How do scientists use science notebooks? How will I use one? These are questions students might have when introduced to a science notebook. Many times students are given the task of keeping a science notebook, but do not fully understand the process or purpose of this endeavor. Science notebooks contain not only data but also questions, predictions, observations, and reflections from their experiences in science.

Effective science teaching involves students making observations and using these observations along with past experiences to create their own personal knowledge. Communication of this personal knowledge is crucial. Students communicate this knowledge verbally with their peers and teachers, but writing these ideas is the next step in solidifying their understanding of science content. The benefits of writing in science are obvious, but what about younger students who are new to the process of writing? Or ELL students who have language barriers that make writing difficult? To maximize the effectiveness of the science notebook, teachers must provide scaffolding for students as they learn to write in a science notebook, just as they would for any form of writing.

Safety Considerations With Mealworms

- For more information on the care of mealworms, visit: www.sialis.org/raisingmealworms.htm
- Each group should have their own container of mealworms that they observe each week. Small, disposable plastic containers work great for this. Just make sure there is adequate bedding (oatmeal) and air holes for ventilation. We numbered the containers to correlate with the student group number to ensure that each group observed the same mealworms each week.
- For weekly observations, we encouraged our students to put the contents of their containers on foam trays and use spoons to move the contents (mealworms, skins, pupa) around.
- If students do touch the mealworms, they need to wash their hands after observations.
- Treat live or preserved animals or animal parts with care to avoid harming the animals or yourself.
The IMSCI model for scaffolding writing in language arts can also be used with a science notebook (Read 2010). IMSCI includes Inquiry, Modeling, Sharing, Collaborative, and Independent phases. To illustrate how the IMSCI model can be used in an early elementary classroom, we’ll describe a six-week unit on insect life cycles completed with first graders at the beginning of the school year.

**Background**

The concept of life cycles is taught in most early elementary classrooms. Students have often heard stories of caterpillars turning to butterflies or tadpoles to frogs; however, many students have never closely observed a mealworm and have no idea that they are even insects. For this reason, we chose to study mealworms for our unit because this would be an opportunity for students to use their inquiry skills to create new knowledge about the life cycle of an unknown organism.

To document their inquiry experiences, students would be using science notebooks. Many of the children in this first-grade class had writing difficulties, so writing independently in a science notebook would have been a daunting task without the scaffolding provided through the IMSCI model. We created a class notebook for modeling and shared writing, had students work with a group notebook for collaborative writing, and encouraged them to write independently in their own notebooks.

**“M” is for Modeling**

The next stage is to model for the students the entire process of writing a notebook entry—not only the writing parts of the entry, but also the “think-alouds” that occur before and during the writing process. Through modeling, teachers can explicitly show the role this internal dialogue can play in the final written product.

Modeling was implemented with the first graders in their first drawings of the mealworms. On the first day of the unit, students observed mealworms. We did not tell them that we were completing a life cycle unit because we did not want the students to know that the mealworms were going to change. Working in cooperative learning groups, the students were given several mealworms on a paper plate. Students were told that these organisms are called mealworms and were asked to make observations of this new organism. With a hand lens, the students examined the external features of their mealworms. From those initial drawings, we found that drawing “scientifically” was a new skill for these first graders. We took out a flipchart

We showed several examples of science notebook pages written by students at the same grade level, bringing to students’ attention the different types of entries and organizational elements found in science notebooks. We also read the fictional story *A Crack in the Night* by Marcy Skinner with Kimberly Lott and Max Longhurst (2010). This story is about a boy using a science notebook to discover what goes “crack in the night.” The boy is a regular kid using a notebook for scientific study, reinforcing the idea that you do not have to be a scientist in a lab to use a notebook.

**“I” is for Inquiry**

When introducing a class to science notebooks, lead the students in an inquiry activity, the first phase of the IMSCI model. Before we began our unit on insect life cycles, we asked the question “What is a science notebook?” Many students answered, “I don’t know” another answered, “a notebook you write stuff in about science.”

