COVER SHEET FOR PROPOSAL TO THE NATIONAL SCIENCE FOUNDATION

FOR CONSIDERATION BY NSF ORGANIZATION UNIT(S) (Indicate the most specific unit known, i.e., program, division, etc.)
Experimental Projects for Women and Girls, Directorate for Education and Human Resources

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NSF PROPOSAL NUMBER

PROGRAM ANNOUNCEMENT/SOLICITATION NO./CLOSING DATE
Announcement No. NSF 93-126 EP WG/September 1, 1994

DATE RECEIVED	NUMBER OF COPIES	DIVISION ASSIGNED	FUND CODE	FILE LOCATION

EMPLOYER IDENTIFICATION NUMBER (EIN) OR TAXPAYER IDENTIFICATION NUMBER (TIN)
1876000525

SHOW PREVIOUS AWARD NO. IF THIS IS:
☐ A RENEWAL OR
☐ AN ACCOMPLISHMENT-BASED RENEWAL

IS THIS PROPOSAL BEING SUBMITTED TO ANOTHER FEDERAL AGENCY? YES ___ NO X IF YES, LIST ACRONYM(S)

NAME OF ORGANIZATION TO WHICH AWARD SHOULD BE MADE:
University of Utah

ADDRESS OF AWARDEE ORGANIZATION, INCLUDING ZIP CODE:
Office of Sponsored Projects
University of Utah
1471 Federal Way
Salt Lake City, Utah 84102

AWARDEE ORGANIZATION CODE (IF KNOWN):
0036756000

NAME OF PERFORMING ORGANIZATION, IF DIFFERENT FROM ABOVE
University of Utah

ADDRESS OF PERFORMING ORGANIZATION, IF DIFFERENT, INCLUDING ZIP CODE:

PERFORMING ORGANIZATION CODE (IF KNOWN):

IS AWARDEE ORGANIZATION (Check All That Apply): (See GPG For Definitions)
☐ FOR PROFIT ORGANIZATION ☐ SMALL BUSINESS ☐ MINORITY BUSINESS ☐ WOMAN-OWNED BUSINESS

TITLE OF PROPOSED PROJECT:
IMPACT

REQUESTED AMOUNT	PROPOSED DURATION (1-60 MONTHS)	REQUESTED STARTING DATE:
$ 357,127	36 months	April 1, 1995

CHECK APPROPRIATE BOX(ES) IF THIS PROPOSAL INCLUDES ANY OF THE ITEMS LISTED BELOW:

☐ VERTEBRATE ANIMALS
☐ HUMAN SUBJECTS
☐ HISTORICAL PLACES
☐ BEGINNING INVESTIGATOR (See GPG SECTION I)
☐ GROUP PROPOSAL
☐ SMALL GRANT FOR EXPLORATORY RESEARCH (SGER) (SEE GPG SECTION II. C. 12)
☐ NATIONAL ENVIRONMENTAL POLICY ACT
☐ PROPRIETARY AND PRIVILEGED INFORMATION
☐ DISCLOSURE OF LOBBYING ACTIVITIES
☐ FACILITATION FOR SCIENTISTS/ENGINEERS WITH DISABILITIES
☐ RESEARCH OPPORTUNITY AWARD
☐ INTERNATIONAL COOPERATIVE ACTIVITY:
Country/countries

PI/PD DEPARTMENT
Dept. of Bioengineering

PI/PD POSTAL ADDRESS
University of Utah
Dept of Bioengineering, 2480 MEB
Salt Lake City, Utah 84112

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Summary Data Worksheet
Model and Experimental Projects, and
Information Dissemination Activities

Program/Initiative submitted to:
MPWG ____
EPWG X
IDA ____

Type all entries. See the reverse side for instructions and codes to be used in filling out this form.

