DOCUMENT RESUME

ED 454 656 EC 308 460

AUTHOR	Hammrich, Penny L.; Price, Lynda; Slesaransky-Poe, Graciela
TITLE	Daughters with Disabilities: A Professional Development Model To Reframe Science, Math, and Technology Education for Girls with Disabilities.
PUB DATE	2001-04-00
NOTE	34p.
PUB TYPE	Reports - Evaluative (142)
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	Academic Accommodations (Disabilities); *Curriculum Design; *Disabilities; Elementary Secondary Education; *Females; Inclusive Schools; Inservice Teacher Education; *Mathematics Instruction; Middle School Students; Preservice Teacher Education; Program Design; *Science Instruction; *Teacher Education; Technology Education; Urban Schools

ABSTRACT

This report describes a program created specifically to address the fact that individuals with disabilities, especially girls, have been widely under-served and under-educated in the areas of science, math, and technology. The "Daughters with Disabilities" project was designed to encourage more girls with disabilities from five inner-city schools to prepare for careers in science, math, and technology by: (1) increasing the interests and achievement in science, math, and technology of girls in special education classes at the five participating schools; (2) enhancing existing science, math, and technology curricula for girls with disabilities in urban settings; (3) introducing and teaching the concept of "pre-transition" knowledge in the science, math, and technology areas; and (4) creating a network of support and training for pre-service and in-service special and regular education teachers, families, and community members in the areas of science, math, and technology that stressed gender-sensitive curricula, instructional modifications, and successful inclusive education. The program was based on constructivism and employed a variety of methods including, teacher training on best practices for inclusionary settings, classroom activities and outreach to schools, Saturday activities, a two-week summer program, and undergraduate teacher training. (Contains 46 references.) (CR)

DAUGHTERS WITH DISABILTIES: A PROFESSIONAL DEVELOPMENT MODEL TO REFRAME SCIENCE, MATH, AND TECHNOLOGY EDUCATION FOR GIRLS WITH DISABILITIES

Penny L. Hammrich, Temple University
Lynda Price, Temple University
Graciela Slesaransky-Poe, Temple University

As many regular and special education teachers will readily agree, providing appropriate instruction in the areas of science, math, and technology to children with disabilities can be a challenging, and often un-expected experience. For instance, one student in the Under-graduate Program in Special Education at Temple University described it this way:

> My first visit to the school was an eye-opener. It just freaked me out to think that I could some day teach in a setting like the one I was exposed to. The children seemed like okay kids, but they were not in a situation that facilitated learning. Instead, they were in situations that they were guaranteed to fail in.

A second adult in the same undergraduate program responded by saying that:

> I think that the most memorable thing [to me] was our speaker telling us that if [we] are going to do science right we should be prepared to get messy. I could not agree with her more. The best way for the children to learn science is to do it. One last thing that I learned is that you can adapt any piece of equipment to make virtually any lesson work for all special students.

A third future special education teacher provided more insights into this topic by explaining that: "Overall, my first visit was a very positive experience. It was a benefit to be able to watch an experienced teacher at work. I watched and learned as she made on the spot changes to the lesson, assisted the students and altered the lesson just slightly to work on other mathematical concepts."

What do these three comments have in common? They all eloquently capture many of the startling ideas and insights that we found during our first year in an urban public school district as part of our work with our new National Science Foundation Project called "Daughters with Disabilities." In addition, these quotes illustrate many of the surprises and confirm many of the trends currently found in the professional literature on science, math, and technology education for students with disabilities.

As a result, the focus of this article is twofold. First, we hope to share with a broader audience a summary of our findings from our first year's efforts. Second, we want to raise questions, while continuing the critical dialogue about the challenges and benefits that classroom teachers face every day when they struggle to teach science, math, and technology to students in special education programs. A special emphasis throughout this article will also be placed on an area that we discovered has received little or no attention in the special or regular education literature--the unique, educational needs of girls with disabilities in elementary or middle schools. Consequently, while our work is being carried out in an inner-city, urban school district, we firmly believe that this information raises provocative questions and ideas for teachers, administrators, and parents in other educational settings as well.

Breaking Down Barriers

Daughters with Disabilities was created to specifically address the fact that individuals with disabilities, especially girls, have been widely under-served and under-educated in the areas of science, math, and technology (Cawley, Kahn, and Tedesco, 1989; Donahue & Zigmond, 1986; Mastorpieri & Scruggs, 1991; NSF, 1996; Shewey, 1997; Stefanich & Dodd, 1994). This disturbing trend has its roots in a simple conclusion: Today the vast majority of the 5.3 million American children or youth in special education programs are receiving inadequate or no education in the areas of science, math, and technology (SEMT). A logical outcome of such poor SEMT educational experiences is the negative way that students with disabilities often perceive science and math--either they have no further interest in these areas or they are denied the opportunities to pursue further education because of their limited or non-existent knowledge base (Kaye, 1997; U. S. Department of Education, 1991; Stefanich; 1994).

An even more serious consequence is they do not consider higher education as an option. For instance, the U. S. Department of Education (1997) states that in 1992-93 only 6.3% of undergraduates and 4.0% of graduate students identified themselves as having disabilities. Such limited educational possibilities, in turn, restrict their lives as adults even more, as they cannot become practicing scientists, engineers, or math teachers. We also believe that this negative trend reflects a significant gender bias.

As Shewey (1997) explained:

> Although women, minorities, and persons with disabilities have made great progress integrating the science world, a disparity still exists in their representation in the science community. In every ethnic group, women still comprise a lower percentage of science and engineering students and professionals than men. These gaps grow larger with age and prominent career positions. Once they reach college, women are 10% less likely to choose a science or engineering major and much less likely to obtain a Ph.D. Women [now] comprise 30% of science and engineering Ph.D. candidates, which is an increase of 5% since 1983. (p.1)

Consequently, the major focus of our project was to encourage more girls with disabilities from five, inner-city schools to prepare for the careers in Science, Math, and Technology by: (a) Increasing the interest and achievement in Science, Math, and Technology of girls in special education classes at the five participating schools; (b) Enhancing existing Science, Math, and Technology curricula for girls with disabilities in urban settings; (c) Introducing and teaching the concept of "pre-transition" knowledge (i.e., future post-secondary education awareness and career exploration through various activities, experiences, mentors strategies, etc.) in the SEMT areas; and

(d) Creating a network of support and training for pre-service and in-service special and regular education teachers, families, and community members in the areas of Science, Math, and Technology that stressed gender-sensitive curricula, instructional modifications, and successful inclusive education.

