

Washington MESA Summer Program for Girls: Using Computers in Science

Nancy Cook, Ph.D.

University of Washington
Seattle, Washington

Washington MESA (Mathematics, Engineering, Science Achievement)

Washington MESA's mission is to assist our state and nation in achieving an educated citizenry that is globally competitive and individually competent in mathematics, engineering, and science, with full participation of African Americans, Hispanics, Native Americans, and women. MESA accomplishes this through a partnership of higher education, school districts, business and industry, and community organizations. The partnership is dedicated to providing underserved students with an education process that increases their interest, effective participation, and contribution to mathematics, science, and engineering.

Washington MESA is housed in the University of Washington's College of Engineering and coordinates programs in four Centers across the state. These four centers serve nine districts which comprise 71% of the African American, Hispanic, and Native American peoples who live in Washington state. The Seattle Center, sponsored by the University of Washington's College of Engineering and the Tacoma Center, sponsored by Pacific Lutheran University's College of Natural Sciences and Engineering, serve large urban school districts in which 85% of the MESA students are African American; the Yakima Valley Tri-Cities Center, sponsored by Washington State University, serves a large rural population in which 76% of the MESA students are Hispanic; and the new Center in Spokane, jointly sponsored by Washington State University and Gonzaga University, is currently developing model programs to serve Native American and rural female students.

Washington MESA is funded by the State Legislature to provide academic support to middle and high school students across the

state from populations that have been historically underrepresented in the sciences - African Americans, Hispanics, Native Americans, and women. In 1989 - 1990, Washington MESA served over 1600 students in 39 schools across the state. MESA's academic support services for these students consist of an elective science class at the high school level, enriched mathematics classes at the middle school level, tutoring, college preparatory workshops, and summer science programs at both the middle and high school levels. This paper presents an overview of the Seattle MESA summer program for middle school girls.

Seattle MESA Summer Program for Middle School Girls

The Seattle MESA Summer Program for Girls, funded by a Department of Energy Pre-Freshman Engineering Program Grant, consists of a five-week summer session held on the University of Washington campus. A multi-cultural group of seventh and eighth grade girls from the greater Seattle area meet for four hours each morning, 8 a.m. until 12 noon, Monday through Friday, to acquire first hand knowledge of computers and how they are used in the sciences. In 1989 - 1990, 31 students - ten African American, three Asian, fifteen Caucasian, two Hispanic, and one Native American - participated in hands-on science labs in which the computer was used as the basic tool to collect and analyze data. (MESA also offered this program to a co-educational group of underrepresented minorities in which sixteen African American, two Asian, three Hispanic, and two Native American females participated.)

The Seattle MESA Summer Program for Girls' staff consists of two teachers and two teaching assistants, all female. The two staff teachers are middle school science teachers who are particularly interested in encouraging young women to enter the sciences. The teaching assistants are university students majoring in the sciences or in engineering. In addition, female university faculty and graduate students, or female scientists employed in industry, work with the students on at least one project a week. In consideration of the need to provide ethnically diverse role models to the girls, the ethnic composition of the staff reflects as closely as possible that of the girls.

Program Curriculum

The program is supported by an Apple, Inc. EQUAL TIME Grant and a

Department of Education Discretionary Fund for Mathematics and Science Education Grant. The Apple Grant provided sixteen Apple IIGS's, and the Department of Education Grant provided funds for the development of curriculum using computers in hands-on science activities. Having the computers in the classroom at all times allowed the teachers to develop activities that depended on computers rather than activities in which computers were optional. The continual access to computers allowed students to use the computer whenever necessary. Frustration was minimized; data could be collected, analyzed, and graphed in one session, rather than having to wait for access to the computer lab, as is the case in most school settings.

The curriculum for the program consists of five one-week units, each focused on a different scientific topic: *Computers in Science*, *The Heart*, *Water Quality Control*, *Machines*, and *Electricity*. The study of each topic begins with a focus on the basic science and then moves to an investigation of the technological applications in that field. Each unit consists of science activities that involve: 1) hands-on laboratory experience; 2) interactive use of computers; 3) small group, cooperative work; 4) scientific reasoning; 5) writing lab reports; 6) keeping science journals; 7) campus field trips to science and engineering labs; 8) activities led by university or industrial scientists and engineers; and 9) field trips to industrial sites involved in projects that are related to the week's focus. For instance, the unit on the heart begins with a study of the heart, its components and their functions. The girls, working in teams, dissect sheep hearts and then learn how to replace valves and do bypass surgery. The next day is spent on physical fitness, and the girls use the *Cardiovascular Fitness Lab* (HRM) - a computer probe that measures heart rate - to investigate the effects of such variables as exercise or relaxation on the heart. The focus then moves to technological aids used in cardiology. The girls use ultrasound to track the blood flow through their arms, they examine artificial hearts, and they visit the cardiology research labs at the University Primate Center. The unit ends with a tour through the Cardiology wing of the University Hospital.