1. Name of Submitting Institution: University of Utah
2. Name of Principal Investigator: Dr. Joseph D. Andrade
3. Project Title: IMPACT
4. Number of participating schools and/or other institutions/organizations involved in project activities: ____

List:
Center for Integrated Science Education, University of Utah
Utah Girl Scout Council
Utah Science Center

Proposal Description Codes (see back page)

5. Major Discipline: 99
6. Focus: MS & HS
7. Highest Degrees: D
8. Institution: PUBL
9. Scope: R
10. Activity Period: MB
11. Project Site(s) 12
12. Project Length (mos): 36
13. Project Status: 11
14. Participant(s)—number and category(ies):
W = Women/Girls, S3 = Grade 9-12 Students, S4 = Undergraduate Students, S5 = Graduate Students, F = College Faculty, G = General Public.

15. Project activities (please check as appropriate):

- ☐ Academic year research
- ☐ Summer research
- ☐ Career counseling
- ☐ Seminars/colloquia
- ☐ Mentoring
- ☐ Curriculum reform
- ☐ Teacher enchancement activities
- ☐ Student enrichment activities (classroom)
- ☒ Community-based programs (e.g., Girl Scouts, museum)
- ☐ After school/summer "clubs"
- ☐ Other (please specify):

NSF Form 1325A (8-93)

PROJECT SUMMARY

IMPACT proposes to increase scientific literacy and understanding; encourage science, engineering, and mathematics (SEM) careers; and develop critical thinking processes with 12-18 year old girls and their adult peers. Science provides a powerful mechanism for the development of skills necessary for success in all fields..

The girls will be directly empowered with critical thinking, problem-solving, leadership, and communicative skills in a series of intensive workshops and related activities wherein they develop interactive modules, learning devices, and activities. In the development of these modules, materials, and activities, the girls' personal interests will be connected to scientific concepts and themes. Their adult peers will be trained as facilitators of the process and further trained to be aware of equity issues, so they can encourage the girls in SEM careers. Both the girls and adult peers will interact with females in science and be made aware of opportunities that exist in higher learning.

This project is a collaborative effort of the Center for Integrated Science Education (CISE) at the University of Utah, the Utah Girl Scout Council, and the Utah Science and Arts Center with the close involvement of the Association of American University Women (AAUW), the Society for Women Engineers (SWE), and the Utah Math and Science Network. Faculty and students from the University of Utah and practicing professionals from the AAUW, SWE, and Utah Math and Science Network will be recruited and trained to provide role models, guidance, and to facilitate skill development with the Girl Scouts.

The project will participate in the Traveling Core Camps Program in an effort to broaden the impact and provide opportunities for the IMPACT girls to teach and influence others, thereby providing an amplification and dissemination mechanism. In 1996, the Utah Girl Scout Council will host over 600 girls nationally from the National Wider Opportunity program As part of the Utah Science and Arts Center, the materials and activities developed by the girls in this program will tour the state with Leonardo on Wheels, a mobile science center which will debut in January 1996.

IMPACT is designed to be easily transferable to various other local and national organizations. IMPACT will empower young women with needed skills and increase their abilities and confidence in science. Although more young women will be expected to pursue SEM careers, many are likely to choose careers in law, business, journalism, public relations, communication, and politics, where issues involving scientific understanding are also important. The critical thinking and science process skills they develop through IMPACT will help them succeed in whatever career they choose.

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For font size and page formatting specifications, see GPG Section II. C.

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	Cover Sheet (NSF Form 1207- Submit Page 2 with original proposal only)	
A	Project Summary (NSF Form 1358)(not to exceed 1 page)	1
B	Table of Contents (NSF Form 1359)	1
C	Project Description (NSF Form 1360)(including Results From Prior NSF Support) (not to exceed 15 pages) **(Exceed only if approved in advance of proposal submission by NSF Assistant Director or Program Announcement/Solicitation)**	13
D	Bibliography (NSF Form 1361)	1
E	Biographical Sketches (NSF Form 1362)(Not to exceed 2 pages each)	6
F	Summary Proposal Budget (NSF Form 1030, including up to 3 pages of budget justification)	6
G	Current and Pending Support (NSF Form 1239)	2
H	Facilities, Equipment and Other Resources (NSF Form 1363)	1
I	Special Information/Supplementary Documentation	6
J	Appendix (List below) **(Include only if approved in advance of proposal submission by NSF Assistant Director or Program Announcement/Solicitation)**	0
	Appendix Items:	

*Proposers may select any numbering mechanism for the proposal.

