edited by
RICHARD STEINER
University of Utah
Salt Lake City, UT 84112

Hands Together Science

Eugene Gennaro and Frances Lawrenz
Department of Curriculum and Instruction, University of Minnesota, Minneapolis, MN 55455

Science, as taught in most elementary schools, is textbook-oriented and provides few opportunities for hands-on experiences (*1*). It comes as no surprise, therefore, that by the time many students leave elementary school they are no longer interested in science and do not see it as relevant to themselves. Several programs have been implemented that attempt to facilitate a hands-on approach to science at the elementary school level. Walton (*2*) reported on an elementary teacher training program where the teachers received content background training and laboratory experiences to facilitate the incorporation of hands-on chemistry activities in their classrooms. Seager and Swenson (*3*) reported on their implementation of a set of chemistry activities in a variety of settings and formats. They found that the students were enthusiastic about participating in the activities and that the elementary school teachers became more comfortable with presenting them. Other science educators have reported on some interesting activities to use with elementary age children. For example, Nicolini and Pentella (*4*) describe how to use historical experiments with soap bubbles and precipitate membranes, and Borer (*5*) describes the incorporation of personally relevant or practical information in the study of common indicators.

The program described here, Hands Together Science, is unique in that it attempts to overcome the lack of activity and relevancy in the elementary school by providing elementary school students with hands-on science experiments that they can complete at home. Mallow (*6*) believes that "the strongest influences in a young person's life are his parents and teachers," and parents have been shown to be interested in teaching their children at home (*7, 8*). Despite the fact that many researchers believe that parents are important in children's learning, only a few studies have been reported on methods used to involve parents in children's learning of science (*9–11*).

The goal of Hands Together Science is to create take-home kits containing science activities for children and parents to do together. These experiences are intended to supplement the science taught in the schools and to foster a greater interest in science using the parent/child interaction as a motivator. Activities were designed to be inquiry-oriented and to promote discussion between parents and children.

The first steps in developing take-home activities were to find an easily transportable container and then to design science activities which would use materials that could fit in the container. A plastic pencil box ($8 \times 5 \times 2\frac{1}{2}$ in.) proved to be ideal. All materials needed for the activities were included in the kits with the exception of some easily obtainable materials commonly found in the home. The average cost of the pencil box and materials is about $3.50. The printed materials in the kit include an information sheet for the parents, a booklet with directions for performing activities and in which students can record data, answer questions, draw pictures, etc., and a quick evaluation form for parents and children to complete together.

The kit developers selected topics that were not part of the school's curriculum. Listed below are kits developed this past year and short descriptions of each.

Second Grade

Equal Halves

Participants attempt to predict which letters of the alphabet and which figures are bilaterally or radially symmetrical. They try their hand at creating prescribed bilateral designs using a mirror.

My Very Own Tree

Participants choose a tree in the neighborhood and measure its circumference, make bark rubbings, and describe its leaves. Kits also have laminated leaves to classify and describe.

Waterworks

Participants determine how many drops there are in a dropper and in a vial, explore the meniscus on the surface of a vial of water, determine the shape of drops of water, and explore the adhesion and capillary properties of water.

Hello

Participants use tuning forks to determine how sound is made, look at the relative merits of air, liquid, and solids for carrying sound, make a homemade telephone with plastic cups and string, and determine which variable (size of cup, length of string, kind of cup, etc.) has an effect on its sound-carrying capacity.

Invisible Ink

Participants write messages with lemon juice and develop them in their ovens and determine other safe products in the home that can be used as invisible inks.

Bubble Fun

Participants use soap bubble liquid to try their hand at blowing and catching bubbles and also examine the colors of bubbles. They create bubble makers from juice cans and pipe cleaners.

Third Grade

Disappearing Acts

Participants determine the factors that influence the rate of dissolving of sugar cubes (e.g, whole vs. pieces, shaking vs. not shaking, warm vs. cold).

Strong and Tall

Participants use paper to build the strongest bridge between books and then try to make paper towers that can support a marble on top. Sturdiness of the towers is checked with the use of "wind" from a hair dryer.

Color Hide and Seek

Participants perform paper chromatography experiments and investigate the ability of coffee filters and paper toweling to separate the colors found in black ink. After separating the colored substances in black ink, participants attempt to put them back together.