This focus was supported by a variety of related activities (e.g., summer programs, summer teacher training, the Saturday Academy, professional development, undergraduate teacher training, outreach to schools, materials dissemination, one-to-one consultation to participating teachers and schools). In addition, the focus was clearly founded on the following goals: (a) To enhance the existing SEMT curriculum through specific activities and learning methods shown to increase girls' with disabilities interest and achievement in science, math, and technology; (b) To facilitate interest and achievement in science, math, and technology among elementary school girls with disabilities; (c) To involve Temple University undergraduate elementary education, science or math education, and special education students in practical hands-on experiences at selected urban, elementary schools; (d) To involve elementary regular and special education teachers, principals, and paraprofessionals in practical hands-on knowledge and activities in their home schools; and (e) To increase the knowledge and participation of families and care-givers of daughters with disabilities in terms of their science, math, and technological education.

Rationale for Daughters with Disabilities

Innovative projects like Daughters with Disabilities are not created in isolation. In fact, throughout our work, we have constantly referred back to the valuable information already available in the extant literature base. While we were often disturbed by the negative trends found previously by researchers in this area, we also discovered much valuable guidance to assist us as we went "into the trenches" in one, urban school district. For instance, there was clear consensus by professionals on the following three trends that were often repeated by educators who saw students with special needs in a variety of settings.

Gender

The first hurdle that girls with disabilities face in inner-city, public schools is that they are female. Research studies (AAUW, 1992; Baker & Leary, 1995; Evans, Whigham, & Wang, 1995; Hammrich, 1996; NSF, 1990; Wilson, & Milson, 1993) have documented the wide gender gap in achievement scores between girls and boys in the areas of science and math. These authors assert that when girls are allowed to work in a manner that is intrinsic to their collective learning style, appropriate science and math learning takes place.

Their work is support by other professionals who have demonstrated that girls frequently have different parental, cultural, and educational experiences than boys

(Bailey, 1993; Kahle & Lakes, 1983; Liaw, 1990; Rosser, 1990; Sjoberg & Imsen, 1988). For instance, some researchers refer to the concept of "selective perception" observed in parents of newborn babies, where parents will perceive differences in infants based solely on the baby's sex. In one study by Rubin and his colleagues in 1974, 30 pairs of first time parents (one half with newborn daughters and one half with sons) were asked to describe their child in the first 24 hours after birth. The researchers reported that girls were rated by their parents as being significantly softer, finer featured, smaller, and more inattentive even though no actual differences in size and weight were found between the male and female newborns. Skolnick, Langbort, and Day (1982) went one step further to describe how these early stereo-types can be translated into the classroom:

> Most elementary teachers will tell you they have more occasion to praise little girls than little boys. But the qualities rewarded in the two sexes are very different. While boys are usually praised for intellectual work, girls are mostly praised for behaving properly and obeying rules of form. They are encouraged to be compliant but not necessarily to be creative, autonomous, or analytic. As a result, they learn they re pleasing but not necessarily that they are capable. (pp. 19, 20)

Such varied experiences will often shape other daily interactions with adults. For example, research has shown that girls tend to rely more on the opinions of others than boys and boys were observed to be frequently encouraged by their parents to solve their own problems first, while girls will receive assistance to solve problems. Skolnick, Langbort, and Day also stressed that:

> There is a mystique about mathematics [and science] that implies that either you have what it takes or you don't. This notion is all too compatible with social messages about female inability. Many girls believe that they simply lack the particular talent, rather than the practice, that permits success. To dissolve the

> mystique, girls need to do what boys do--practice. As they experience success, they will gain credibility with themselves as math and science learners. (1982, p. 23)

It is interesting to note that our own efforts at Temple University have supported this thesis. For instance, we found that if girls are given the opportunity to learn in an environment where they felt their voice is heard, they obviously enjoyed science, while simultaneously demonstrating an increase in their self-esteem and identity (Hammrich, 1998).

It is interesting to note that recent data points to another, hidden area where gender may shape the SEMT experiences for girls with disabilities. New studies have emphasized the role of mothers in educational levels in relation to special educational needs. For instance, George (1996) has found that lower parent educational experiences--especially for mothers--is a significant predictor of how and when students will receive special education. In fact, children whose mothers completed college will receive special education over two years earlier in their educational profile than those whose mothers only finished the eighth grade. In addition, parental educational experiences (and maternal intelligence) seem to be directly tied to inner-city settings (George, 1996; OCR, 1992). Peng (1992) found that 22% of the families in inner-city settings dropped out of high school in comparison to an 8% secondary drop-out rate for the families who lived in other urban/suburban areas. As a result, if parents are high school drop-outs themselves, it may make it much more difficult for their daughters to see them as role models for further SEMT education or careers.

Ethnicity and Urban Education. Gender is usually only the first hurdle that girls with disabilities face in the American public educational system. The second equally important hurdle is where their education takes place. For instance, although only 8% of all U. S. school districts (like the one where Daughters with Disabilities takes place) have been classified as inner-city, these same public schools educate over 26% (or one fourth) of all American school children (OCR, 1992). And one of the key characteristics of many inner-city neighborhoods like the one served by Daughters with Disabilities is a high poverty rate. Socio-economic status is a critical factor because poverty is a common condition for many students with disabilities, especially those like the participants in Daughters with Disabilities. Many studies have shown that these three factors--poverty, disabilities, and inner-city settings--have strongly interconnected ties to each other (Ahren, 1995; OCR, 1992; Peng, 1992; Wagner, 1995). For example, as George (1996) says, "Mild mental retardation is consistently reported to be associated with low socioeconomic status and race. . . . Socio-economic status may [also] account for some of the disproportionate representation of African American children in that category." (p. 1)

In addition, often schools in inner-city settings do not have the resources to provide an adequate special education program for special needs students. As George (1996) explains, the provision of appropriate [special education] services rests in part on the districts ability to obtain an adequate supply of qualified personnel, to select appropriate curriculum and instructional methods, and to maintain active parent involvement (p. 4). As studies and testimonials in Section C below underscore, such supports rarely happen. In fact, OCR data (1992) has shown that most inner-city students with disabilities are very likely to be placed in the most restrictive, least appropriate environment, as a segregated resource room is all that is available to meet her needs (e.g., 43% of the students versus 23% of the students in non-urban areas).

