

The Union County 4-H Summer Science Program

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Program of Distinction Category

Workforce Preparation, Science Engineering and Technology

Sources of funding that support this program

Schering-Plough Corporation - \$8,800 per year, non-profit day camps in Union County, NJ - \$1,000 per year and Rutgers Cooperative Extension 4-H Program of Union County – 50 hours of salary for one 4-H Agent.

Program Content

Knowledge and Research Base

The 4-H Summer Science Program is unique in many ways. First, it is a 4-H program that is not volunteer-based. Due to the intensive nature of the program (40-hours per week, seven-weeks), it was decided that using paid employees would work best, a finding that is corroborated by the Extension Expanded Food and Nutrition Education Program. Secondly, this program was the first of its kind in Union County to bring science into day camps located in the low-income parts of the county. While science is a field of study in all of the county's grammar schools, it had rarely been offered at a professional level through the low-income summer day camps. Lastly, this program was implemented with several groups that had not previously collaborated with 4-H.

The Union County 4-H Summer Science Program is partially based on the 4-H S.E.R.I.E.S. program as developed by Dr. Richard Ponzio in 1989. "S.E.R.I.E.S." stands for "Science Experience and Resources for Informal Education Settings." S.E.R.I.E.S. was developed with support from the National Science Foundation. According to personal correspondence with the principal author of the curriculum, Richard Ponzio, S.E.R.I.E.S. has been used throughout the United States. (A web search documented it had been used in many states and is currently being used in Nebraska, California and Wisconsin.) It is also being used in Africa and several Latin American countries. Although a formal evaluation of the program could not be found, personal use of the curriculum by the program's director, several New Jersey 4-H colleagues, and its wide-spread use, attest to its effectiveness.

S.E.R.I.E.S. is effective because it is experiential in nature. Quoting from S.E.R.I.E.S. materials, "The instructional model used in presenting the inquiry based activities is an adaptation of Karplus' Learning Circle." The learning cycle consists of the following steps: Exploration, Concept Introduction, and Concept Application. In the Exploration phase, again quoting from the S.E.R.I.E.S.

curriculum, "the youth learn through their own actions and reactions with minimal guidance or expectation of specific accomplishments." In the Concept Introduction phase, they "begin with the introduction of a concept or principle related to the activity or unit." The last phase is the Application phase. Activities in this phase provide "relevance and connection between what is being learned in the world by focusing on high intrinsic interest topics chosen by the participants themselves."

The effectiveness of programs such as S.E.R.I.E.S. was evaluated by the National Science Foundation in 1998. In its report, "A Report on the Evaluation of the National Science Foundation's Informal Science Education Program," there is a broad overview of the effectiveness of programs such as S.E.R.I.E.S. More specifically, Exhibits 8, 9 and 10 of the study document how a significant number of current scientists became interested in science because of exposure to it through programs such as S.E.R.I.E.S. A copy of the report is available from the National Science Foundations' website at <http://www.nsf.gov/pubs/1998/nsf9865/nsf9865.htm>.

While the 4-H Summer Science Program initially used the S.E.R.I.E.S. materials to start the program, we have since used many other curriculum source materials such as those from the National Science Teachers Association and School Age Notes.

Needs Assessment

Union County New Jersey is an urban/suburban county of 496,000 people. While much of the county is of middle to upper income background, large pockets of poverty remain. In the City of Plainfield, 15% of the residents live below the poverty level; in Rahway, 6%; and in Elizabeth, 17% (The New Jersey Municipal Data Book, 2005, p. 131, 400, 413, 592). In these pockets, test scores in the area of science are extremely deficient. The county average on the New Jersey Science Proficiency test in the 4th grade is 81%. However, the three poorest areas of Elizabeth, Plainfield and Rahway score 27%, 57% and 62%, respectively (*The Star Ledger*, 2006). In the case of Elizabeth, this is almost 54% lower than the state average.

The low-scores in the New Jersey Science Proficiency test in the 4th grade occur despite the fact that the children in the areas of Plainfield, Elizabeth and Rahway like science. A 4-H questionnaire given to the children in 1996 and 2000 showed that a majority of the children do like science.