We then started our inquiry into science notebooks. We explained that scientists use science notebooks to record information about the natural world. We read the children’s book about a famous scientist *Neo Leo: The Ageless Ideas of Leonardo Da Vinci* by Gene Barretta (2009). Leonardo Da Vinci was not only an artist, but also an inventor, engineer, and scientist who made thousands of notes and drawings that would become modern day inventions like airplanes, automobiles, contact lenses, and many more. The book beautifully illustrates the drawings taken from Da Vinci’s notebook alongside the modern-day invention the drawing inspired.

We have also found that sharing examples of science notebooks written by children is appropriate. We downloaded sample pages from student notebooks at *Science Notebooks in K–12 Classrooms* (see Internet Resource).
and modeled for the students how to draw and label a picture of a mealworm in the “class notebook.” We spoke aloud (e.g., “It looks like a worm, but it has a hard shell” “The shell looks like it has parts, so I need to make sure I draw that” and “It is moving with what looks like legs, but the legs are not on the entire body, just in the front.”) and then made a large drawing of a segmented body and labeled the legs in the class notebook. After modeling, the students made another drawing of a mealworm in their science notebook beneath their original drawing (Figure 1). As you see from Figure 1, the initial drawing was small and with few accurate details. After modeling, the student drew the picture larger with more details and included labeling. In some cases, students added their own labels in addition to the ones listed in the class notebook drawing (e.g., a student added “tail” to his diagram to indicate the tail of his mealworm, which was not in the modeled drawing.)

“S” is for Sharing

Shared writing is when the teacher is the scribe for the students as they compose aloud. Shared writing can also be combined with modeling when the teacher starts out writing a notebook entry, but the students help finish composing the entry.

During the second week of the unit, the students observed their mealworms again and wrote a shared entry in the class notebook. To guide their inquiry, we wanted them to focus on specific questions when observing their mealworms. We started out by writing two questions on the class notebook flipchart:

• “Is a mealworm really a worm?”
• “How does a mealworm move?”

We asked the students to think of other questions that they wanted to know about mealworms. The student questions—“What do mealworms eat?” “Can they see?”—were then added to the class notebook.

Working in cooperative groups, the students observed their mealworms again looking for evidence that could be used to answer the questions in the class notebook. They used plastic spoons to move the mealworms around the plate to watch their movements. They also used the spoons to see whether the mealworm could “see” it if it were placed in its path. They used hand lenses to look for “eyeballs.” After their observations, we answered the questions through a whole-group discussion and recorded student responses in the class notebook (Figure 2).

“C” is for Collaborative

Collaborative writing occurs when students write in pairs or groups on one notebook entry. Collaborative writing entries can also be between teacher and student, but the most feasible method for most elementary classrooms is collaboration between students. This form of writing is especially effective in a diverse student classroom to help meet the learning needs of all students. For
example, more advanced student writers can be paired with less skilled writers. Also, ELL students can work with other students, which will provide support in the form of comprehensible input and meaningful repetition (Neuman and Koskinen 1992).

Students made weekly observations of their mealworms over the next four weeks and documented their findings in a “group notebook.” Students were asked to observe and document any changes that they observed in their mealworms or mealworm containers. The students would spend several minutes observing their mealworms on a paper plate and talking aloud about any changes that they observed. After the observations, the group would make a collaborative entry in the group notebook. Students worked together in groups of four with each one being a scribe for one of the weeks. These entries varied by the skill level of the scribe, with more skilled writers using more written language (Figure 3a), and less skilled writers using more numbers and pictures in their entries (Figure 3b). A checklist was used to monitor student progression during these four weeks of collaborative entries (Figure 4, p. 50).

Students observed a variety of changes during the four-week observation period including changes in mealworm color (some lighter or darker than previously observed); changes in mealworm size; changes from mealworm “shells” at molting stage to pupa stage; changes from pupa stage “shells” to beetles; and changes in beetle coloring (from lighter to darker). We let students use whatever vocabulary they wanted to describe their mealworms. In some cases, students already knew terms like molting when they observed skins of their mealworms. Other times, they used terms like thingy to describe the pupa stage of the life cycle. A word wall with content-specific terminology generated during these hands-on observations can be helpful when students are composing notebook entries.

“I” is for Independent

This is the phase in which students write their own entries in their science notebooks. Because the students have participated in inquiry, modeling, and shared and collaborative writing, they will be more successful when writing entries independently.

