

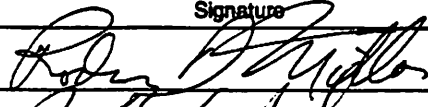
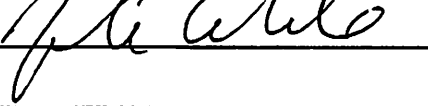
CERTIFICATION PAGE

Certification for Principal Investigators and Co-Principal Investigators:

I certify to the best of my knowledge that:

- (1) the statements herein (excluding scientific hypotheses and scientific opinions) are true and complete, and
- (2) the text and graphics herein as well as any accompanying publications or other documents, unless otherwise indicated, are the original work of the signatories or individuals working under their supervision. I agree to accept responsibility for the scientific conduct of the project and to provide the required progress reports if an award is made as a result of this application.

I understand that the willful provision of false information or concealing a material fact in this proposal or any other communication submitted to NSF is a criminal offense (U.S. Code, Title 18, Section 1001).

Name (Typed)	Signature	Date
PI/PD Rodney D. Millar		1/30/95
Co-PI/PD Joseph D. Andrade, Jr.		1/30/95
Co-PI/PD		
Co-PI/PD		
Co-PI/PD		

Certification for Authorized Institutional Representative or Individual Applicant:

By signing and submitting this proposal, the individual applicant or the authorized official of the applicant institution is: (1) certifying that statements made herein are true and complete to the best of his/her knowledge; and (2) agreeing to accept the obligation to comply with NSF award terms and conditions if an award is made as a result of this application. Further, the applicant is hereby providing certifications regarding Federal debt status, debarment and suspension, drugfree workplace, and lobbying activities (see below), as set forth in the Grant Proposal Guide (GPG), NSF 94-2. Willful provision of false information in this application and its supporting documents or in reports required under an ensuing award is a criminal offense (U.S. Code, Title 18, Section 1001).

Debt and Debarment Certifications

(If answer "yes" to either, please provide explanation.)

Is the organization delinquent on any Federal debt?

Yes ___ No X

Is the organization or its principals presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency?

Yes ___ No X

Certification Regarding Lobbying

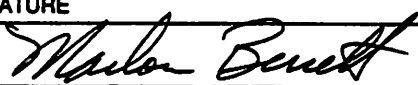
This certification is required for an award of a Federal contract, grant, or cooperative agreement exceeding \$100,000 and for an award of a Federal loan or a commitment providing for the United States to insure or guarantee a loan exceeding \$150,000.

Certification for Contracts, Grants, Loans and Cooperative Agreements

The undersigned certifies, to the best of his or her knowledge and belief, that:

- (1) No federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.
- (2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.
- (3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

AUTHORIZED INSTITUTIONAL REPRESENTATIVE	SIGNATURE	DATE
NAME/TITLE (TYPED) Marlon Berrett, Chair		1/30/95
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NSF ¹ LEONARDO ON WHEELS ⁹⁷ ~~NSF~~
A SCIENCE EDUCATION OUTREACH PROGRAM
PHASE II
GRADES K-9

A PRELIMINARY PROPOSAL TO:

THE NATIONAL SCIENCE FOUNDATION
INFORMAL SCIENCE EDUCATION PROGRAM

SUBMITTED BY:

THE UTAH SCIENCE CENTER AUTHORITY

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Project Summary

The Gateway Center proposes to expand and enhance its educational outreach program, *Leonardo on Wheels*, to communities of the Intermountain West including New Mexico, Arizona, Wyoming, Idaho, Nevada, and Utah. A semi-truck will carry as many as 30 modularized exhibits to 20 sites in these states. This project will engage students, teachers and the public in new forms of education previously unavailable because of geographic location.

Combined under the umbrella theme of Leonardo Da Vinci and his work, the project will orchestrate its offerings into four concept areas: **Macroworld, Earth and Biosphere, You-The Visitor, and Microworld**. A resource library and shop, computer workstations using Internet, and other visitor support components will be located in or around the center of exhibit activities. The four methods to be used throughout the *Leonardo on Wheels* project are:

1) Interactive Exhibits: Because we know individuals learn better by doing or experimenting, this project requires that the participant interact with each exhibit to start the learning process and move it forward. Each exhibit experience requires series of actions, with each subsequent action triggered by what *was learned* from the previous action.

2) Hierarchical learning: A specially-designed card-tracking and monitoring system will control the level at which participants enter the exhibit experience, and requires that the participant enter the next level of learning by "proving" his/her understanding of the first level.

3) The Science/Art Connection: Leonardo da Vinci was a scientist, an engineer, and an artist; the quality and quantity of his work suggests that he integrated science and art disciplines in ways that expanded the body of knowledge in both. Participants in the *Leonardo on Wheels* project will be invited and encouraged to do the same.

4) Collaboration: To promote the efficient use of all available resources, collaborative teams comprised of representatives from local museums, school districts and teachers, state school boards in the effected regions will meet before, during, and after each Leonardo visit. Collaborations are also being developed with regional, national, and international science museums doing similar work.

