

AN INTERVENTION MODEL PROGRAM FOR MIDDLE SCHOOL GIRLS

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ABSTRACT

GEMS, Girls in Engineering, Math, and Science, is a pre-college interventional model program for 11 year old girls designed to enhance the probability that girls will eventually follow careers in science, engineering, and math. The program was developed through a grant from the National Science Foundation. The program was first held on the Texas A&M campus during June and July of 1994. The applicants were primarily from the Bryan/College Station and San Antonio areas. Applicant selection was based on a first come - first serve basis. The parents of participants were also required to attend a pre-camp meeting to introduce the goals of the program and to provide them with information on college entrance requirements and student scholarship and loan availability.

The program places 120 eleven year old girls in a university residence setting for one week and allows them the opportunity to have successful "hands-on" laboratory experiences with complex (to them) scientific equipment. The program is designed to enhance their self-confidence at a crucial transition period between elementary and middle school. The laboratory activities include introductions to microscopy, electronics, materials testing, computer aided design, and chemistry to name a few. This program introduces young girls to a new subject matter in a fun and friendly environment, but also by presenting the girls student and faculty role models.

Key Words: Girls Science Program, NSF Model Program, Girls Intervention Program in Science, Math, and Engineering.

THE GEMS MODEL PROGRAM

The Girls in Engineering, Math, and Science (GEMS) program is a model intervention program sponsored by the National Science Foundation that focuses on the middle school level. The program is designed to enhance the probability that girls will remain on the math and science path throughout high school and eventually select careers in engineering, math, and science.

The GEMS Program offered a unique opportunity for 120 eleven year old girls to come to the Texas A&M University campus for a five day residential



program providing "hands-on" science and engineering activities.

RECRUITMENT OF PARTICIPANTS

While there are many programs directed toward the gifted and talented, the GEMS program was open to all eleven year old girls, on a first come, first serve basis. The girls were required to pay a ten dollar application fee. Recruitment was first through the "Expanding Your Horizon (EYH) in Science and Math Conference for Girls" under the auspices of the Math/Science Network and sponsored by many colleges and universities. This program is a one day program which seeks to increase girls' interests in science and math. The GEMS recruitment was first through the EYH program since their participation demonstrated an interest in science and math. The program was then opened to recruitment through the schools. The response was overwhelming with over twice as many girls applying as could be accommodated. About one third of the participants were minorities.

Pre and Post Program Meetings

All participants and their parents were required to attend a pre-program and post-program meeting. Attendance at the pre-program was mandatory for participation in the program. At the pre-program meeting, the girls and their parents were introduced to the activity leaders who were all women scientists and engineers. Each activity leader gave a short introduction to their specialty. The dorm counselors and day helpers, students majoring in SEM, were also introduced. The Program rules were distributed to the girls and their parents. The parents were put on notice that they would be notified to pick up their child if the rules were not followed. A presentation was also made on the high school requirements to enter SEM majors in college and financial aid and scholarships. The parents were also given literature on both subjects.

At the Post-Program meeting, the girls were presented with certificates of achievements for their participation in the GEMS program. Each girl's name was announced as she walked across the stage to receive her certificate. The certificate provides a positive, tangible, and lasting reinforcement for their participation in science and math endeavors. The girls and their parents were also informed of other youth programs the university sponsors for other age groups.

GEMS PROGRAM ACTIVITIES

The residential setting on a university campus offered the girls a unique opportunity to attend a special program just for them, increases their standing among their peers. In addition, the "hands-on" *successful* laboratory experiences with complex (to them) scientific equipment enhances their self confidence at a crucial transition period between elementary and middle school. The girls were



also given an introduction to college dorm life and school spirit. It was felt that this was an important component of the program because it provides a more tangible experience for them to look forward to and strive for academically. The activities were selected to give them as broad an experience as possible of science and engineering for their age level and within the limited time available.

A typical schedule of activities for the GEMS Program is presented below. There was some variation between the three sessions, forty girls each session, to reflect special events on campus. The activities are briefly discussed in chronological order.

Concrete Lab

The girls were first given a brief lecture on the properties of concrete, the equipment to be used, and the procedures for making and molding the concrete batches. Each group was given a different mix design. Each group made a small batch of concrete, measuring, weighing, and mixing the materials themselves, and then cast three cylinders. After the cylinders cured for four days, the cylinders were tested using an Instron, and the strength data was graphed.

Microbiology Lab

The girls were first introduced to the parts of the microscope and how to use one. The activities included: (1) inoculating blood agar plates with their fingertips and observing the bacteria growth after 24 hours of incubation; (2) examining pond water under the microscope and identifying the organisms; (3) activating yeast, incubating the preparation in a water bath, observing the formation of gas through the use of a balloon covering the test tube, and examining the budding yeast under the microscope; (4) examining nematodes at different stages under the microscope; and (5) examining stained peripheral blood smears under a teaching microscope with an activity leader pointing out the types of cells and their importance.

Computer Lab

The girls were taught the basics of the computer-aided drafting program they would use later in the week. The role of the engineer in planning projects and elements of good site planning were discussed after which the girls played Sim City.