This poor performance in science has severe consequences. It excludes students from well-paying careers in the science field. According to the Bureau of Labor Statistics, the average salary for a physical scientist is \$80,000 per year. This is almost four times what many restaurant and service workers earn. Even a lower level science job, such as a science technician, pays well at an average salary of \$29,000 per year (United States Department of Labor, 2004-5). Union County also has many science related jobs. It is the world headquarters for the pharmaceutical company Schering-Plough. Its corporate campus in Kenilworth, New Jersey, employs over 5,000 workers. Merck, another New Jersey pharmaceutical company, has a facility in Rahway that employs over 4,000 workers. The county has many other smaller firms that require knowledge of science.

Goals and Objectives

The goal of this program is to increase low-income students' interest in science. The program's objectives include:

- Enroll 500 students in the 4-H Summer Science Program; 300 of whom will be from low income backgrounds.
- Have 50% of the students in the program report that they can solve a problem better as a result of the 4-H Summer Science Program.
- Have 50% of the students in the program report that they can observe things better as a result of the 4-H Summer Science Program.
- Have 50% of the students in the program report that they can do an experiment as a result of the 4-H Summer Science Program.
- Have 50% of the students say they like science more as a result of the 4-H Summer Science Program.
- Have 50% of the students say they would like to learn more about science as a result of the 4-H Summer Science Program.
- Have 50% of the students in the program report that they will tell someone what they learned.
- Have 25% of the students in the program report that they would like to become a scientist someday.
- Have 50% of the students in the program meet at least one scientist in person.

These goals are based on similar 4-H programs that have been done by 4-H in Union County in the areas of horticulture, nutrition, and other programs.

Target Audience

The target audience for this program is 300 low-income youth in grades 1 to 6 residing in the Union County, NJ, from the communities of Plainfield, Elizabeth and the eastern section of Rahway. These communities were chosen because of their high poverty rates (15, 17 and 6 percent respectively), free school lunch figures and their low achievement on standardized test scores. While 300 is only a very small percentage of the low-income youth in these communities, it is still a significant number of youth, especially in light of the effort needed to reach low-income children. We note that children in this program were not hand-selected based on family income. Rather, we assume that children in the program are likely to be poor because they are drawn from poor neighborhoods.

The majority of the youth in these areas are of African-American and Hispanic backgrounds. These backgrounds are taken into consideration when we select role-models to visit the programs. We try to have role-models who the children can ethnically relate to. In the course of a summer, the program serves approximately 500 youth. The sites are located in the neighborhoods with the greatest need. These youth attend the following summer day camps: in Plainfield - the YMCA, King's Daughters Day School, Neighborhood House, The Black United Fund, Girl Scouts of Washington Rock Council, and the YWCA Summer Day Camp; in Rahway

- the JFK Community Center Day Camp and the Rahway Recreation Department; in Elizabeth - the Elizabeth Coalition to House the Homeless Day Camp and the Elizabethport Presbyterian Center Day Camp. These are not all the day camps in these areas, but our resources do not allow us to service more groups.

Program Design and Content

Type of program

Enrichment Program for summer day camps.

Methods used to deliver the program

4-H hires and trains instructors for the program. The majority of the instructors have been experienced grammar school teachers with an interest in science. We have also hired college students with an interest in teaching and with backgrounds in science. The college students have done well with the program but need more training and supervision. Training is provided by the program director, a certified K to 12 science teacher, and other New Jersey 4-H Faculty.

The instructors then provide the children with seven 45-minute sessions of science instruction over a seven-week period, or one visit per week for seven weeks. The children are participants in summer day camps. These camps are run by a variety of non-profit groups (e.g., YMCA) in the low-income neighborhoods of Union County. 4-H provides a science component for the camps. Without 4-H, the camps would not be able to offer science as a component. Not only does 4-H empower the camps to offer science by providing the instructors, but the instructors travel to the day camp sites rather than have the sites transport the children to the Union County 4-H Center.