Such restrictive, out-dated, educational practices are further complicated by inner city schools that traditionally are burdened by such negative factors as: lack of funds, over-crowded classrooms, out-dated or non-existent laboratory equipment, few technology resources, and over-worked, ill-prepared teachers in the SEMT area (George, 1996; Rivera, 1997; Mastropieri, Scruggs, & Shiah, 1991, Mastropieri & Scruggs, 1992). It is no wonder then that nearly half of the high school students in the inner-city district where our participants live are failing their science and math courses. In 1991 for instance, only 55% of the 9th-12th grade students received course credit in math or 57% in science.

Disability

But girls with disabilities face a third hurdle that is often the most crucial to their success as adults. Whether they are taught in the traditional, out-dated, resource room (where they are usually completely segregated from their peers) or included into regular classes, they usually will not find the resources available for an adequate science and math education. All too frequently, students in special education classes are losers when it comes to any science or math education that will address their special needs (Rivera, 1997; Mastropieri, Scruggs, & Shiah, 1991, Mastropieri & Scruggs, 1992; Ysseldyke, Thurlow, Wortruba, & Nanaia, 1990). First, there usually is a shortage of teachers trained in special education in inner-city settings. As George (1996) stresses:

> Recruiting and retaining qualified teachers and related service providers is critical to meeting students educational needs. Although special education teachers are in short supply in many places, the shortages are particularly severe

> in inner-city areas. Thirty -eight percent of all public schools had teaching vacancies in special education in 1990-1991. . . .[with a] 42 percent in inner cities. Public school administrators said that vacancies in special education were among the most difficult to fill, with 26 % of the schools finding them very difficult or impossible. (p. 6)

This disturbing trend is clearly illustrated in most resource rooms, where typically only math facts are drilled and re-drilled in a tutorial manner. Often, basic remediation is the extent of the math curricula for students with a variety of special needs and disabilities. Also, due to the heavy emphasis on basic literacy and life skill development in resource rooms, science is usually completely neglected altogether (Rivera, 1997; Mastropieri, Scruggs, & Shiah, 1991, Mastropieri & Scruggs, 1992). Even if the special education teacher attempts to teach science or integrate math and technology into lesson plans, s/he is usually not prepared or poorly trained in these critical areas (Baker & Zigmond, 1990; Balzer & Roberts, 1993; Ysseldyke, Thurlow, Wortruba, & Nanaia, 1990). As Stefanich (1994) explains, "Most university programs which required preparation for exceptional students provided a general course with a focus on definitions of exceptionalities and special education legislation, but with little or no [science] methodology" (p. v.).

In fact, even if students with disabilities are gvien access to more inclusive settings, the SEMT educational picture for them in regular classes is usually not much better. For example, it is interesting to note that over half of all students (approximately 2.7 million children) with disabilities currently get their science and math education in regular classrooms (Kaye, 1997; U. S. Department of Education, 1991). But, the professional literature stresses that while regular classes are taught by teachers who may be competent in teaching science and math to regular students, they frequently have virtually no idea how to teach students with disabilities.

As Stefanich stresses:

> The general classroom teacher of science receives little or no academic coursework on meeting the needs of special students and are seldom afforded opportunities to teach these students in preservice or graduate teacher preparation programs" (p. v.). Based on her personal experience teaching a student with a disability in a regular science class who required a wheelchair, Bazler says that: "I still make the classic mistake of isolating the student [with disabilities] from other classmates rather than making her an integral part of the class. . . Students [with disabilities]. . . are a fact of life, but many teachers are anxious, fearful and unsure of how to meet their special needs (p. 302, Bazler & Roberts, 1993).

It is important to compare this negative picture with the current, substantial research base which clearly demonstrates how girls can succeed in environments that are specially structured to meet their special needs (Leaf, 1994; Norman & Caseau, 1994; Stefanich and Dodds, 1994). This literature shows that it is critical to ensure that appropriate supports are available to promote the resilience of students with disabilities, especially girls, in science and mathematics (AAAS, 1991a; AAAS, 1991b; AAAS, 1991c; Burgstahler, 1994; Burgstahler, 1996; Burgstahler, 1997; Hammrich, 1996; Hammrich, 1997).

<u>A New Instructional Model for Girls with Disabilities</u>

The attempt to address these sobering statistics in a proactive, positive way quickly became the heart of Daughters with Disabilities. To meet the complex needs of such a significant problem, our Project used a multi-faceted approach that stressed a variety of activities, materials, and strategies that were applicable to the science, math, and technology needs of girls with disabilities while also being gender-sensitive and culturally relevant. This new model was also clearly rooted in two other projects also funded by the National Science Foundation: Sisters In Science (SIS) and Project DO-IT, along with our other collaborative partners from the American Association for the Advancement of Science (AAAS). Examples of the activities and materials available to the five participating schools through Daughters with Disabilities during the first year included:

1. Teacher Training. Teachers were taught how to deliver instruction that was based on the "best practices" for inclusionary settings for elementary aged girls with a wide range of disabilities. (Special emphasis was placed on materials, strategies, and lesson plans previously developed and tested in elemmentary classrooms by Sisters in Science and AAAS.) Also, a beginning emphasis was placed on integrating pre-transition methods and materials for SEMT education and careers into special education instruction through materials from SIS and Project DO-It.

2. Classroom Activities and Outreach to Schools. During the first year, a wide variety of classroom activities and supports were available in fourteen special education classrooms in the five participating elementary schools. Approximately 36 students from the Temple graduate and undergraduate certification program in special education made on-site visits to each class. Based on individual student needs and teacher suggestions, each teacher-in-training gave one-to-one support as requested. For instance, some students observed the classroom as a whole while others tutored individual students on specific classroom activities that stressed math skills. Other students used a simple cooking lesson to teach the students about such basic concepts as using your senses to

observe changes, measuring ingredients to discover which is heavier or lighter, and using basic mathematics to increase or decrease a recipe. These activities were so successful that the pre-service teachers were invited back into the classrooms for a second year to continue interacting with a new set of 4th and 5th grade students.

3. Saturday Activities. The Saturday program was held for the girls on the Temple University campus one Saturday per month during the regular school year in the morning for three hours per session. To promote inclusion when-ever possible, a collaborative model was utilized. The girls from Daughters with Disabilities were taught by the same staff and used the same lessons from Sisters In Science. The Saturday Coordinators, undergraduate special education students, and volunteers' facilitate the program. Activities include environmental service learning projects and reflection sessions. Girls with disabilities were fully integrated into all activities, but also received individual support as needed. An example activity was a lesson plan that stressed using ratio proportions where girls created a giant hand that was based on comparisons to their own body dimensions.