PROJECT DESCRIPTION

Project Goals & Objectives

This project will directly connect young women to the learning of scientific concepts while developing problem-solving, communication, computational, decision-making, and leadership skills. The practices used in this project will be expanded to other groups and organizations and permanently change the way young women perform and think in the sciences.

Rationale

Many girls begin to lose confidence and interest in scientific and mathematical activities during the upper elementary and middle school years. Many girls are socialized into believing that science, engineering, and mathematics are too intellectually challenging for them and that demonstrating aptitude in these areas is just not 'cool'. Although girls are quite capable of mathematical and scientific activities, they are further discouraged by counselors and peers from enrolling in college-prep science and math courses. This leads to low enrollment of women completing SEM degrees and an even lower number of women in SEM fields.

In Utah, gender differences show up in test scores. Despite a push over the past few years to get more girls to take math and science in the secondary grades, boys continue to outscore them on the statewide Stanford Achievement Test (SAT). When the SAT was administered in 1993, fifth-grade girls actually outscored boys in math and were close behind them in science. By eight grade, when students begin to have more choices about the classes they take, the girls began to lose ground and the eleventh grade scores showed the boys well ahead in both categories.

TEST SCORES
1993 Utah
Statewide Test Results

	Math			Science	
Grade	Female	Male	Grade	Female	Male
5	63	59	5	52	56
8	54	51	8	53	58
11	54	63	11	54	66

Scores are percentile ranks, 50 is the national median score.
Source: David E. Nelson, Assessment Specialist, Utah State Office of Education.

Research indicates that girls often learn and perform better in same-sex work groups than they do in mixed-sex groups.[1] Girl Scouts is an ideal environment emphasizing informal, noncompetitive learning.

The traditional Girl Scout Council structure is the division of girls into troops each led by a troop leader. Nationally, Girl Scout Councils are restructuring into various levels of involvement -- the girls may join a troop, group, or interest group. The role of the leader diminishes in the group settings. In addition, the retention rate of Girl Scout troop leaders i only 50% in Utah compared to 70% nationally. Utah is one of the few councils to fully support an individual registration program. In 1993, over 975 girls registered as individual participants. Therefore, we have chosen to focus on the development of critical thinking skills and science understanding in women.

IMPACT creates a reciprocal mentorship program for females on all levels. Seventy percent of this project will target Girl Scouts in the middle and high schools. These young women benefit from seeing a project through to its completion, with the guidance and encouragement of undergraduate and graduate college female students and practicing professionals. The younger women can grow in self-confidence when they experience success in learning. Learning often takes place best when students have opportunities to express their ideas and get feedback from their peers.

Related Research and Projects

The National Science Partnership (NSP) is a National Science Foundation funded project that establishes partnerships between Girl Scout Councils and science-technology museums. Initiated in 1988 between the Franklin Institute Science Museum and the Girl Scout Council of Greater Philadelphia and the Washington Rock Girl Scout Council of New Jersey, the goal is to increase enthusiasm and interest in science and encourage more girls into SEM careers. Hands-on science activity kits and training workshops assist Girl Scout Leaders in badge-related science activities within their troops. The Franklin Institute is currently expanding their training to museums across the country.

"Bridging the Gap", a project designed to provide long-term systemic change in the local Girl Scout Council, is now being initiated at Discovery Place in Charlotte, North Carolina. This project is a longitudinal approach to change the attitudes and interest of girls and leaders from the youngest Girl Scout to the adult leaders. Working closely with the Franklin Institute, this project will expand beyond the kits to focus on instructional content for all age levels. Parents and science teachers will be invited to assist in the project activities.

