. Thinking before the investigation involves planning the investigation, predicting what may happen, and connecting ideas to prior experiences.

Considering outcomes before the investigation guides students to look for evidence that will prove or disprove their thinking during their work. How students record their thinking during the investigation differs from how they record observations; students have to not only communicate what they are observing but interpret that information and process it. Initially, this may be difficult for the students; however, with time and practice they will improve. After the investigation, students record their thinking as

- reflections on what they noticed and how that may impact future investigations
- concrete thoughts based on the evidence gathered
- new understandings based on what they have learned
- questions resulting from the recognition of gaps in their thinking
- ideas of what they will try next

The following vignette describes how two fourth-grade students explored their thoughts.

> The summer school extension academy began at 8:30 each morning during the last three weeks of June. About a week into the academy, one student started arriving at 8:15 each morning. He would take out his notebook and begin to independently write. As other students started to arrive and look at their materials from the previous day, he would continue to write, reflecting on his experiences from the prior day and recording his gathered thoughts about where he would begin that day. During the final week, a second student joined in this morning ritual. Together, they would sit and share their notebooks, discussing and recording their thoughts.

How do students record their thinking?

Recording thinking is not an easy task for students; many understand what is happening but struggle when it comes to translating their thoughts into words. Figure 11 shows a student's attempt at recording thinking. One way to support students is to provide them with time to discuss and write with a partner or small group about their ideas. During these discussions, they examine each other's notebooks and gather evidence of how they might record their thinking in their own notebooks.

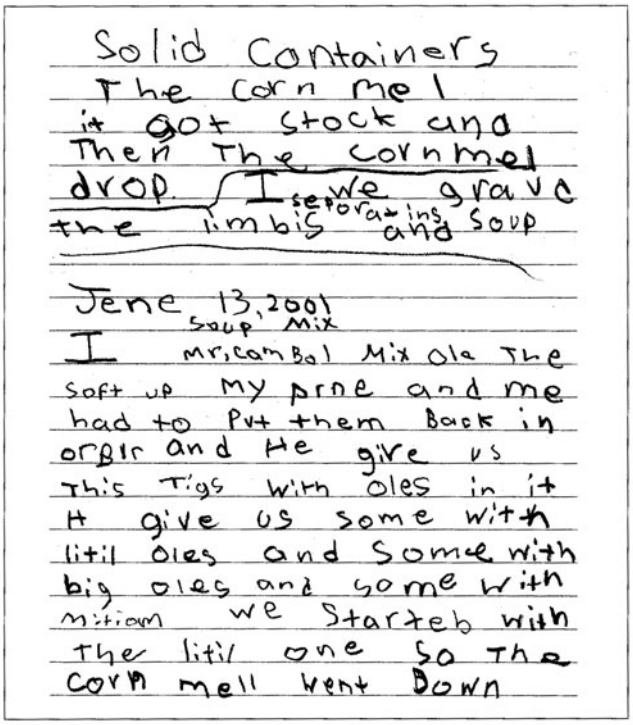

Figure 11 A fourth grader's initial attempt at recording thinking demonstrates action and some thought.

In the following vignette the teacher explains how second graders worked in groups as they explained their thinking.

After discussing their observations on air in containers, I asked the students to share their thoughts on what they observed. After ten minutes of sharing, the students recorded their thoughts on why they believed the air acted the way it did. Their writing contained hypotheses that were supported by their observations.

As they wrote, the students shared their thoughts in small groups. Students found this sharing time beneficial, especially if they had difficulty putting their thoughts into words. Over time, more and more students began sharing and recording their thinking on their own. I started to hear my students say, "Hold on, I just had a thought. I need to write it down before I forget it," or "What she said reminded me of something I was thinking." Students started to link their new thoughts to prior thoughts as well as other students' thinking—very similar to what scientists do.

How much time is needed for students to record their thinking?

Students should be encouraged and given time to write in their notebooks before, during, and after an investigation. Students cannot be expected to synthesize their thinking in thirty seconds; time must be built into the lesson. How this is incorporated into the lesson varies. Sometimes specific time needs to be set aside for students to record their thinking, and at other times it needs to be embedded in the investigation. If students don't have time to record their thinking, their notebooks may become just logs of data.

Thinking point: How and when will you provide time to reflect?

Other Elements

What else might be included in science notebooks?

Science notebooks are collections of information gathered over time. There are some basic elements of notebooks that help document the process students are going through and should be included with every entry. These include

- date
- time
- heading (topic, title, or question)

Each of these elements aids students when they look back at entries and analyze their data; therefore, it is a good idea to establish the habit of including these elements with every entry.

There are other elements that are not essential to science notebooks; however, they may be powerful tools for the students to use from time to time. When working with materials students may find it helpful to collect samples, when appropriate, and include them in their entries. A leaf sample, insect molt, or results from a chromatography experiment may be taped in for future reference. When a sample is not a viable option, students may want to consider including a rubbing of the object in order to capture the texture of it.