4. Summer Program. A two-week summer program was conducted by staff from Sisters in Science for girls both with and without disabilities on the Temple University Campus, along with a simultaneous, three day, intensive Teacher Training for special education teachers, principals, paraprofessionals, and parents from the participating schools. The focus of the summer program was urban water-ways, with a special emphasis on how water impacts our daily lives in myriad ways in an inner-city environment. An example activity included designing model rivers and testing the effects of run-off, acid rain, and so forth.

5. Undergraduate Teacher Preparation. Approximately 70 students in regular and special education classes at Temple University were exposed to best teaching practices in the areas of science, math and technology as part of two Special Education methods and one General Education theory courses. Special emphasis was placed whenever possible to underscore how to most effectively teach girls with disabilities in inner-city schools in these critical areas, especially in inclusive settings if possible. Numerous activities were completed by the undergraduates including: a) two visits or more to one of the target schools in Daughters with Disabilities (including such experiences as: formal classroom observation concerning gender equity, math/ science teaching, and inclusion, continued volunteer work with specific students as requested by the teacher, teaching a science/math lesson to the whole special education class, etc.); b) participation in debriefing meetings for follow-up comments and questions led by Temple University faculty; c) hands-on experiences with science/math materials and lesson plans applicable to girls with disabilities in inner city schools as demonstrated by two different consultants and instructors (Dr. Penny Hammrich from Temple University and Laureen Summers from AAAS); d) on-line communication with an assigned DO-IT mentor (i.e., a college student from the University of Washington or working professional in the Seattle area who has a disability and is actively involved in the areas of math, science, or technology) to discuss inclusive SEMT education, career preparation, and disability related issues and accommodations; and (e) the development of a case study and personalized teaching material for one of the students observed during the classroom visits.

Science, Math, and Technology Curricula and Experiences

Each of the previously described components of the program clearly centered around promoting gender sensitive approaches to teaching science and mathematics in inclusive settings for girls both with and without disabilities. As a result, one important facet of teaching strategies and approaches used with girls involved in both Sisters in Science and Daughters with Disabiltiies facilitated an environment that was directly relevant to their lives, accommodating, noncompetitive, cooperative, and respectful of their opinions both as females and as elementary students. In addition to infusing this crucial educational philosophy throughout all activities and curricula, all experiences in both Projects stressed the development of science and math process skills such as: observations, communication, classification, and experimentation. Also, as previous research suggested that when girls find science and mathematics relevant to their lives, they will achieve more in these areas, the activities that the girls both with and without disabilities participated in were directly shaped by the urban environment where the girls lived everyday. Examples of both this overall philosophy and how it was implemented into practice were illustrated by the experiential learning through the curricula from the Summer Academy and within individual lessons taught during the Saturday sessions of Sisters in Science, as described below.

Experiential Learning in the Summer Academy

While the overall theme of the two week Summer Academy held on the Temple University campus was "Water All Around Us", each component and individual lesson within the curricula was created in concert to provide the girls with a physical environment that was both psychologically, emotionally and socially safe and accessible to all students. In addition, each activity clearly connected the SEMT subject matter to real-world issues that were culturally relevant to students. For instance, during each meeting, students were actively encouraged to: generate and gather data, pose scientific and mathematical problems, generate possible explanations and propose methods for evaluating the best explanations. Across all of the events, teacher, parents, volunteers, and Temple University students were providing a level of mentoring that extended the students learning base beyond the walls of the classroom.

It should also be stressed that all learning experiences and lessons were founded in constructivism. For instance, whereas in the past, a curriculum often meant a set of answers to be transferred from teacher to student, the curriculum created for the Summer Academy was framed around a set of questions posed to a class of elementary aged girls, both with and without disabilities (Skilton Sylvester, 1997,). In this way, the process of inquiry was equally constructed by the students and teachers to foster a true community of learners, while also remaining gender-sensitive, culturally relevant, and inclusive. Each learning adventure utilized real life situations to explore the subject matter in depth, such as the waterways of our urban setting. So instead of simply studying the names and structures of various bodies of water in isolation, the girls actively explored their own urban environment in a large, Eastern city (e.g., they mapped local waterways, visited the water treatment plant that processed their waste water, built model rivers, located various lakes, rivers and tributaries in their region, and tested the quality of water in their own neighborhood).

In addition to these exciting activities, each of the central studies of the program in general was structured around one or more central questions, which became a focal point for the whole group inquiry. The questions were woven from a fabric of unifying SEMT themes (i.e., systems, models, scale, constancy, and change) and cross-cutting competencies. The five cross-cutting SEMT competencies were: participatory citizenship, communication, multicultural competencies; problem-solving; and school-to-career readiness, and technological literacy (School District of Philadelphia, 1996). The unifying themes constitute those skills that allow people to play effective roles in the community. These themes and competencies, along with related activities are summarized in Table 1.

Table 1.
A Comparison of Themes, Competencies, and Student Activities in a Series of Lessons on "City Rivers

SEMT Themes	SEMT Competencies*	Student Activities
Systems	Multi-Culturalism Participatory Citizenship	Explore city neighbohoods Visit water treatmentplant Visit Riverbend Environmental Educational Center
Models/ Scale	Communication Problem-solving	Build a scale model of a river Identify the water cycle
Constancy/ Change	School to Career Readiness	Study professionals who use water in their jobs Write local scientists
	Technological Literacy	Research water quality & use on the Internet

These competencies are from the Philadelphia Public School System. Curriculum Standards Framework

Numerous activities, strategies and experiences were implemented in the Summer Academy curricula about water to encourage the development of these themes and competencies. For example, within the context of the girls' exploration of city rivers, they learned about systems as seen in the water cycle. Along the way, the girls also discovered the three states of matter: liquid, solid, and gas--an important SEMT lesson, which is fundamental to the understanding of the concepts of constancy and change. During the two weeks, the girls studied models as they create their own rivers, while also utilizing the principle of scale.

In the study of city rivers mentioned above, students were guided to ask this central question: How do the city rivers get clean so that people can drink the water? In searching for answers to this question, the girls then visited a city water treatment plant. They also researched ways of making drinking water safe by finding sites on the Internet and wrote local scientists for their answers and suggestions to their important question. Related activities from the Summer Academy curriculum included: (a) cooperative student teams of girls who designed an experiment to purify samples of dirty water (each group then predicts, designs, experiments and communicates their results to the class); (b) a discussion led by adult, female, team leaders about the effects of reduction, reuse, recycling of water in their urban environment; (c) pairs of girls who created animal sanctuaries, habitats and rooftop biomes from craft materials and household objects to show the inter-relationships among humans, plants, and animals in a urban environment ; (d) an exploration with their group leaders about how to practicing water conservation in their local, inner-city neighborhood; and (e) field trips to examine the effects of community involvement in local revitalization projects in their home environment.