Kits provide wonderful opportunities to train leaders with activities pre-prepared in a highly structured format. Step-by-step instructions can be easily followed by anyone with a limited science background. The conceptual and curriculum development is thoroughly thought out by others before the kits are assembled. Although kit-based activities are very useful and effective, they must be supplemented with more open-ended project-based activities in order for the scientific process to be more fully experienced.

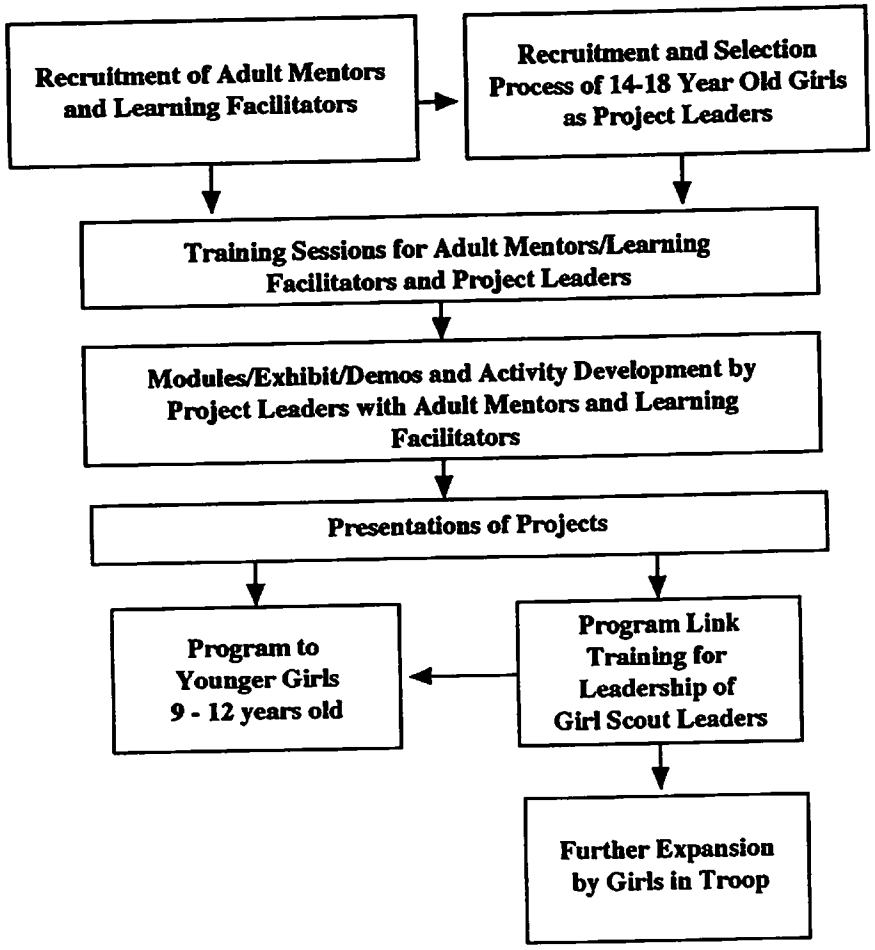
We propose that the girls connect to the concepts through the actual learning process that goes into developing a kit, including curriculum preparation and resourcing for material. Instead of developing kits, however, the girls in this project will create modules/exhibits/demos and activities that will be used to teach the younger girls and other peer groups. These modules/exhibits/demos and activities are intended to be used as new learning devices in community gatherings, after-school programs, and in the Utah Science and Arts Center.

This program is modeled after a project that Jim Weimer, Program Director of the Utah Girl Scouts *(See Supplemental Documentation)*, initiated and successfully completed while at the Maumee Valley Girl Scout Council in Ohio. The goal was to support leadership development and involve the girls in program planning. Jim presented teams of girls with pre-selected topics on scientific concepts and a four week deadline to research the topics, obtain resources and materials, and develop an activity. At the end of four weeks, the girls were required to give a polished presentation of their topic to parents and Girl Scout troop leaders. The projects were then used to teach and interest the younger girls in science.

