

My World and Me: Evaluation of a Model for K-2 Integrated Science

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ABSTRACT

An interdisciplinary model for providing science and health instruction to students in grades K-2 was created and evaluated by scientists and educators at Baylor College of Medicine. The model was evaluated as a unit on “Needs of Living Things,” which included 10 sequenced science explorations and a story book. The field tested unit covered science topics related to the differences between living and non-living things, and introduced the basic needs of plants and animals (air, food, water and a place to be/shelter). The unit was evaluated in a field test with 18 teachers and 394 students in Texas and in the Washington, DC area. Field test results suggest that the unit was effective in promoting student learning of science content, and in developing specific science and language skills.

INTRODUCTION

The National Science Education Standards (NSES) recommend that students have opportunities to experience science through inquiry from the earliest grades (NRC, 1996). As noted by NSES, young learners explore the world by observation and manipulation, and are able to describe, compare and sort as they learn. While they may have difficulty using evidence to formulate experiments, young students are able to follow linear sequences of ideas and to observe variables one-at-a-time (Lowery, 1990). These skills are different from the abilities of slightly older students, who are able to make inferences, classify objects into subgroups, and understand relationships among variables. Thus, instructional materials designed for upper elementary school students are not necessarily effective for instruction with students in grades K-2.

The elementary science curriculum development team at Baylor College of Medicine began addressing the challenge of creating age-appropriate science and health instructional materials for K-2 students in 1998. With funding from the National Institutes of Health, we explored ways to create teaching materials that would reflect recommendations of the NSES, be appealing to teachers and students, and allow teachers to integrate science and health instruction with other subject areas. The resulting *My World and Me* series and instructional model combines guided inquiry lessons with health, reading, language arts and mathematics. The *My World and Me* model, described in the following sections, was evaluated and refined through focus groups and the field-testing of a unit on requirements of living organisms (“Needs of Living Things”). A second unit, “Resources and Environments,” currently is being field-tested.

DEVELOPMENT AND FIELD TESTS

The interdisciplinary model for *My World and Me* was based on the *My Health My World*[®]

science and health curriculum, also created at Baylor (with funding from the National Institute of Environmental Health Sciences). Each of the four *My Health My World* units (indoor air, water pollution, global atmospheric change, and food safety and nutrition) consist of an illustrated adventure story, a guide to activities, a reading/language arts supplement, a mathematics supplement, a take-home mini-magazine to be shared with parents, and a materials kit. *My Health My World* project materials are in use in schools in more than 30 US states and are being disseminated through a demonstration project in Houston called the Environment as a Context for Opportunities in Schools (ECOS) (Moreno, et al., 2001). The challenge for the development team was to create a model that would be as acceptable and effective with K-2 audiences as *My Health My World* is becoming with grades 3–5.

For each *My Health My World* unit, project scientists and educators generate a list of key concepts to be taught, and then submit the list to an external panel of scientists and teachers for suggestions. After concepts are developed, a draft activities guide for teachers and a storyline are created and subjected to a similar review and revision process, which may be repeated several times. External reviewers in specialized areas are consulted as needed. Final drafts are developed into versions for field-testing, which are designed to look and feel similar to the final products, so that appearance does not influence field test results. After field-testing by teachers and students, the materials are revised and submitted again to project advisors before publication (Moreno and Tharp, 1999).

A similar development process was followed for *My World and Me*. The goal is to produce materials that integrate science, health, reading/language arts and mathematics around important biological and environmental science themes. However, we introduced an additional step to the development process for the first unit, “Needs of Living Things.” Once a draft unit consisting of 10 student activities and a student story had been created, the unit was submitted for review by a focus group assembled by the American Physiological Society in Washington, DC. This group, consisting of 15 Kindergarten through second grade teachers and early childhood educators, made numerous suggestions about the appropriateness of the story and the proposed student activities. In particular, the focus group recommended that (1) the unit focus more on individuals, (given the egocentric nature of young children); (2) the discussion of needs vs. wants take place much earlier in the unit; and (3) activities be re-designed to be more student-driven, instead of teacher-driven. These and other recommendations were reflected in a completely revised draft that was field tested in Washington, DC, Houston, TX and other locations in October-November, 2000.