Integrating Science Lessons and Inclusion. Clearly, one of the key strengths of Daughters with Disabilities was its on-going infusion of successful inclusive educational techniques, accommodations and strategies into the effective lessons that the staff from Sisters in Science previously developed to teach science, math, and technology to elementary-aged girls without disabilities. An example of this critical integration can be illustrated in the Sisters in Science lesson on measuring and graphing the density of familiar objects. Various components of the lesson, along with appropriate accommodations for girls with disabilities in inclusive classrooms have been summarized in Table 2.

Table 2.

Suggestions for Inclusive Education in a Science Lesson about Weight and Measurement

Specific Activity	Suggested Accommodations
▪ Fill out mystery object lab sheet	Do the activity with a peer Use a laptop computer to fill out sheet for both girls Lab partner acts as a scribe to fill out the lab sheet
▪ Manipulate objects and tools	Partner manipulates objects and tools to compensate for fine motor problems
▪ Verbal discussion and oral problem-solving	Partner sits at eye-level (for wheelchair) Encourage student to speak slowly Give both students extra time, if needed
▪ Measure each foil-covered mystery object	See number 2 above
▪ Rank each foil-covered mystery object	No accommodation needed
▪ Hypothesize about each object	No accommodation needed
▪ Graph the weight and rank of each object	See numbers 1 and 2 above

This information is based on a lesson plan originally developed by Sisters in Science.

Girls typically complete this Sisters in Science activity by forming pairs to fill out a mystery object lab sheet. Each pair is given 6 foil-covered objects to be measured and ranked on the sheet by weight. They are also told to guess what the object is and form a hypothesis about it. After removing the foil, they check their guesses. The also complete related activities on mass and volume using water, graduated cylinders and graph paper for measurement and graphing. In addition, they will read Kim Hubbard's biography: a computer engineer at NASA.

A brief examination of this lesson shows that all students will be required to complete these skills and competencies: to follow several visual and auditory instructions; to use various tools for measurement; to speculate and hypothesize about the relationships and comparisons among the mystery objects; and to record the results, either by graphs or by written answers on the lab sheet. Students must also apply the cognitive concepts of lighter versus heavier weights and use mathematical reasoning for measuring, comparing, charting and graphing the objects as needed.

Obviously, each set of accommodations for this lesson will be personalized to meet the unique strengths and disabilities of each girl in the class. However, to further illustrate these suggestions, the following ideas might be useful for a girl with physical disabilities (i.e., has difficulty using her hands and uses a wheelchair) who is being taught this lesson in an inclusive classroom. If this student has fine motor difficulties, she could be assigned a partner either with or without disabilities to manipulate the objects and tools, as necessary. If she has problems with handwriting, the mystery lab sheet could have already been put into an adapted laptop computer by an aide or a classmate, so the responses can more easily be recorded for herself and her partner. If she uses a wheelchair for mobility, her partner, teacher, or the classroom aide should sit at eye-level for discussion purposes. Also, even though this student may be very sociable, if she has difficulty verbally expressing her thoughts when under stress, she should be encouraged to speak slowly or given extra time to complete the assignment with her partner. Throughout this lesson, it should be emphasized however, that both girls will be expected to turn in the same high quality of work as the other teams. In addition, follow-up feedback will be given to the special education teacher and the girl's parents or caretakers, as requested.

First Year Findings

Such an innovative approach to teach the critical knowledge of science, math, and technology to girls with disabilities is clearly an important first step to address the often surprising and sobering findings that we found during our preliminary experiences in one urban school district. The following six findings became guideposts for us as we navigated the frequently confusing, but interesting world of special education for elementary students in public education today.

Gender Prevalence

The first overall finding that was a total surprise to us was the significant absence of girls in the special education programs in all five target schools. In fact, in our observations of the five target schools, we have estimated that an average of less than 20% (or the clear minority) of students in the special education classrooms were female. In addition, we found a few classrooms where there were no girls at all in the designated special education classes. This startling trend was reflected in an article written by a public school teacher who also observed the same phenomena in her classroom in the New York City Public School System. As Mosle (New York Times, 2000) described her third grade class:

> I had Room 306, indicating that I was teaching in the third grade and had the six or 'bottom', monolingual class. . . .I had twice as many boys as girls--not because boys are less intelligent than girls at that age, but because

> they they're rowdier. They get labeled behavior problems and are often put in the worst classes. . . And in truth, the class was challenging. Although Adam and Keemy were sociable and outgoing, they had severe learning disabilities and entered third grade still reading primers. (p. 25)

Mosle's observations could be describing the classes that we went into during our first year of Daughters with Disabilities. While we have no hard data at this time to support any speculations or reasons for the prevalence of boys in special education or remedial settings, this lack of girls became a constant pattern in our work in an urban, educational setting.

Disability Categories

In addition, to the lack of girls, it is important to note the composition of disabilities that we found in our designated special education classrooms. For instance, just as we discovered a majority of boys in each class, we also saw that a few, if any, of the students had either sensory, physical or significant disabilities. In fact, the vast majority of all students seen in the special education classes had mild learning or behavioral disabilities. They were served in this school system in classrooms designated as "Learning Support" (i.e., students with diagnosed learning disabilities) or "Emotional Support" (i.e., students with diagnosed with emotional behavior disorders). No students with significant physical and/or sensory disabilities we found in these schools could be beneficiaries of the resources and instruction from our project. It should also be noted that this trend was graphically illustrated for us when we discovered that only one of the original five schools that we had asked to participate in the project was accessible for individuals who use wheelchairs.

Special Education Teachers as Gatekeepers

A third, thought-provoking finding was the significant role that teachers played as gatekeepers in the recruitment of participants, and the implementation of the program in their classrooms in our five targeted schools. For instance, the first months of the program we spent on very intensive efforts to recruit special education girls to attend our program activities through personalized correspondence distributed by individual classroom teachers, due to confidentiality. But as time went by, we were surprised at the little response we were getting from the students and their families. Intrigued by this and searching for an explanation, we asked the teachers again for feedback and assistance. They told us informally that almost all of them felt that their students we not "good candidates" for the program, as their girls were "too low functioning to learn math, science, and technology."