There are times when neither a sample nor a rubbing is possible, and a drawing would be too difficult. In these situations a photo might capture the event (digital cameras allow for immediate viewing). Students like to include photos in their notebooks, so it is important for teachers to think carefully about the use of this technology. For some items drawings may be more appropriate than photos, as drawings require close observation and attention to detail.

Photos can also be used to capture those moments when students are so engaged with the materials that recording in their notebooks would be difficult. The photos can be inserted into their science notebooks, and students can use them as prompts to write about the experience. This type of writing is called photojournalism and is a motivating tool for students.

Thinking point: When is a photograph a hindrance and when it is a help in learning the science content?

We felt so happy about what we did! We banged the tuning fork on the wood block and put the tuning fork next to the ping pong ball and it bounces! Because it was new! We used a tuning fork , a wood block and a ping pong ball . The ping pong ball is touched by the vibrating tuning fork .We know that the tuning fork is viberating by feeling it move and seeing it move.

Figure 12 A sample of photojournalism

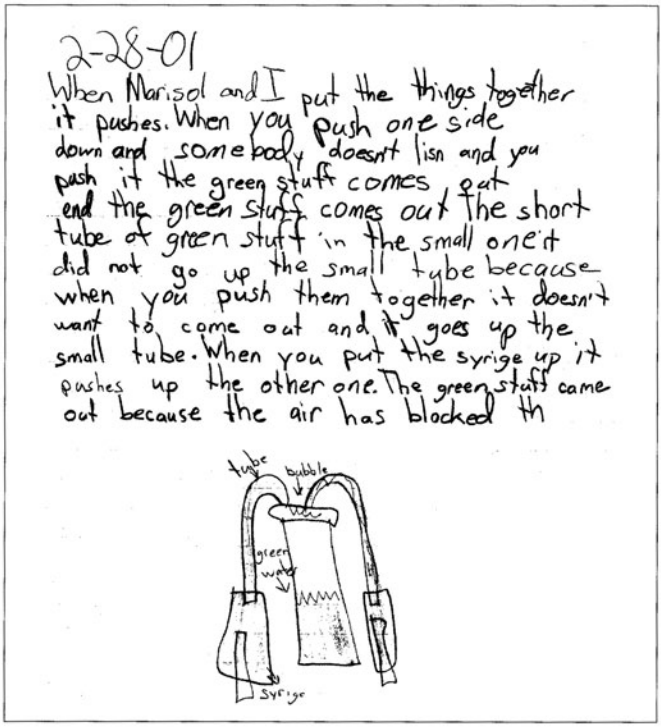

Figure 13 A second-grade student drawing of what materials were used along with written details about the investigation.

It is important that students are able to recall the materials they worked with in an experiment; however, students do not always need to write a materials list. Quite often students include the materials they used within the explanation of what they did or within drawings and the reader needs only to extract that information, as shown in Figure 13.

Elementary teachers are always looking for ways to integrate curricula and many teachers have pulled various features of expository text into science notebooks. These include the table of contents, glossary, and index. If teachers choose to incorporate these features, they need to consider how they will be utilized and if the time spent setting them up will be worthwhile.

Thinking Point: How will students make use of expository text features (glossary, index, etc.) in future lessons?

Assessing Student Learning in Notebooks

The primary goal of the notebooks is to have students, with the guidance of their teacher, use them as a tool to assess their own learning in terms of their

- conceptual understanding of science concepts
- ability to organize ideas and information in writing
- recognize the connection between thinking and writing

As a part of this process, it is important to check students' notebooks often. Glance at the notebooks during class and collect them periodically for a more thorough review.

You may give feedback to students in many ways. Some teachers prefer to use Post-it Notes™; others write on the notebook page itself; others may prefer to enter their comments in the back of the book. Use a color that is distinguishable from the black or blue that students generally use (green is one idea); it's best not to use red ink.

Some teachers ask students to bring their tape recorders to school so they make their comments into the recorder.

Make your feedback positive and constructive. Grade students for the completeness of their work and for their effort. Do not grade ideas as "right" or "wrong." Misspellings or grammatical errors should not be circled or criticized in the notebook. Date and initial all your written comments.

To bring objectivity to the assessment process, some teachers use rubrics. A simple assessment rubric is as follows:

Rubric for Assessing Science Notebooks

STANDARD	SCORE
Date and purpose of inquiry	
Appropriate prediction	
List of materials	
Sequence of procedures	
Diagrams and labels	
Chart or data table as it corresponds to student's results	
Conclusions as they relate to data and answers to the inquiry questions	

3 = Achieved the standard with honors.
2 = Achieved the standard.
1 = Achievement below the standard.
0 = No evidence of achievement.

Conclusion

Student notebooks fill many roles. They promote students' science learning and give students an opportunity to enhance their writing skills. They help students better appreciate the process of scientific inquiry. They help students organize their learning and, by the end of the unit, realize how much they have learned. For teachers, notebooks are a unique means of reviewing student learning.

These guidelines should help you and your students take full advantage of the many benefits that student science notebooks bring to the STC classroom.

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Acknowledgment

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