Examples initiated through Jim's successful program became innovative learning projects. One group purchased a toilet and connected it to a water supply to study water pressure and the function of valves. They even simulated a clogged toilet with a loaf of bread to observe and understand the mechanics of the system! Another group simulated a crime scene and performed forensic science experiments with the younger girls. Projects generated through IMPACT are expected to have a similar level of science sophistication and emphasize concepts that are traditionally taken by boys in high school.

IMPACT will utilize the inquiry techniques and concepts from a Liberal Education course at the University of Utah called *Science Without Walls* (SW/OW). This course was developed by Joe Andrade, Co-Director of the Center for Integrated Science Education and reflects the findings of Project 2061: Science for All Americans. S W/O W consists of major science concepts, applicable to all science "disciplines." S W/O W is intentionally multi- and inter-disciplinary and considers science as a set of concepts and phenomena relevant to all areas and to nearly all problems. The goal is to help people learn *science* -- concepts, phenomena, skills -- to provide them with the strong base and confidence.

Program Design & Content



Step 1: Recruitment Process

The Center for Integrated Science Education will meet with the American Association of University Women, Society for Women Engineers, and Utah Math and Science Network to recruit practicing professionals into the project. Flyers and phone calls will be made on campus to recruit University faculty, students, and staff. Over the past year the Center has developed a group of individuals interested in projects supporting females in science.

Initial recruiting and selection of project leaders (Girl Scouts, ages 12-18) will start in the Greater Salt Lake Area in May 1995. Another publication will be distributed in August 1995 to promote the project and further encourage submittal of applications for project leaders. Those individuals most committed to an interest in SEM will be selected first. Twenty-five to forty girls are expected to participate in the first year with expansion in the second to third year.

Step 2: Training Process

Training of the adult mentors/learning facilitators will occur on the University of Utah campus in the Center's Leonardo Laboratory. These adults will be briefed on project expectations as facilitators and leaders. The nature of the modules/exhibits/demos and activities will be discussed. Several workshop training sessions will be conducted by the staff at the Center for Integrated Science Education and will focus on:

Equity/Gender Issues -- Kathleen Christy, an equity/gender consultant *(See Supplemental Documentation)*, will train the adults on gender issues and their importance to this project and SEM learning. The adults will learn to be aware of these issues and to assist the project leaders in working with gender biases. The project leaders will be steered towards projects that are not traditionally thought to be "feminine." Kathleen's work parallels the findings of the AAUW Report: *How Schools Shortchange Girls.*[1]

Inquiry techniques -- adults are often tempted to answer or provide solutions to questions or problems that young people encounter. In this project the girls will do the learning with the adults stimulating their projects and the learning process with questions.

Scientific Process -- adults will guide the project leaders in the scientific process - observing, collecting and analyzing data, formulating hypothesis, and drawing conclusions based on their data.

Resources and Networking -- the University of Utah is a rich resource of research laboratories and scientists. Many other opportunities and facilities exist throughout the region to provide materials, data, and information for the projects. The adults will be available to steer the girls in a direction appropriately related to their interests and project.

Scientific Themes and Concepts -- these are outlined in Project 2061: *Science for All Americans*[2] and are an integral part of the Science Without Walls course at the University of Utah (see table on next page).

General Themes and Concepts in Science, Mathematics, and Technology

SYSTEMS:	The Universe, the Earth, your little toe, a bacteria? What to focus on.
SCALE:	Size, dimensions, measurement
STRUCTURE:	What is matter? How are things organized? What is their function? What is their shape?
CONSTANCY:	What is constant? How is it constant? Properties. "Constants".
CHANGE:	What is changing? How much? How fast? Why? Forces, Variables?
ENERGY:	What is it? Are there different kinds? How can we change it, use it?
DISORDER:	How are things disorganized? Why are most things statistical? What is entropy?
EVOLUTION & DIVERSITY:	How does life change? Interdependence -- ecology - ecosystems.
PREDICTION:	Models and theories -- experiments -- hypotheses -- the scientific process.
DECISIONS:	What and who is right? wrong? How can complex decisions be made? Who makes decisions?