The science class we offer complements the other activities offered at the day camps, such as arts and crafts and recreation. We are not duplicating an existing program. 4-H presents a different science theme each year. Some past themes have been the human body, aeronautics, robotics, kitchen chemistry, and physics with toys. We work with small groups at the day camps--only 10 children or less. This allows us to proceed more rapidly than similar lessons in a classroom of 20 students or more. Thus, the students begin to understand that science is action-oriented, rather than tedious and slow- moving. The standard length of each group session is 45 minutes.

In addition to the standard group sessions, we also have scientists and science workers who visit the day camps. They offer a hands-on activity that reflects their occupation. We have had chemists demonstrate a variety of chemical reactions. Biologists demonstrate mock programs about how a compound becomes a pharmaceutical, and microbiologists show the children how scientists look at cells. These activities are successful because they are age appropriate, hands-on and reflect what the scientists actually do in their full-time positions.

A sample schedule for the seven week program is as follows:

- Unit Title – Trees
- Week One and Two – The Process of Science;
- Weeks Three, Four, and Five – Using Your Senses to Learn About Trees;
- Week Six – Being a Tree Doctor;
- Week Seven – Science as A Career – Visit from Schering Plough Scientist.

Curricula and/or educational materials

4-H S.E.R.I.E.S. Curriculum – S.E.R.I.E.S. stands for “Science Experience and Resources for Informal Education Settings”. It was created in 1988 by the University of California. The overall goal of the 4-H S.E.R.I.E.S. curriculum is to increase the quality and quantity of science experiences for youth. The curriculum is designed for 9 to 12 year olds, but can be simplified for younger audiences. The curriculum is made up of eight units. The units used in the Union County 4-H Summer Science Program were: *Beyond Duck and Cover*, *Chemicals Are Us*, and *Sciencing with Snails*. In *Beyond Duck and Cover*, the first lesson details how earthquakes are measured. The children construct their own quake meter using a coffee can. The next lesson uses slinkies to show the motion of earthquakes. The final lesson allows the children to construct model buildings and subject them to earthquake-like forces. *Chemicals Are Us* uses basic household chemicals like vinegar and salt to explore how elements react. One of the lessons has the children test household products such as salt and baking soda to see which one can clean soiled copper pennies. *Sciencing with Snails* uses live snails to learn the basic processes of science. The first lesson is about discovering what snails prefer to eat. The second puts the snails through a variety of physical challenges to see what they are capable of. For instance, children learn whether snails can walk over a tight-rope, pull a toy car, or crawl over a nail. All the units are useful, but *Sciencing with Snails* has become difficult to use due to a lack of availability of snails. (Many suppliers can no longer ship them across state lines.)

According to the author of the curriculum, Dr. Richard Ponzio, it has been used in almost every state and several other countries. It has also been translated into Spanish. The 4-H Summer Science Program initially used the S.E.R.I.E.S. materials to start the program, but have since used other curriculum materials. From the National Science Foundation, we have used “Teaching Physics with Toys – Activities for Grades K to 9” by Taylor, Poth and Portman. We have also used “Fender Bender Physics” by Bevin and Raudebaugh. The School Age Notes company provided us with several publications that are no longer in print.

Partnerships or collaborations

The program is supported by several non-profit groups that host the day camp sites. In Plainfield, our partners are the King’s Daughters Day School, The YMCA and YWCA, Neighborhood House, The Black United Fund, and the Girl Scouts of Washington Rock Council. In Rahway, our partners are the JFK Community Center and the Rahway Recreation Department. In Elizabeth, we work with The Union County Coalition to House the Homeless and The Elizabethport Presbyterian Center.

The non-profits mentioned above provide sites for our program to meet and recruit the children for the programs. Without their efforts, we would not have students or places to meet. It is their complete program. Besides the science help we provide, the camps provide an environment that attracts children - arts and crafts, recreation, meals, and all day supervision. A one period stand-alone science program would not attract children who need all day childcare. The centers also provide funds for the science materials.

