Students as Authors

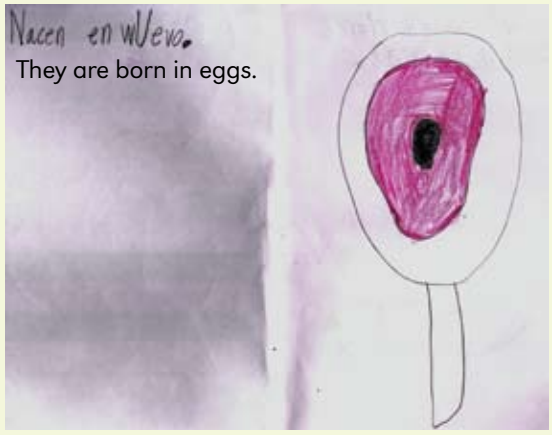
Illustrated science information books created during integrated units are windows into student understanding.

By Maria Varelas, Christine C. Pappas, Sofia Kokkino, and Ibett Ortiz

Are you looking for ways to effectively integrate—and assess—science and literacy learning? Try having your students create their own books! The Integrated Science Literacy Enactments (ISLE) approach to teaching and learning science is one way to develop students' science understandings while simultaneously enhancing their communication skills. We have extensively implemented this approach and studied it in two science units—one on matter and another on a forest ecosystem—with classes of first- through third-grade students in Chicago public schools. The ISLE approach engages young children in science through hands-on explorations and numerous literacy-oriented learning experiences, including read-alouds of children's literature information books; keeping science journals; creating a class semantic map; dramatic role plays; home projects that include literacy and hands-on components; reading other information books in small-group literature circles and presenting new, interesting ideas to the class as a panel; and more. Each unit culminates in the writing and illustrating of an information book on a topic of students' own choice. The book serves as a tool to assess student understandings developed throughout the unit and is the focus of this article. While the experiences discussed here took place in curricular and instructional units using the ISLE approach, the discussion is relevant to any science learning experience that culminates in the creation of a nonfiction science book written and illustrated by students.

Figure 1.

A page from the book "Ranas/Frogs."



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Illustrated Information Books

When students created their end-of-unit books, they had already spent around eight weeks learning about various aspects of the unit theme in a wide range of ways. In *Matter*, children study solids, liquids, and gases; their properties; similarities and differences among the three states of matter (both at the macro level and at the micro level, namely how molecules behave); examples of each state in everyday life; changes of states of matter, such as freezing, melting, boiling, evaporation, and condensation; and how rain is formed (i.e., the water cycle). In *Forest*, children study a temperate forest community; animals that live under and above the ground, seeds, plants, and food chains and webs; and interactions among living and nonliving entities.

You can read synopses of the Matter and Forest units online (See NSTA Connection).

After completing each unit's activities, the students were given the following directions regarding the construction of their own illustrated information book on a topic of their choice:

Write about a part of what we have studied in the unit—something that other students who haven't studied this unit would like to read.

Your book should include both writing and drawing, like the books we read.

You can look at the class semantic map, your journals, and other things we created during the unit, but this book should be your own book on a

topic that you are interested in, not something that you have copied from other books.

You won't be able to write/draw about everything we studied, so you will decide what to include. In making your book, you should think about what ideas you want to explain in writing and what ideas you want to explain in pictures.

Teachers can use any of their favorite ways to make a blank booklet for this activity. We folded four 8.5 × 11" sheets of white paper along the longest side and stapled them along the fold. We spent about one week creating the books. First, we reviewed as a class all the activities we had done in the unit and put out all the information books that we had used for read-alouds or literature circles. Children had the freedom to work first on their pictures or on their text, depending on what made most sense to them. If children were stuck, we asked them to tell us about some of the ideas we talked about in the unit, and as they were talking we pointed out to them that any of their ideas could be good for their books. Usually, children did not have trouble coming up with more ideas after they started on their first page. We avoided providing specific feedback or help on their book content, writing, or illustrating, because we wanted to use the books as a major summative assessment tool.