Step 3: Bringing the Project Leaders and Adult Mentors Together

Through a series of workshop sessions at the Girl Scout Council Resource Center in the Greater Salt Lake Area, the project leaders will be introduced to their adult mentors and learning facilitators. The girls will be made aware of opportunities that exist in the community to encourage SEM careers and interests. Selected videos, such as *Mothers of Invention*[3], and other materials[9,10,11] will show the historical role of women in science. Together the project leaders and their mentors will brainstorm potential project ideas that will interest the girls and at the same time increase their sophistication level in science. For example, a group may want to do the physics of gymnastics, or a project may focus on the materials used in contact lenses.

The girls will be introduced to the Leonardo on Wheels Project of the Utah Science and Arts Center, as well as examples of existing exhibits for the mobile science center. Several of the existing exhibits were developed in the Science Projects course at the University of Utah taught by Joe Andrade. This class actively engages University students from all departments into groups to brainstorm ideas based on scientific concepts and phenomena and develop those ideas into innovative learning modules and interactive, hands-on exhibits and activities.

Students researched and consulted with experts and professionals in the community. Visits to science and technology museums in San Diego, Los Angeles, San Francisco, Portland, and Seattle were arranged for the students. Considerable emphasis was placed on the innovation and hierarchical learning of the topic or theme.

Step 4: Project Development of Science Activities and Content

Project selection will be based on topics and activities that appear to generate the most interest and motivation for individual participants. The girls and adult leaders will then be drawn together in groups, based on that interest area. These particular topics will then be matched with the array of projects and topics available from the Leonardo Project of the Utah Science and Arts Center and the Center for Integrated Science Education's Leonardo Laboratory.

Working in groups with appropriate university professionals, as well as professionals drawn from local industry, the girls will develop the science process skills and concepts related to the exhibit and activity selected. They will then participate in sessions on designing and developing the exhibit/activity to make the key concepts more readily experienced, appreciated, and understood. An interested individual with little background or experience is expected to be motivated by the exhibit/activity. This self-directed approach to science experiences and education is a key component of the Utah Science and Arts Center and the Center for Integrated Science Education.

Although there will be many specific exhibits and activities developed around each of the General Themes and Concepts noted earlier, many of the activities will enable the girls to experience that several and, in many cases, many different concepts are involved in science and technological activities and problems.

Emphasis will be placed on the process of developing the idea into the learning module. The majority of the project will be on researching the idea through community and national resources, connecting and interacting with practicing scientists, learning to effectively communicate with peers, and being able to teach others.

Working in teams, the project leaders will make decisions on each girl's responsibility to the project and the steps needed to fully develop their ideas. Each group will need to develop the accompanying curriculum thereby having to think through the process of how they would teach others their topic or theme. At the Center for Integrated Science Education's Leonardo Laboratory, a technician and staff will assist the girls in construction of their projects.

Step 5: Presentation of Projects

This step will broaden the SEM efforts to others within the Girl Scouts and the community. The presentations will increase the girls communicative skills with adults, involve the girls in community interactions by demonstrating their projects in community settings, and give the girls opportunities to teach others.

Within the Girl Scouts, the project leaders will present their projects to the younger girls and, using their developed curriculum, teach them scientific concepts or phenomena. The enthusiasm and interest of the project leaders will be reflected in these presentations in a dynamic synergism, thereby interesting the younger girls. By first teaching to the younger girls, the project leaders can gain confidence by verbalizing their scientific concepts and polish their presentations before going to their peers.