That dialogue taught us a very valuable lesson--that these impressions were based on their own negative math and science school experiences, as well as their own lack of preparation in these areas. As a result, we designed personalized training sessions for the teachers as well as their students to stress hands on science and math activities, along with discussions on how to adapt SEMT lessons to a variety of disabilities. We discovered after these sessions that focused on what people with disabilities can achieve that teacher participation and enthusiasm increased significantly. This changed attitude, in turn, is starting to translate itself into new, more challenging curricula for students to use and the teachers to try out in their own classrooms in a variety of daily activities and lesson plans. Perhaps, the greatest benefit is that we have found that the teachers and principals are becoming active partners to help us recruit more girls and parents into the program. We feel confident that these teachers will become our most valuable asset to act as communication facilitators between school, home, and Temple University.

Unusually High Turn-Over Rates for Special Education Teachers

Another unexpected and discouraging outcome found during our first year as an NSF project was the high turn over rate for special education teachers in the five participating schools. The national issue of retaining special education teachers in urban public schools is a problem that was not foreign to us, as it had already been explored in depth in the professional literature. But we never imagined that it would have such magnitude or a personal impact on our first year's activities. Based on informal testimonials from teachers and administrators, we found to our consternation that most special education positions in inner city schools like our targeted district were perceived by teachers as being temporary jobs while teachers waited for offers in either "better" schools or suburban districts. As a result, it was not unusual during Year 1 to find ourselves facing the immediate challenge of loosing two very committed teachers in the course of the first two months of our extensive work with them. In addition, by the end of Year 1, we found that approximately 40% of the teachers that started participating with Daughters with Disabilities had either been transferred to non-participating schools or had left our school district entirely. Such excessive mobility and retention issues required that we were continually going back to the beginning to recruit new teachers into our project.

Very Little Exposure to Science for Students in Special Education

A fifth, disturbing finding that has been already described by other professionals in the extant literature base was the total lack of any type of challenging science, math, or technology education taking place for any students in our designated special education classrooms. In fact, both our on-site school observations and numerous formal and informal conversations with special education teachers clearly underscored that both boys and girls had little or no exposure to age-appropriate technology or science education. In addition, while mathematical lessons were taught in these classes, they definitely were remedial in nature and tone. Most were heavily based in rote learning with an emphasis on simplistic, limited activities and worksheets. It should be stressed that to our knowledge, no science education was taking place at all in any of the classrooms where we observed. However, some of the teachers were doing "science-related" activities (i.e., looking a the daily weather, discussing the seasons, describing a few plants or animals, etc.), but when we explored these curriculum topics with them, they clearly did not perceive these ideas as being "science" or "science-related". We also found that a few of the classrooms had computers, but we only observed limited, if any, technology-related activities. In addition, to our knowledge, none of the computers had any connection to the Internet. We can again speculate that such limited or non-existent SEMT education for girls with disabilities may have two inter-related causes: the teachers' and principals' own beliefs that special needs students are not able to learn math, science, and technology, along with the teacher's own lack of experience in these academic areas. (See previous findings for more information.) It should also be noted that none of the curricula or materials that we saw in the classrooms or reviewed to share with the teachers addressed the areas of gender-sensitivity or cultural relevance in terms of students with disabilities.

The Lack of Teacher Preparation and Inservice Support

It is logical to assume that the sixth finding from the first year of our efforts with Daughters with Disabilities would go hand-in-hand with the fifth finding discussed in the previous paragraph. As part of our on-going dialogue with the teachers, principals, and paraprofessionals in our five participating schools, we uncovered another disturbing trend that had been earlier reflected in the professional literature. It was the unanimous consensus among all professionals that we talked to that they were clearly under-prepared or totally unprepared to teach any science, math, or technology skills beyond the most basic remediation. For instance, when we recently asked them if they had felt prepared to teach science, math, or technology to students with disabilities before their participation with our Project, we discovered that: a) Only two of the nine teachers present felt prepared to teach science; b) Five of the nine teachers were prepared to teach math; and c) One of the nine teachers felt competent to teach technology to her students.

We also learned that many of the teachers who had been responsible for special education classes for many years had trouble remembering any support that they had received in terms of appropriate science or technology education. To probe further, we asked all the participating teachers and principals if they could remember any pre-professional training in science skills for students with or without disabilities. All of our participants (except one principal who herself was a former science teacher) drew a complete blank.

To further underscore this need, we were often astonished and touched to see how hungry these same professionals were to receive specific materials and strategies to use in their classrooms. For example, after completing their Sisters-In-Science lessons during one training session, the teachers told us that they never believed that science and math could be so much fun. They also applauded the use of common, household materials to teach science and math. In addition, they eagerly requested catalogues to order materials. They also asked for follow-up lesson plans to explore further with their students a wide variety of basic science topics and experiments (e.g., gravity, force, and motion; electricity; magnetism, weather forecasting; chemical changes to matter; urban ecology; and cooking). The teachers repeatedly told us that they were learning as much as their students. As one teacher aptly summed up her experiences: "This is a whole new world. . . .I can bring so much to my students, even though [sometimes] they may be too low [cognitively] to do most of the science. . . .But this translates well into all of my teaching".

Conclusion

As the previous information has shown, in the future we plan to chip away at the obstacles that we found during our first year with one girl at a time, one teacher at a time, and one school at a time to give as many girls as possible the long-lasting benefits of an appropriate education in science, math, and technology. When we look back on our first year's work, we discovered that just as there was often a total absence of any appropriate science, math, or technology instruction for girls with disabilities in our targeted classrooms, there was an equal enthusiasm by the girls and their teachers to learn this new information when they had the tools and training to access it. Perhaps, one of the Temple undergraduates summarized it best for all of us when she said:

> I learned [from participating with Daughters with Disabilities] that teaching science isn't as difficult and scary as I once thought. I grew up hating science. I was never good at it through school and out of that developed a fear of teaching it . . . . I knew that I wasn't strong in science and I was constantly worried that the students would ask me a question that I

> couldn't answer. . . This experience has changed my preconceptions of science 180 degrees. I no longer think that science is boring. In fact I think that science is very exciting. . . I learned so much from doing these experiments but most importantly that science is FUN! I also learned that there is a place for women and girls in the field of science.