Instrumentation and Measurements

The girls were introduced to the basic vocabulary of measurements and instrumentation. The activities included: (1) measuring a set of spools with a tape measurer, vernier caliper, and micrometer. They were also taught to average the results of multiple readings; and (2) measuring the resistance of electrical resistors and voltage of 9V batteries using a digital multimeter.



Physics

The girls were introduced to the principles of forces in motion, friction, and pulley systems. The activities included: (1) measuring the force required to lift a load using different configurations of pulley systems; (2) investigating the types of wheels used for different jobs: wheels with treads, wheels on rails, or smooth wheels; and (3) investigation of the effect of friction from different surfaces on moving objects.

Drafting Lab

The night before the drafting exercise, the girls were given measuring tapes and asked to sketch their dorm room with furniture, and add dimensions to the sketch.

In the drafting lab, they were given engineering scales, triangles, and paper. After a brief discussion on how to use the drafting tools, the girls were asked to prepare a drawing of their room to scale. Almost every girl had never drawn an object to scale prior to this experience. Most girls felt this was the most difficult exercise. The second drafting lab was held in the computer lab where the dorm room was again drafted using a computer aided design drafting program they were introduced to earlier in the week.

Chemistry

The girls were given an introduction to polymer chemistry. The experiments included: (1) making Slime and Gleup, (2) measuring the absorbency of hydrophobic and hydrophilic synthetic polymers, and (3) "shrinking" and "stretching" polymers.

Tours

The girls were taken on several short tours of: (1) the Offshore Technology Research Center containing the wave testing facility, (2) the Ocean Drilling Research Center, (3) the Equine Center, (4) the Dairy Center (Milking Barn), (5) the Exotic Animal Research Center at the School of Veterinary Medicine, (6) the Mapping Science Laboratory, (7) the Meteorology Center, and (8) the Laser Research Laboratory.

PROGRAM EVALUATION

Program Evaluation consisted of three parts: (1) Daily Reflections to open ended questions, (2) a Post-Program Questionnaire of participants and parents, and (3) a Long Term Assessment of the influence of the GEMS Program on their career path at the college level.

Daily Reflections

At the end of each day, the participants met in groups with their assigned counselor. Each girl was given a bound notebook with tear out pages and carbon paper in which to respond to the questions presented below. The original was turned in to the counselor and the copy remained in their notebook. The girls were also encouraged to use the notebook as a diary. The written responses were followed by a group discussion. The written responses and group discussions were directed toward the following questions: (1) What was the best thing about your day today? (2) What one thing you did today will you remember for a long time? (3) What suggestion would you like considered in planning for tomorrow? (4) What did you do today that you have never done before? (5) What did you do today that required you to use math? (6) Describe the type of work an engineer or scientist does related to today's activities? (7) Would you like to be an engineer or scientist? Why or why not? The responses to the activity related questions closely reflect the responses to the questions posed in the post program questionnaire.

Post-Program Questionnaire

Responses to activity related questions are presented in Table 1, Participant Perceptions: Pre and Post Activity Evaluations. The activities the participants liked the best were chemistry, microbiology, and concrete labs. The activities with the lowest ratings were the measurements and manual drafting activities. These two activities were also the most tedious and sedentary activities which may account for the lesser interest.

THE GEMS ACTIVITY BOOK AND PROGRAM MANUAL

Each girl was given a three ring binder containing detailed instructions for each of the program activities and data recording sheets. The Activity Book also contained additional experiments and activities that could be done at home.

The Program manual contains examples of all the administrative materials developed such as letters, forms, instructions, and rules. The Manual also includes an Activity Book.

CONCLUSION

The GEMS program provided an opportunity for 120 eleven year old girls to be introduced to many areas of science and engineering using hands-on activities. The girls' academic careers will be followed through college to measure the effects of the program.



Table 1. Participant Perceptions: Pre and Post Activity Evaluations

Survey Question	Before the activity, did it interest you?		Did you like it after it was over?		Did you like it more or less than you thought you would?		Would you like to do this type activity again?		How would you rate the activity?			
	Responses		Responses		Responses		Responses		Responses			
	Yes	No	Yes	No	More	Less	Yes	No	Very Interesting	Interesting	Not Interesting	
Activity									3	2	1	
Concrete n Percent*	69 73%	25 27%	87 93%	7 7%	77 82%	17 18%	82 87%	12 13%	66 70%	25 27%	3 3%	
Microbiology n Percent*	72 77%	22 23%	91 97%	3 4%	79 84%	15 16%	89 95%	5 5%	72 77%	22 23%	0 0%	
Computer n Percent*	75 80%	19 20%	79 84%	15 16%	75 80%	19 20%	82 87%	12 13%	65 69%	21 22%	8 9%	
Measurements n Percent*	54 57%	40 43%	72 77%	22 23%	56 70%	38 40%	66 70%	28 30%	33 35%	42 45%	19 20%	
Physics n Percent*	61 65%	33 35%	84 89%	10 11%	74 79%	20 21%	77 82%	17 18%	36 38%	51 54%	7 8%	
Drafting n Percent*	60 64%	34 36%	63 67%	31 33%	68 72%	26 28%	68 72%	26 28%	53 57%	24 25%	71 18%	
Chemistry n Percent*	79 84%	15 16%	94 100%	0 0%	84 89%	10 11%	88 94%	6 6%	77 82%	16 17%	1 1%	