Just as much as 4-H needs the centers, they also need us. They do not have sufficient funds to hire workers who can teach science lessons to the children. Without the 4-H teachers, they would eliminate science from their programs. The funder for our program is the Schering-Plough Corporation of Kenilworth, New Jersey. This company also supplies science role-models. This means they allow their chemists, biologists, and other science workers to visit the day camp sites. During their visits with the children, they describe their work, carry out a hands-on activity that relates to their work, and discuss the training their job requires. When the program first started in 1992, the camps had much input into the schedule of the program. We would meet as a group and try to come up with a schedule that worked for everyone. Since that time, we have pretty much stuck to this schedule and added new groups into spots vacated by old. As to the sites giving input into the curriculum, this is something we have not done. However, they seem to be happy with what we select as some camps have been with the program since its inception.

Program Evaluation

Process Evaluation

The 4-H Summer Science Program has grown greatly since its inception in 1992. Only 40 students participated that year. The program expanded greatly during the next year, reaching approximately 250 students. This increase was made possible by increasing our teacher's hours from half-time to full-time. We also made the program less intensive. Instead of offering 14 sessions, we lowered the number to seven so that we could reach more youth. In 1996, the number of students doubled by hiring an additional full-time teacher. Since that time, we have had approximately 500 students in the program each summer. They each receive seven science lessons during the course of a summer.

A typical lesson at a center looks like this. The children, usually a group of 8 to 10, meet with the 4-H Instructor in a quiet area. There, the instructor takes attendance and teaches her lesson. A lesson lasts about 45 minutes. The lesson is repeated for six groups of children during the course of a day.

As we implemented this program, we identified several challenges. First, despite the positions being fairly well paid (\$14 to \$15 per hour), initially it was difficult finding instructors for the program. The program director found that full-time teachers often do not want full-time jobs during their summer vacations. Also, some were unwilling to work in low-income neighborhoods. To overcome this, the program director refocused his recruiting efforts, advertising more for the type of teachers who were interested in summer work--new teachers and those who worked in private schools. Both were more interested in summer positions because of their financial situation.

Another initial challenge was locating day camps in low-income areas. They were often difficult to find because they were not widely advertised. This may be due to limited funds for advertising. However, we were able to locate them through recreation departments, religious organizations, and our local Community Coordinated Child Care Program.

Outcomes and Impacts

In 1996 a pre-test and post-test questionnaire was given to the students. It revealed that the program:

- increased the number of students who would consider a science as a career by 20% (100 out of 500 students)
- increased the number of students who like science by 8% (40 out of 500)

A separate post-program evaluation in 2001 revealed that:

- 70% of the participants said the program taught them a lot about how to solve a problem (350 out of 500 students)
- 66% said they learned a lot about how to do an experiment (330 out of 500 students)
- Quotes from the children on the evaluation such as "I can do an experiment", "I can be my family's scientist," and "This is something I could do for my school science program" further attested to the program's usefulness.

Our most recent evaluation of the program in 2006 (Please see Appendix 1: 4-H Summer Science Program: Post-program questionnaire for a copy of the evaluation instrument) was an end of program survey of selected students. As the table below illustrates, we found that the program increased the children's problem solving ability, observation skills, and fondness for science.

Table 1: Results of 2006 End of Program Survey

Survey Statement: "As a result of the 4-H Summer Science Program..."	% YES	% NO
...I can solve a problem better now."	120 of 136 88%	16 of 136 12%
...I can observe things better."	111 of 136 82%	25 of 136 18%
...I can do an experiment."	120 of 136 88%	16 of 136 12%
...I like science more than before."	95 of 133 71%	38 of 133 29%
...I would like to learn more about science."	103 of 134 76%	31 of 134 24%
...I will tell someone what I learned."	90 of 134 67%	44 of 134 33%

Survey Statement: "As a result of the 4-H Summer Science Program..."	% YES	% NO
...I would like to become a scientist."	46 of 134 34%	88 of 134 66%

Because of its effectiveness, the program has been in existence for 13 years. In that time, the program has received \$96,000 in donations, most of which has come from the Schering-Plough Corporation.