Critter Watch

Participants compare the structure and behavior of two types of snails using magnifying glasses, a ruler, and a watch.

Reflect on It

Participants explore reflections in a mirror, the angles of incidence and reflection, and their relationship. They also look at the concave and convex surfaces of a spoon and draw some anamorphic images using a curved mirror.

Let's Go to the Movies

Participants make some moving picture "machines" that are dependent on the persistence of vision concept. Flip booklets and spinning wheels with slots are used to show this concept.

The program has been tried in several schools in the Twin Cities area of Minnesota, most recently at Willard Elementary School in Minneapolis. Willard School is a science magnet school so the student population consists of students from the geographic area and of students whose parents chose to send them to Willard. The school is in a low socioeconomic area and has approximately a 50/50 minority–white ratio. Funding for developing the kits was provided to staff at the University of Minnesota by Cray Research, the American Chemical Society through its PACTS (Parents and Children for Terrific Science) grants, and from the school itself.

This year at Willard school, two classes of first-graders and two classes of third-graders were randomly selected to be given the opportunity to take the kits home, while one first-grade class and one third-grade class acted as controls, i.e., students weren't given the opportunity to take kits home. Several copies of each of the described kits were made, and then students selected those that they wanted to take home. A total of 518 kits were checked out by students in the experimental classes during a six-week period. Checkout of the kits took about 10–20 min per week. Losses of materials from the kits were minimal (approximately $20.00). At the end of the check-out phase, a "show and tell' session was held by project staff and classroom teachers where students had a chance to demonstrate what they had learned by having additional hands-on experiences with the ideas contained in the kits.

Data were collected on the parents' and children's responses to the program, and the results were overwhelmingly positive. There was an 87% voluntary participation rate in the selected classes, and, of those that participated, at least three-quarters of the children took either five or the maximum six kits home. Most families selected additional activities to do from the "More Things To Do" section at the end of the activity booklet, indicating, we believe, that the kits further served as a motivating influence for families to learn more about a kit's topic.

The parents reported that they found working with their children on the kits a rewarding experience, and that they wished to have more kits to do with their children. Significantly more mothers than fathers reported doing the kits with their children at both grade levels. The students reported enjoying the kits and feeling that they had learned from them. Interestingly, although all children enjoyed the kits a great deal, the girls were more positive about their experiences than the boys. Perhaps if programs of this nature became more common, they could help relieve the gross underrepresentation of women in the sciences. In any event the program was well received by the participants and provided the students with hands-on science experiences that they otherwise never would have received.

The experimental and control group pre–post comparisons showed few differences but did reveal that the parents of experimental group third-graders became more enthusiastic about encouraging their child's interest in science. The program also appears to have encouraged first-grade girls to be more inquisitive and third-grade girls to be more favorably inclined toward interacting with their mothers and/or fathers.

This year we are developing kits for second and fourth grades. For more information, write to Gennaro.

Literature Cited

1. Bennett, W. J. *First Lessons: A Report on Elementary Education in America;* U.S. Department of Education: Washington, DC, 1986.
2. Walton, K. *J. Chem. Educ.* **1987,** *64,* 714–715.
3. Seager, S.; Swenson K. *J. Chem. Educ.* **1987,** *64,* 157–159.
4. Nicolini, N.; Pentella, A. *J. Chem. Educ.* **1988,** *65,* 615–616.
5. Borer, J. *J. Chem. Educ.* **1987,** *64,* 446–447.
6. Mallow, J. V. *Science Anxiety: Fear of Science and How to Overcome It;* Thomond: New York, 1981.
7. Fredericks, A. D.; Taylor, D. *Parent Programs in Reading;* International Reading Association: Newark, DE, 1985.
8. Stenmark, J. K.; Thompson, V.; Cossey, R. *Family Math;* University of California: Berkeley, 1986.
9. Gennaro, E. D.; Heller, P. *J. Mus. Educ.* **1983,** *8*(2), 4–5.
10. Ostlund, K.; Gennaro, E. D. *J. Res. Sci. Teach.* **1985,** *22,* 723–741.
11. Smithsonian Institute. *Smithsonian Family Learning Project;* Smithsonian Institute: Edgewater, MD, 1980.