In conclusion, one project or one group of committed science, math, or special educators alone cannot tear down all of the barriers for girls with disabilities in the areas of science, math, and technology. One set of dedicated teachers, mentors, or undergraduates by themselves cannot change the often negative course of employment or post-secondary education for future female scientists or mathematicians with disabilities previously described in the professional literature. But this project clearly is a start. For girls with disabilities, the concentrated, personalized efforts of Daughters with Disabilities can be a significant tool to accomplish many, important objectives. For example, participation in project activities and the dissemination of project materials will clearly raise vital SEMT issues and suggest powerful solutions to a wide variety of critical audiences (e.g., future science, math, and special education teachers; parents of girls with disabilities; current regular education and special educators; administrators, paraprofessionals, and related staff in urban settings; college faculty, and so forth). On-going, pro-active involvement by the girls themselves can both teach important science and math skills, while simultaneously expanding new horizons through early transition awareness.

Sisters in Science has repeatedly shown that these successful experiences can happen for girls in elementary classes who are not formally diagnosed with disabilities. Isn't it time that these same, powerful experiences and materials be available to their classmates with disabilities as well?

References

AAAS Project on Science, Technology and Disability. (1991a). *Barrier free in brief: Laboratories and classrooms in science and engineering.* Publication #91-27-S. Washington, D.C: American Association for the Advancement of Science.

AAAS Project on Science, Technology and Disability. (1991b). *Barrier free in brief: Access in words and deeds.* Publication #91-28-S. Washington, D.C: American Association for the Advancement of Science.

AAAS Project on Science, Technology and Disability. (1991c). *Barrier free in brief: Access to science literacy.* Publication #91-29-S. Washington, D.C: American Association for the Advancement of Science.

Ahern, L. (1995). *NASDSE Directors Survey.* Washington, DC: National Association of State Directors of Special Education.

American Association of University Women. (1990). *Agenda for action* (Publication No. 90-13S). Washington, DC: Author.

Bailey, S. M. (1993). The current status of gender equity research in American schools. *Educational Psychologist, 28*, (4). 321-339.

Baker, D. & Leary, R. (1995). Letting girls speak out about science. *Journal of Research in Science Teaching, 32,* 3-27.

Baker, J. M., & Zigmond, N. (1990). Are regular education classes equipped to accommodate students with learning disabilities? *Exceptional Children, 56*, 515-526.

Bazler, J. A., & Roberts, R. (1993). Safe science classrooms for students with disabilities. *The American Biology Teacher, 55*, 302-303.

Burgstahler, S. (1997, April/May). *Closing the gap. Microcomputer Technology for People with Special Needs, 16.*

Burgstahler, S. (1996). Teaching lab courses to students with disabilities. *Information Technologies and Disabilities*. 3(2). http://www.rit.edu/easi/itd.html.

Burgstahler, S. (1994, December). Increasing the representation of people with disabilities in science, engineering, and mathematics. *Information Technology and Disability. 1*(4).

Cawley, J.F., Kahn, H., & Tedesco, A. (1989). Vocational education and students with learning disabilities. *Journal of Learning Disabilities, 22*, 630-634.

Donahue, K., & Zigmond, N. (1986, April). *High school grades of urban LD students and low-achieving peers*. Paper presented at the annual meeting of the American Educational Research Association, San Francisco.

Evans, M.A.; Whigham, M., & Wang, M.C. (1995). The effect of a role model project upon the attitudes of ninth-grade science students. *Journal of Research in Science Teaching, 32*, 195-204.

Hammrich, P. L. (1998). An intergenerational science program for elementary school girls. *School and Community Journal. 8* (2), 21-36.

Hammrich, P. L. (1997, January). Yes, daughter, you can. *Science and Children*, 21-24.

Hammrich, P. L. (1996). *The resilience of girls in science: Empowering parents the first step*. Paper presented at the first annual Temple Education Research Association Conference. Philadelphia, PA: Temple University, College of Education.

Hammrich, P. L. (1996). *Sisters in science: A model program. Spotlight on Student Success. 201*. Philadelphia, PA: Mid-Atlantic Regional Educational Laboratory, College of Education, Temple University.

Kahle, J. B., & Lakes, M. K. (1983). The myth of equality in science classrooms. *Journal of Research in Science Teaching, 20*, (2). 131-140.

Kaye, H. S. (1997, July). *Disability statistics abstract: Education of children with disabilities, Number 19*. San Francisco, CA: Disability Statistics Rehabilitation Research and Training Center, University of California, San Francisco.

Lang, H. G. (1994). A demonstration lecture in physics for deaf and hard-of-hearing students in mainstream settings. In: G. P. Stefanich & J. E. Dodd (Eds.), *Improving Science Instruction for Students with Disabilities, Proceedings for the Working Conference on Science with Persons with Disabilities,* March 24-28, 1994. Washington, D.C: The National Science Foundation.

Linn, M. C. (1990, July). *Gender, mathematics, and science: Trends and recommendations*. Paper prepared for the Council of Chief State Officiers Summer Institutes, Mystic, CT.

Mastropieri, M., & Scruggs, T. (1992). *A practical guide for teaching science to students with special needs in inclusive settings*. West Lafayette, IN: Purdue Research Center, Purdue University.

Mastropieri, M. A., Scruggs, T. E., & Shiah, S. (1991). Mathematics instruction for learning disabled students: A review of the research. *Learning Disabilities Research and Practice, 6*, 89-98.

Mosle, S. (2000, July 2). The vanity of volunteerism. *The New York Times Magazine,* 22-27, 40, 52-54.

National Science Foundation. (1990). *Women and minorities in science and engineering* (NSF #90-301). Washington, DC: Author.

National Science Foundation. (1996). *Women, minorities, and persons with disabilities in science and engineering.* (NSF #96-311) Washington, DC: Author.

Norman, K., & Caseau, N. (1994). Integrating students with learning disabilities into regular science education classrooms: Recommended instructional models and adaptations. In: G. P. Stefanich & J. E. Dodd (Eds.), *Improving Science Instruction for Students with Disabilities, Proceedings for the Working Conference on Science with Persons with Disabilities,* March 24-28, 1994. Washington, D.C: The National Science Foundation.

Office for Civil Rights. (1992). *The 1992 Common Core of Data Public School Universe File.* Washington, D.C: Office of Civil Rights, U.S. Department of Human Rights.

Rivera, D. P. (1997). Mathematics education and students with learning disabilities: Introduction to the special series. *Journal of Learning Disabilities, 30,* 2-19.

Rosser, S. V. (1990). *Female friendly science.* New York: Pergamon.

Scruggs, T., & Mastropieri, M. (1994). The construction of scientific knowledge by students with mild disabilities. *The Journal of Special Education, 28,* 307-321.

Shewey, K. (1997, February 10). *Women, minorities, and persons with disabilities.* Washington D.C: Government Affairs Program, American Geological Institute. govt@agiweb.org.