The field test version of “Needs of Living Things,” covered the differences between living and non-living things, and introduced basic needs of plants and animals (air, food, water and a place to be/shelter). Science standards for young students addressed include: objects have many observable properties, which can be measured; organisms (animals and plants) have basic needs; there are differences and similarities between plants and animals; and individuals have responsibility for their own health. The storybook, “Tillena Lou’s Day in the Sun,” had a small cast of characters consisting of Tillena Lou, a pond slider turtle, and her brothers. Using a repetitive, rhyming format, the story introduced the basic needs of all living things. “Tillena Lou’s Day in the Sun” was intended to be published as a big book (large format book, designed

to be used by a teacher in the front of the class), but the field test version was produced as an 8 1/2 by 11 inch, spiral-bound book with provisional color sketches by the artist.

The guide to activities included ten sequenced activities, beginning with an open-ended pre-assessment of student knowledge. The pre-assessment asked students to draw pictures of themselves, and to include any items that they, as living things, might need to live, grow and survive. Other activities included growing and observing radishes (needs of plants), observing and comparing candy “gummy” worms and earthworms (needs of animals), creating puppets of plants and animals (differences between plants and animals), making a nutritious snack (food for people) and lemonade, creating and observing bubbles (to learn about air) and playing a concentration-type game in which animal and plant cards were matched to habitats/homes. The unit also included a post-assessment that repeated the drawing assignment used for the pre-assessment.

Eighteen teachers and 394 students in grades K through 3 in schools in Washington, DC, and Houston, Austin, and San Antonio, Texas participated in the field tests. The student population was 3% Asian, 27% African American, 30% Hispanic, 37% White and 3% representing other groups. Field tests were conducted as part of normal science classroom activities led by teachers. Each field test teacher completed a detailed questionnaire about the unit. In addition, teachers administered pre- and post-assessments about needs of living things that were included as classroom activities within the unit. These were graded and reported using a standard rubric.

FIELD TEST RESULTS

Teachers expressed a high level of satisfaction with the draft unit and gave it a mean overall rating of 4.3 (st dev = 0.75) on a five-point scale (in which 5 = excellent). Ratings of specific aspects of student hands-on activities are given in Table 1 below.

Table 1. Teachers’ evaluations of “Needs of Living Things” activities guide. Each aspect of the guide was rated using a scale of 1 to 5, in which 1 = poor, 2 = fair, 3 = uncertain, 4 = good, 5 = excellent (N = 18).

	Mean	St Dev
Readability of the Activity Guide	3.89	1.18
Adequacy of background information	4.50	0.51
Clarity of instructions for teachers	3.89	1.18
Interest level the activities evoked in students	4.67	0.59
Appropriateness of activities for your students	4.44	0.62
Effectiveness in teaching concepts to students	4.22	0.73
Effectiveness in helping students develop problem-solving skills	4.11	0.90

When asked to rate each of the 10 hands-on activities individually, teachers rated each at or above 4.3 on the same five-point scale described in Table 1. Ratings of the storybook, which was not evaluated as a “big book,” were somewhat lower. Format, illustrations, usability and type size were rated between 3.5 and 4.0 on the five-point scale. These results are believed to reflect the provisional nature of the storybook that was tested. Teachers did rate the clarity of the science concepts introduced by the story at 4.2 (st dev = 0.8). Teachers spent an average of 2.1 hours of class time using the story and an average of 12.3 hours on the activities.

After completing the unit, teachers reported that their students had increased their understanding of several science concepts and had demonstrated increased abilities to perform science skills. These outcomes are presented in Tables 2 and 3.

Table 2. Teacher reports of student content knowledge development. Teachers answered the following statements using a scale of 1 to 5, in which 1 = strongly disagree, 2 = disagree, 3 = uncertain, 4 = agree, 5 = strongly agree (N = 18).

After using this unit, my students demonstrated increased knowledge about:	Mean	St Dev
living vs. nonliving things	4.30	0.59
the needs of plants	4.50	0.62
the needs of animals	4.50	0.51
human needs vs. wants	4.33	0.91
habitats	4.24	0.90
differences between plants and animals	4.33	0.84
the importance of air	4.61	0.50
the importance of water	4.67	0.99
the importance of food	4.61	0.50

Table 3. Teacher reports of student science skills development. Teachers answered the following statements using a scale of 1 to 5, in which 1 = strongly disagree, 2 = disagree, 3 = uncertain, 4 = agree, 5 = strongly agree (N=18).