The students use the computer in different ways in each unit. During the first week, in *Computers and Science*, the students become familiar with general applications, such as word processing and spread sheets. The girls are introduced to keeping a science

journal, and they learn how to use spread sheets for data collection and analysis. In the *Heart* unit, the students utilize probes to collect on-line data and simulations to better understand the function of the heart and its role in the circulatory system. In *Water Quality Control* and *Machines*, the students enter data into spread sheets and do the necessary data analysis on the computer. In both these units, the data are automatically downloaded into *TimeOutGraph* (Beagel Brothers), which allows the students to experiment with a variety of graphing techniques. In *Machines* and *Electricity*, the students use simulations to help them better understand the concepts being introduced. In *Machines*, the students explore the building of compound machines and study the effect of each component on the overall efficiency ratio, in preparation for the Compound Machine Contest to be held on the last day of the unit. In *Electricity*, the students experiment with a variety of circuits. After introductory sessions with parallel and series circuits, they experiment with them. They learn that if they use numerous toasters and hairdryers at the same time they will overload the circuit and trip the breaker, whereas they can plug televisions or radios into every outlet without tripping the breaker.

One facet of the program that has become pivotal to the day's activities is the *Daily Bulletin*. The computer is used to communicate on a daily basis with the students regarding the work they have just completed as well as to introduce the work for the next day. During the last half-hour of each day, the girls enter their questions and comments onto the master disk. After the class is dismissed, the staff responds to all questions and concerns, which are taken into account when planning for the next day's work, and the instructions and worksheets are then entered onto the master disk. The student's first job of each day is to read the *Daily Bulletin*. They review the comments regarding the prior day's work and then download the instructions and the worksheets for the day. The computer has become the hub of the program in a way we had not expected.

Program Benefits

One goal of the Seattle MESA Summer Program for Girls is to provide girls interested in science the opportunity to meet and work with other girls who have the same interests. The girls in the MESA program come from many schools within the greater Seattle area. Program planning includes frequent regrouping of the students as

well as special activities designed to facilitate their getting to know each other. Much of the first day of the program involves getting acquainted activities, and the Friday of the first week is devoted to *Project Initiative*, a series of outdoor group problem solving activities designed to facilitate cooperative effort and group cohesiveness. The planning throughout the program is designed to facilitate the growth of relationships among the girls, thereby maximizing the potential of sustaining their interest in science despite peer pressure to do otherwise.

The benefits from conducting the Seattle MESA Summer Program for Girls on the University of Washington campus are many. One of the most important benefits is to familiarize the girls with the campus. Exposing them to the university environment on a daily basis for five weeks can lead to major changes in their thinking about the future. The university becomes a familiar place with which they can identify. In addition to visits to academic labs, such as going through the fisheries salmon labs with graduate students in fisheries or working with faculty and students in the mechanical engineering lab, the students are taken on many short campus tours just to see what campus life is all about. They are particularly interested in the dorms and the many libraries. The girls are also given daily chits to use in the Student Union Building cafeteria on break time, and this time spent in the cafeteria among college students facilitates the development of the girls thinking that they really can and should go to college.

Another goal of the Seattle MESA Summer Program for Girls is to instill and nourish an interest in the sciences. The classes are held in the freshmen biology labs and the freshman physics labs. In many cases the girls use the same equipment in their morning labs as the college students use in their afternoon labs. The girls are quite aware of this, and much impressed, and this in turn, facilitates their gaining self-confidence in their scientific capabilities.

There are certain attitudes and behaviors over which middle school girls have control that facilitate success, and recognition is given to the girls who exhibit such attitudes and behaviours. Awards are given for *Leadership*, *Good Partnering*, *Curiosity*, *Hard Work*, *Perserverance*, *Computer Knowledge*, and *Software Expertise*. In addition, the girls themselves, give an award to each student in recognition of her outstanding trait.

Program Evaluation and Impact

Results of voluntary, anonymous evaluation indicate that students feel the program is worthwhile. Students are asked to fill out a Likert-type rating on each unit, and then to list those activities they like best as well as those activities they think are in need of improvement. Last year, four of the units, *Electricity*, *Water Quality*, *The Heart*, and *Machines* received overall ratings of above average in interest. No one activity stood out as the overriding favorite in any unit. The girls reported liking a variety of activities in all the units, - "I really liked it when we had to make our own machines" and "It was a lot of fun working with the batteries and making the lights work"; and in each of these units, there were reports of liking everything best - "I liked everything about the water week." Last year, the program began with a unit titled *Tools and Computers*, which received below average ratings. The girls enjoyed learning how to use computers and were irritated that they were called away from them to work with tools. The program now devotes the entire first week to computers, and tool use is integrated into each of the remaining units.

Parents, guardians, relatives, and the teachers who recommended them for the program, are invited to join the girls and program staff for the Award Luncheon on the last day of class. Parents and younger siblings of many of the girls, in addition to many classroom teachers, come to see their daughter, their sister, or a memorable student, receive a certificate of completion, and to join us for pizza and pop. This contact with the parents and younger siblings is quite important in the development and reinforcement of the thinking that a career in the sciences can and should be an attainable goal for their daughter.

How do we know we are making a difference? The program has not been in existence long enough to know the impact on girls choosing a career in the sciences or engineering, however, there are the expected comments - "It was a great program with lots to do! Thanks," or "My Mom wants to know how I can get in next summer," and "I almost learned more things here than in regular school." But one quote really sums it up: "Whenever I now pass a construction site, I look to see if I can see any machines." When was the last time you heard that from an eighth grade girl?