Skilton-Sylvester, E. (1997). Beyond Sweet Cakes Town: Using a few good questions to guide students' inquiry into their urban neighborhood. In Edelsky, C. (Ed.) *Making justice our project.* New York: National council of Teachers of English.

Sjobers, S., & Imsen, G. (1988). Gender and science education. In P. Fenshem (Ed.), *Development and dilemmas in science education.* (pp. 218-248). London & Falmer.

Skolnick, J., Langbort, C., Day, L. (1982). *How to encourage girls in math and science: Strategies for parents and educators.* Englewood Cliffs, NJ: Prentice-Hall.

Stefanich, G. P. & Dodd, J. E. (1994). Improving Science Instruction for Students with Disabilities. *Proceedings for the Working Conference on Science with Persons with Disabilities, March, 1994*. Washington, D.C: The National Science Foundation.

Stefanich, G. P. (1994). Preface. In: G. P. Stefanich & J. E. Dodd (Eds.), Improving Science Instructonfor Students with Disabilities, *Proceedings for the Working Conference on Science with Persons with Disabilities, 1994*. Washington, D.C: The National Science Foundation.

Task Force on Women, Minorities, and the Handicapped in Science & Technology. (1989). *Changing America: The new face of science and engineering*. Washington, DC: Author.

U. S. Department of Education. (1991). *Thirteenth annual report to Congress on the implementation of the Education of the Handicapped Act.* Washington D.C: U. S. Government Printing Office.

Wagner, B. V. (1994). Guidelines for teaching science to students who are visually impaired. In: G. P. Stefanich & J. E. Dodd (Eds.), *Improving science instruction for students with disabilities, Proceedings for the Working Conference on Science with Persons with Disabilities, 1994*. Washington, D.C: The National Science Foundation.

Wagner, M. (1995). *The National Longitudinal Transition Study of students in special education.* Menlo Park, CA: SRI.

Whyte, J. (1986). *Girls into science and technology*. London: Routledge & Kegan Paul.

Wilson, J. S. & Milson, J. L. (1993). Factors which contribute to shaping females' attitudes toward the study of science and strategies which may attract females to the stude of science. *Journal of Instructional Psychology, 20*, 78-86.

Ysseldyke, J. E.,Thurlow, M. L.,Wortruba, J., W., & Nanaia, P. A. (1990). Instructional arrangement: Perceptions from general education. *Teaching Exceptional Children, 22*, 4-8.

U.S. Department of Education
Office of Educational Research and Improvement (OERI)
National Library of Education (NLE)
Educational Resources Information Center (ERIC)

ERIC®

Reproduction Release

(Specific Document)

I. DOCUMENT IDENTIFICATION:

Title: Daughters with Disabilities: A professional development model to reframe science, math, and Technology education...	
Author(s): Penny L. Hammrich, Lynda Price, Graciela Slesaransky-Poe, Temple University	
Corporate Source: Temple University	Publication Date: April 2001

II. REPRODUCTION RELEASE:

In order to disseminate as widely as possible timely and significant materials of interest to the educational community, documents announced in the monthly abstract journal of the ERIC system, Resources in Education (RIE), are usually made available to users in microfiche, reproduced paper copy, and electronic media, and sold through the ERIC Document Reproduction Service (EDRS). Credit is given to the source of each document, and, if reproduction release is granted, one of the following notices is affixed to the document.

If permission is granted to reproduce and disseminate the identified document, please CHECK ONE of the following three options and sign in the indicated space following.

The sample sticker shown below will be affixed to all Level 1 documents	The sample sticker shown below will be affixed to all Level 2A documents	The sample sticker shown below will be affixed to all Level 2B documents
PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL HAS BEEN GRANTED BY .... SAMPLE .... TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)	PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN MICROFICHE, AND IN ELECTRONIC MEDIA FOR ERIC COLLECTION SUBSCRIBERS ONLY, HAS BEEN GRANTED BY .... SAMPLE .... TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)	PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY .... SAMPLE .... TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
Level 1	**Level 2A**	**Level 2B**
↑ [✓]	↑ [ ]	↑ [ ]
Check here for Level 1 release, permitting reproduction and dissemination in microfiche or other ERIC archival media (e.g. electronic) *and* paper copy.	Check here for Level 2A release, permitting reproduction and dissemination in microfiche and in electronic media for ERIC archival collection subscribers only	Check here for Level 2B release, permitting reproduction and dissemination in microfiche only

Documents will be processed as indicated provided reproduction quality permits.
If permission to reproduce is granted, but no box is checked, documents will be processed at Level 1.

I hereby grant to the Educational Resources Information Center (ERIC) nonexclusive permission to reproduce and disseminate this document as indicated above. Reproduction from the ERIC microfiche, or electronic media by persons other than ERIC employees and its system contractors requires permission from the copyright holder. Exception is made for non-profit reproduction by libraries and other service agencies to satisfy information needs of educators in response to discrete inquiries.

Signature: [signature]	Printed Name/Position/Title: Penny L. Hammrich Associate Professor	
Organization/Address: Temple University 337 RH, 1301 Cecil B. Moore Ave. Philadelphia, PA 19122	Telephone: 215-204-1520	Fax: 215-204-1414
	E-mail Address: phammric@temple.edu	Date: 5/01

III. DOCUMENT AVAILABILITY INFORMATION (FROM NON-ERIC SOURCE):

If permission to reproduce is not granted to ERIC, or, if you wish ERIC to cite the availability of the document from another source, please provide the following information regarding the availability of the document. (ERIC will not announce a document unless it is publicly available, and a dependable source can be specified. Contributors should also be aware that ERIC selection criteria are significantly more stringent for documents that cannot be made available through EDRS.)

Publisher/Distributor:
Address:
Price:

IV. REFERRAL OF ERIC TO COPYRIGHT/REPRODUCTION RIGHTS HOLDER:

If the right to grant this reproduction release is held by someone other than the addressee, please provide the appropriate name and address:

Name:
Address:

V. WHERE TO SEND THIS FORM:

Send this form to the following ERIC Clearinghouse: Elementary Science Education or Disabilities Education

However, if solicited by the ERIC Facility, or if making an unsolicited contribution to ERIC, return this form (and the document being contributed) to:

ERIC Processing and Reference Facility
4483-A Forbes Boulevard
Lanham, Maryland 20706
Telephone: 301-552-4200
Toll Free: 800-799-3742
e-mail: ericfac@inet.ed.gov
WWW: http://ericfac.piccard.csc.com

EFF-088 (Rev. 9/97)