During the final week of mealworm observation, it was time to put together the life-cycle of the mealworm. We read Monarch Butterfly by Gail Gibbons (1991). We modeled for them how to draw a life cycle of a butterfly (egg, caterpillar, pupa, and butterfly) in the class notebook. Using the evidence they had collected in their group notebooks the previous weeks, the students then independently drew the life cycle of the mealworm including egg, mealworm, pupa, and beetle in their own science notebooks. We noticed that the more skilled writers put only words in their cycles (Figure 5a, p. 51) and the less skilled writers used invented spelling and pictures in their cycles (Figure 5b, p. 51). We went on to explain the more scientific terms...
for the mealworm (larva) and the beetle (adult) stages of life. The scoring rubric for the final independent entry can be found online (see NSTA Connection). We ended the unit by asking one of the initial questions, “Are mealworms really worms?” The boy in the class who was the most insistent at the beginning of the unit that they were worms because they were “squirmy” answered, “No. They are really beetles!”

**Final Thoughts**

This unit was completed at the beginning of the year with children who had little experience with science notebooks; therefore, it was the perfect unit in which to illustrate every step of the IMSCI model. However, the IMSCI model can be adjusted depending on the levels of your students. With older students, teachers can start with an inquiry and then decide, based on the students’ abilities, the next step in the scaffolding process. More skilled writers may need little modeling and sharing, so a class notebook may not be necessary. A group notebook for collaborative writing might be a more appropriate starting point.

Science notebooks are students’ personal records of their learnings about the world around them and also provide teachers an effective method for assessing and giving feedback (Ruiz-Primo, Li, and Shavelson 2002). When students are just beginning to use science notebooks, scaffolding in the form of modeling, shared writing, and collaborative writing will provide the needed support as they learn the features that can be included in a notebook.

---

### Figure 4.

**Checklist for collaborative entries.**

<table>
<thead>
<tr>
<th>Week</th>
<th>Basic</th>
<th>Proficient</th>
<th>Advanced</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Data entered in a random pattern, not organized. Only records ideas when prompted. Ideas recorded may be both accurate and fictional.</td>
<td>Data is more organized (i.e., titles, groupings). Drawings present with labels. Sentences added to describe thinking. Less prompting from the teacher. Ideas recorded are accurate.</td>
<td>Data is organized in a thoughtful manner that can be justified by the student (not just instructed by teacher). Method of recording data takes on many different forms including drawings, sentences, charts, and tables.</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Is a Mealworm Really a Worm?

Connecting to the Standards

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

Content Standards

Standard A: Science as Inquiry
- Abilities necessary to do scientific inquiry

Standard C: Life Science
- Characteristics of organisms
- Life cycles of organisms

Internet Resource

Science Notebooks in K–12 Classrooms
www.sciencenotebooks.org

NSTA Connection

For a rubric, visit www.nsta.org/SC1201.

Figure 5.

Independent writing samples: (A) Skilled writer and (B) less-skilled writer.


Kimberly Lott (kimberly.lott@usu.edu) is an assistant professor of science education and Sylvia Read is an associate professor of language arts, both at Utah State University in Logan, Utah.

References


If teachers do not scaffold students as they learn to write in their science notebooks, students may become confused, not because they misunderstand the science concepts, but because they may be uncertain about how to write in a science notebook. For this reason, the written entries in a science notebook may not accurately reflect the students’ actual scientific knowledge. To assess what students have learned in their science notebooks, they have to adequately communicate this knowledge through their writing and visual representations. By using the IMSCI model, teachers can be more confident in their assessment of science content in science notebooks because they know that the students have had adequate scaffolding during the writing process.

entry. If teachers do not scaffold students as they learn to write in their science notebooks, students may become confused, not because they misunderstand the science concepts, but because they may be uncertain about how to write in a science notebook. For this reason, the written entries in a science notebook may not accurately reflect the students’ actual scientific knowledge. To assess what students have learned in their science notebooks, they have to adequately communicate this knowledge through their writing and visual representations. By using the IMSCI model, teachers can be more confident in their assessment of science content in science notebooks because they know that the students have had adequate scaffolding during the writing process.

Kimberly Lott (kimberly.lott@usu.edu) is an assistant professor of science education and Sylvia Read is an associate professor of language arts, both at Utah State University in Logan, Utah.

References