Table 2: 4-H Summer Science Program Enrollment from 1992 To 2006

YEAR	APPROXIMATE # OF STUDENTS	# OF CENTERS PARTICIPATING
1992	40	1
1993	250	5
1994	250	6
1995	250	4
1996	500 (added 2 nd full-time teacher)	5
1997	500	4
1998	400	8
1999	400	9
2000	500	8
2001	500	9
2002	500	9
2003	500	9
2004	500	10
2005	500	9
2006	600 (added 3 rd teacher for quarter-time)	12

Communication to stakeholders

Information about the 4-H Summer Science Program has been widely distributed. Articles about the program have appeared at various times in the major newspaper of Union County, *The Star-Ledger*. The articles highlighted the purpose of the program and the concepts that were being taught. In 1996, we wrote an annual report about the program and distributed it to all the participants. In 2004, an article about the program was published in *The Journal of Extension*. In that same year, information about the program appeared in Schering-Plough's annual shareholders report. Lastly, in 2005 the program was featured on the NBC Nightly News, New York City affiliate. More efforts will be made in the future to inform the students' parents about the program, as will efforts to share evaluation results with the host centers.

Program Sustainability

When the 4-H Summer Science Program started, it was initially funded by a private foundation known as the Janet Memorial Fund. When the Fund was no longer able to support the program, the program director approached the Schering-Plough Corporation. They have been our funder for the last 13 years. They have funded the program so faithfully because it reaches an audience that they are deeply committed to helping.

However, if Schering-Plough could no longer fund the program, it is likely that many other funding streams could be found. For instance, Union County is also the home to the pharmaceutical company, Merck. Lastly, if sufficient funds could not be found to carry on the program as it currently exists, a 'Train-the-Trainer' model could be adopted. Using this model, we would train summer camp staff to carry on the program in place of paid teachers. This would be a dilution of the program, but at least not a cessation of it.

Replication

Information about the program was distributed to 70 4-H professionals at the 2003 NAE4-HA Conference in Salt Lake City, Utah. This information included sample proposals to use with funders, sample letters to recruit the centers, sample letters to recruit teachers, and sample evaluations. All together, there were 25 pages of information shared with workshop participants. The recipients of this information were mailed a follow-up survey in January 2004 to find out how they had used the information. Of the people who responded, 58% said they were using the information as reference material for creating some type of science program for youth.

Rationale and Importance of Program

Union County, New Jersey is an urban/suburban county of 496,000 people. Much of the county is of middle to upper income, but large pockets of poverty remain. In the City of Plainfield, 15% of the residents live below the poverty level, in Rahway 6%, and in Elizabeth 17%. In these pockets, test scores in the area of science are extremely deficient. While the county average for science testing in the 4th grade is 81%, the three poorest areas of Elizabeth, Plainfield, and Rahway score a 27%, 57%, and 62%. The 4-H Summer Science Program provides low-income

youngsters with additional science instruction and encouragement to pursue their school academic work with vigor.

The need for low-income students to pursue science studies with vigor was emphasized to the program director in 1998 when he was speaking with Plainfield High School Students. They were discussing careers they might pursue in the future. While the majority wanted careers in sports, entertainment, beauty culture, and the post office, not one mentioned science. Yet just 10 miles from where they stood, there were hundreds of well paying career opportunities in the field of science. The program director concluded that they hadn't considered these jobs because they had never met anyone in the field of science.

References

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Appendix 1: 4-H Summer Science program: Post-Program Questionnaire



Date: _____

Grade in September: _____

Center: _____

As a result of the 4-H Summer Science Program...
(Please circle "yes" or "no" to finish each sentence.)

- | | | |
|--|-----|----|
| 1. I can solve a problem better now. | YES | NO |
| 2. I can observe things better. | YES | NO |
| 3. I can do an experiment. | YES | NO |
| 4. I like science more than before. | YES | NO |
| 5. I would like to learn more about science. | YES | NO |
| 6. I will tell someone what I learned. | YES | NO |
| 7. I would like to become a scientist. | YES | NO |