Books as Assessment Tools

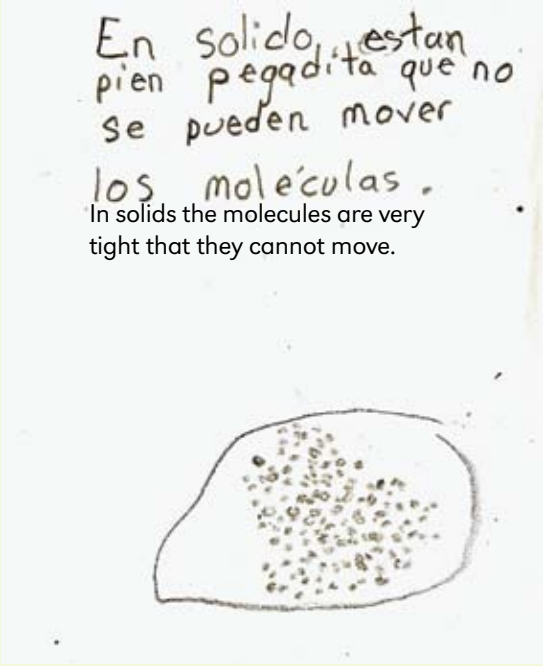
After students create their books, we have individual conversations with students about them. An alternative is to have children read their books to the whole class or in small groups and talk about their text and pictures. These books—and the conversations around them—offer teachers an opportunity to explore what children think and have learned about particular ideas of the unit (Varelas, Pappas, and the ISLE Team 2006).

In our individual conversations, we ask students to share their book with us, reading it page by page and explaining their pictures (what the different elements of their pictures are, why they decided to draw these pictures, why they used particular sizes, colors, shapes, etc.). The pictures communicate scientific understandings that students may not be able to express in words, so we treat the illustrations as elements of meaning rather than "embellishments" of the text. In this way, we get a richer sense of children's ideas while also demonstrating for students the idea that pictures in scientific texts are significant and important (Pappas et al. 2008).

There are various dimensions that can be assessed in the children's information books. To accurately assess scientific knowledge presented in such books, it is necessary to examine and interpret

Figure 2.

A page from the book "La Materia/Matter."



In solids the molecules are very tight that they cannot move.

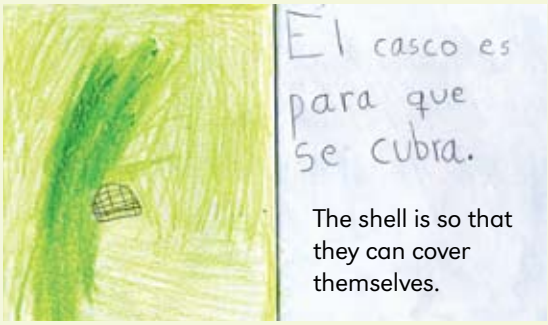
Figure 3.

The opening spread from the book "Tortugas/Turtles."

The turtle[s] walk slowly.

Figure 4.

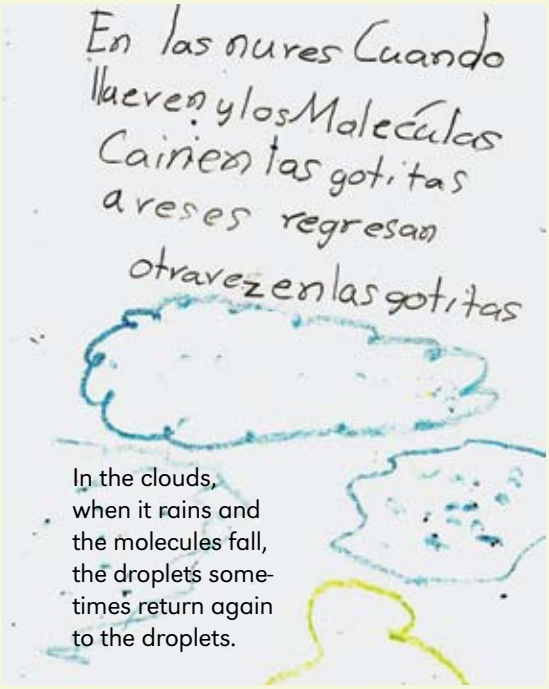
The second spread from the book "Tortugas/Turtles."



The shell is so that they can cover themselves.

Figure 5.

The last page of the book "Todo Sobre Moléculas/Everything About Molecules."



In the clouds, when it rains and the molecules fall, the droplets sometimes return again to the droplets.

both text and pictures and to consider and assess a book not on a page-by-page basis but rather as a whole, related artifact. Here, we focus on how to assess children's scientific ideas developed during instructional units.

The following examples are from children's books from the Forest and Matter units created in Ibett Ortiz's second-grade bilingual class. As the students were speakers of Spanish who were learning English, she allowed them to express their ideas in Spanish. In the examples below, Spanish text has been translated into English. All students' names are pseudonyms.

Lazaro wrote a book entitled "Ranas/Frogs" in which he portrayed his ideas of metamorphosis and characteristics of frogs. His book began with the text: "They are born in eggs" (Figure 1, p. 58). His picture featured a dark, filled-in circle surrounded by a red membrane. During our conversation about the book, Lazaro specified that around the red membrane there was a "magnifying glass" allowing an up-close view. He added that the frogs were "in the egg with the jelly…and they are not mammals… [because] they are born in eggs."