After using this unit, my students demonstrated increased abilities to:	Mean	St Dev
solve problems as part of a group	3.71	1.02
make and record observations	4.06	0.54
use a magnifier	4.00	1.21
follow directions	4.08	0.57
draw conclusions from their own observations	4.39	0.50
ask questions	3.97	1.01
use tables and charts	3.72	0.96
make predictions	4.33	0.49

Teachers also were asked about development of students' language skills, as shown in Table 4.

Table 4. Teacher reports of student language skills development. Teachers answered the following statements using a scale of 1 to 5, in which 1 = strongly disagree, 2 = disagree, 3 = uncertain, 4 = agree, 5 = strongly agree (N=18).

After using this unit, my students demonstrated increased abilities in the following reading/language arts skills:	Mean	St Dev
mastery of new vocabulary	4.39	0.70
listening critically	4.11	0.68
communicating ideas in a variety of ways	3.89	0.96
using descriptive language in writing	3.67	0.97

identifying cause and effect relationships	4.17	0.62
following directions	4.17	0.86
differentiating between fiction and non-fiction	3.89	0.96
identifying or sequencing the order of important events	3.89	0.83
drawing visual images based on text or oral descriptions	3.69	1.20

100 percent of field test teachers stated that they would use equivalent *My World and Me* units as part of their curriculum in the future.

Of the 394 students participating in the field test, 152 students completed both the pre- and post-assessment drawings in class. As described earlier, students were asked to draw pictures of themselves and then add drawings of any things that would be necessary for them to live. Students received one point for each element (self, food, water, shelter and air) that they included in their responses. The maximum score on each assessment was 5. The pre-assessment mean for all grades K-3 was 3.06 (st dev = 1.26). The post-assessment mean was 4.09 (st dev = 0.87), and represents a significant change from the pre-assessment scores ($p = 0.001$, paired T-test, $N = 152$).

DISCUSSION AND CONCLUSIONS

The field test of the “Needs of Living Things” unit yielded important information that is being used to shape the final format for the *My World and Me* series, as well as the final version of the unit itself. In particular, instructions for teachers are being revised for clarity and readability, and the storybook is being reformatted as a true big book. Almost all of the field test data support continued use and development of the current model, which combines sequenced inquiry lessons (lessons in which students investigate questions about the natural world, usually through hands-on methods) with reading/language arts activities. Field test results suggest that the content and approach is appropriate for the targeted grades (K–2).

Specifically, the field test provided evidence that the model does lead to increases in student science knowledge in areas addressed by activities. Overall, students scored an average of one additional point on their classroom post-assessments after completing the unit. We currently are investigating these outcomes further to determine the extents to which time spent on the unit, teacher self-reported practices and grade level influenced student learning about the needs of living things. As part of the ECOS project, we also will begin examining how the approach used in the *My World and Me* model compares to traditional, teacher-driven textbook instruction in building young students’ science understandings.

In addition, as reported by teachers, the field tested model aids in the development of student skills in reading and science. In particular, results point to improvements in students’ abilities to make and record observations, use a magnifier, follow directions, draw their own conclusions, and make predictions. All of these are science skills recommended for grades K–4 by the NSES.

Inquiry-oriented science instruction includes many opportunities for students to use new vocabulary in context and to make formal and informal, written and oral presentations (NRC, 2000; Their and Daviss, 2002). During the *My World and Me* field test, we observed similar trends in the development of student language skills as reported by teachers. Teachers noted that students demonstrated increased abilities to master new vocabulary, listen critically to identify

cause-and-effect relationships, and follow directions. It should be noted, however, that most other science instructional programs do not target reading/language arts as explicitly as the materials described here.

We are incorporating recommendations by field test teachers into a final version for publication of the unit, “Needs of Living Things.” A second unit, entitled “Resources and Environments” is currently is being field tested following similar procedures. In addition, we will begin a larger pilot project of the *My World and Me* integrated science model in spring 2003, as part of the ECOS project in Houston, Texas.

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