The project leaders will present to the Girl Scout troop leaders. Their presentations are intended to demonstrate that science is fun, girls do have an interest in these areas, girls are capable of doing science, and that the leaders need to encourage others in SEM efforts. Kathleen Christy, the equity consultant, will point out how the troop leaders can coach the girls to success in SEM efforts.

The Director of the Traveling Core Camp Program will be trained on the use of the projects and activities in the camps. Together the girls and the staff will coordinate and assemble the projects into the program. In the first year, the girls will present their projects at the two camps close to the Greater Salt Lake Area.

In July of 1996, the Utah Girl Scout council will host over 600 girls nationally in the Wider Opportunity Program. This program will take place at three different locations throughout the state. The project leaders will present at these sites.

In the second year, the projects will be incorporated into the traveling Leonard On Wheels program of the Utah Science and Arts Center. This mobile science center will tour the state in 1996, Utah's Centennial year. In it's second year, the museum will expand regionally. Leonardo on Wheels will travel to rural areas, to schools, malls, community centers, and fairs taking science to all people in the region. By incorporating their project with Leonardo On Wheels, the girls can increase recognition for their efforts and reach out to more girls in an effort to stimulate their interests.

The Utah Girl Scout Council will make this project part of their after-school program to increase the number of girls participating in SEM activities. This outreach will be more fully developed in the third year of the project.

Step 6: Taking IMPACT into the Future

The Utah Science and Art Center permanent facility is expected to be fully operational in late 1988. At this time it will have developed a positive working relationship with the Girl Scouts, as well as have a wealth of projects and activities available. IMPACT is the initial step towards involving the local Girl Scouts and other similar groups into long-term relationships and successful activities with the museum. The project leaders will benefit from having their projects functioning and used by others many years from now. Girls in the Girl Scout Program often return as Girl Scout leaders. With their experiences and connections to the community, the project leaders can continually inspire and instill others towards positive attitudes and understanding of science. IMPACT is their connection to the future of the Utah Science and Art Center and the community it will serve.

See timeline for activities on next page.

Timeline for Activities:

Project Approval, Funding Available Organizational Meeting of the Center for Integrated Science Education, Utah Girl Scout Council, and Utah Science and Art Center	April 1995
Recruitment Process to Begin: Meetings with AAUW, SWE, and Utah Math & Science Network, Recruitment from existing list of interested individuals and from University faculty, staff and students Initial application process of Girl Scout project leaders	May 1995
Final application process of project leaders	August 1995
Training of mentors and learning facilitators *(See Program Description and Content)*	Sept. 1995
Program Introduction and Training Sessions	Oct. 1995
Girls Develop Modules/Exhibits/Demos and Activities	Oct. -Dec. 1995
Evaluation Process Begins *(See Evaluation Section)*	Oct. 1995
Complete Construction and Curriculum for the Projects	Jan. & Feb. 1996
Deliver Project Presentations to Younger Girls	March & April 1996
Train Director of Traveling Core Camps on use of project activities in camp program, Traveling Core Camps Staff Training	April - May 1996
Present the Projects at Traveling Core Camps	June 1996
Presentations to National Wider Opportunities 3 Different Selection Sites in State	July 1996
Beginning in May 1996, the application process will begin again to recruit and increase the number of project leaders participating Recruitment will continue with the AAUW, SWE, Utah Math and Science Network and University of Utah	May 1996
Dissemination of Year 1 begins *(See Dissemination Plan)*	May 1996
After completing the pilot year, the program will repeat with expansion of the program to include more groups and to increase the dissemination efforts to other organizations. The presentations will be expanded to collaborate with the Leonardo on Wheels Project of the Utah Science and Art Center. This will allow the project to reach out into the rural areas. In year three, presentations of the project will expand to the after-school programs supported by the Utah Girl Scout Council. By year three, IMPACT will have generated a vast source of fresh modules/exhibits/demos and activities to have made a difference. The Utah Science and Art Center facility will be able to incorporate selected projects as permanent displays.	May 1996 through April 1998