From this page and the conversation about it, we know that Lazaro has learned that frogs start off as eggs and that frogs' eggs have a certain characteristic—jelly that surrounds the frogspawn. We also know that he understood that frogs are different from mammals, which are not born in eggs.

In another example, Flor wrote about "La Materia/Matter" and expressed some ideas in both text and pictures and some ideas exclusively in pictures. For some concepts she revealed emergent, or developing, understandings, and for other concepts she showed correct understandings. For example, on one page of her book (Figure 2) she wrote about molecules being very tight in solids, so tight that they cannot move, an idea she reiterated during her conversation with us. This molecular closeness was also depicted in her illustration with the small dots all positioned right next to each other. Flor's idea that molecules in solids are not moving at all is not accurate—molecules in solids actually move *very* slowly. However, relative to liquids and gases, which Flor presented in the rest of her book, a solid's molecules are practically stationary, so this idea should be considered emergent.

In contrast, Flor revealed her correct understanding that a solid's molecules are very close. In addition, what Flor's picture communicates that her text does not is her understanding that solids have distinct shape. In the illustration, she has drawn a distinct boundary around the solid that she called a

"rock" during the conversation.

A third example is from Cesar's book "Tortugas/Turtles." Cesar communicated many of his understandings about turtles in both text and pictures. He also introduced some of his understandings, and then he reinforced them in pictures only throughout his book. For example, on one page (Figure 3, p. 59), Cesar wrote correctly about turtles walking slowly, and in his picture he depicted a turtle participating in a footrace versus a person who clearly won. Cesar also depicted the turtle's body parts correctly, including its flippers, shell (upper carapace), head (including eyes and the mouth), and tail. On a later page (Figure 4, p.60), he revealed more of his understanding of turtles' shell functions as protecting them and providing camouflage because the shell blends into the green background.

A final example from this class is Leonara, who wrote a book entitled "Todo Sobre Moléculas/Everything About Molecules." On her final page (Figure 5, p. 60), she wrote, "In the clouds, when it rains and the molecules fall, the droplets sometimes return again to the droplets." In the picture, Leonara represented droplets as small blue dots in the clouds as well as floating freely in the air. In our conversation about the book, she stated, "When it's raining…the cloud fills up and when the Sun comes…the same little drops go up to the clouds." Using Leonara's text, pictures, and conversation, we know that she understood the idea of the water cycle (even though she did not use this term) as the same substance (water) being in the clouds and evaporating from the ground. However, she did not indicate understanding of any changes of states associated with the water cycle—liquid to gas (vapor) and vice versa, indicating emergent understanding of the water cycle.

Reflections

These children composed interesting and detailed books that showed what was salient for them and how they made sense of ideas explored and developed in the units. As a culminating activity and an assessment tool, the books enable teachers to see what ideas students chose to communicate and how they do so in words *and* pictures. Such student-created books can serve as a summative or a formative assessment tool. If used as formative, teachers could revisit with the class the ideas that the students' books revealed to be less well formed than others.

Teachers can easily score such books by creating a list of the main ideas explored in a unit and assigning one of three scores (0, 1, 2) to each idea addressed in a student's book. A 0 can be assigned for a totally incorrect idea; a 1 for an emergent, developing idea; or a 2 for a completely correct idea. Of course, students may not address all ideas in their books, and for those not addressed they will not get any score. A total score for their books may be calculated by averaging the scores they receive on the ideas they addressed.

Connecting to the Standards

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

Teaching Standard A:
Teachers of science plan an inquiry-based science program for their students. In doing this, teachers: Select teaching and assessment strategies that support the development of student understanding and nurture a community of science learners.

Assessment Standard D:
Assessment practices must be fair.
Assessment tasks must be appropriately modified to accommodate the needs of students with physical disabilities, learning disabilities, or limited English proficiency.

As these books revealed, children may own scientific ideas without naming them in scientific terms. This is important to remember and consider for all students—including those in bilingual classrooms, like those whose books we described in this article, who made sense of English read-alouds, coordinated them with hands-on and other experiences predominately in Spanish, and wrote and discussed their own books in Spanish. The creation of such books—and their assessment—should focus on authentic understanding of scientific concepts rather than translation and memorization of vocabulary terms and should focus on *both* words and pictures. Meeting this goal and seeing the pride in students' ownership of their books was worthwhile in many ways. ■

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Acknowledgment

The ISLE program development and research has been funded by a four-year (2004–2008) U.S. National Science Foundation (NSF) ROLE (Research On Learning and Education) grant (REC-0411593). The data presented, statements made, and views expressed in this article are solely the responsibilities of the authors and do not necessarily reflect the views of the National Science Foundation.

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NSTA Connection

To read synopses of the ISLE Matter and Forest units, visit *www.nsta.org/SC0803.*