The objectives of this phase of the Leonardo on Wheels project are:

- Twenty-one (21) new exhibits are designed, constructed, and evaluated in 1997, and put into use throughout the 1998 *Leonardo on Wheels* tour.
- Leonardo on Wheels events occur at 20 sites in Colorado, Wyoming, Nevada, Idaho, Arizona, New Mexico and Utah between January 1, 1998 and December 31, 1998.
- The "Leonardo Hotline", available through telephone and Internet, increases education and enhances the long-term impact of the *Leonardo on Wheels* event by providing practical support and resources to teachers, students, and public.
- Project results, evaluations, and activities are disseminated through informal science/arts education media including, but not limited to, collaborations with other science centers, presentations at Association of Science/Technology Centers Conferences, science education publications, and Internet.

Living in more rural areas of the country often means limited access to or unavailability of new and innovative learning opportunities. In the manner described above, *Leonardo on Wheels* will provide 150,000 individuals with these opportunities.

Leonardo on Wheels, A Science Education Outreach Program, Phase II

Abstract

Leonardo On Wheels is a two year old outreach program of hands-on, exploratory science exhibits serving students, parents, educators and the public throughout Utah and surrounding states. It is designed to provide an interactive hub of educational activities within local communities by traveling to these locations in a twenty-four foot moving van and setting up in a school or civic center for anywhere from two days to two weeks. Focusing primarily on higher elementary through ninth grade students, the exhibits present scientific concepts to engage the interest in and further pursuit of science.

The goal of Leonardo on Wheels is to improve science literacy and interest, increasing the number of youth and their parents who are excited about science. The exhibits are designed around the state science education core curriculum, developed substantially on the National Science Foundation Standards. Therefore, the student experience with Leonardo significantly reinforces and enhances classroom curriculum.

Based on lessons learned through the first year of Leonardo's travels, this phase of the project proposes to expand and enhance its educational outreach by development of new exhibits including a new "cluster" on the "Science of Human Performance". As Utah will be hosting the 2002 winter Olympics, Leonardo hopes to focus attention on the scientific principles of physiology, health, nutrition and energy as they relate to athletes in competition. Additionally, other exhibits will be added to Leonardo in current cluster areas, again focusing on those directly addressing principles identified in the state core curriculum.

Leonardo on Wheels, A Science Education Outreach Program, Phase II

I. Goals and Objectives:

1. Design, construction, implementation and evaluation of a new cluster of exhibits entitled "The Science of Human Performance".
2. Design, construction and evaluation of 7 new and expanded exhibits in current cluster areas requiring additional focus on core curriculum principles.
3. Continuation of outreach efforts with these new exhibits as a part of Leonardo On Wheels at sites throughout the state of Utah and surrounding areas.

II. Introduction

Named after one of the most creative people in history, Leonardo on Wheels is an innovative approach to science, math and technology education. It consists of highly interactive, thought provoking, hands-on exhibits designed specifically to address the need to "engage" more people in science, stimulating their curiosity with the intent of encouraging their pursuit of further

investigation and knowledge. It is based on knowing that learning is more effective if it is done through experience and interaction rather than passivity.

The objective of Leonardo on Wheels is to reach out, presenting scientific concepts and experiences in an interesting, fun and meaningful manner. Currently traveling in a semi trailer, Leonardo consists of approximately 40 modularized exhibits occupying approximately 5,000 square feet, setting up at pre-arranged sites such as schools or civic and National Guard auditoriums, bringing informal science education to areas under served by traditional science museums.

Currently, the exhibits are clustered into four thematic areas: Balance and Motion, Sound and Light, Energy, and Structure and Patterns and are based upon principles and activities of the Utah State Science Core Curriculum. Every cluster area contains at least one exhibit that directly addresses each grade's science core curriculum for levels K-9. For example, in the Energy cluster, the "Magnetic Circus" exhibit directly addresses the fifth grade curriculum concept of electricity and magnetism. Additionally, several other exhibits in the Energy cluster address other aspects of the fifth grade curriculum to varying degrees. Other grades' curricula are addressed in similar fashion in each of the cluster areas.

Each classroom visiting Leonardo is presented with a list of pre-activities and vocabulary words/definitions prior to the visit, allowing the teacher to introduce the principles and activities which will be examined at Leonardo On Wheels. Specific pre- and post-activities have been developed for each grade level with specific references to the state core curriculum. For example, the seventh grade's pre-activity dealing with the Structure of Matter is the "1+1 (doesn't)=2" experiment. This pre-visit activity presents ideas on how to introduce or expand explanations of these core curriculum concepts to seventh grade students.

Leonardo began traveling in February 1996, visiting 9 sites throughout the year and has been experienced by more than 25,000 students, teachers and members of the public. Assessment of the program to date through teacher and student surveys and self-evaluation has indicated that Leonardo is successfully accomplishing its mission. Additionally, numerous letters from teachers and students have been received stating the positive experience and impact of the Leonardo exhibits. Indeed, numerous letters of support have even been received by Governor Leavitt, requesting continuation of funding for this popular and effective use of state funds. Review of the first year operations, indicated that successful continuation of Leonardo on Wheels was dependent on addressing two issues: 1) operational costs had to be reduced; and 2) the number and scope of the exhibits must be upgraded on an ongoing basis.

Operational costs have been addressed on several levels allowing a projected 50% decrease in operating expenses. First, the exhibits have been and are currently undergoing substantial redesign and modification, increasing transportability and decreasing the number of staff and time required for set up and take down. Additionally, the trailer used previously to transport the exhibits will be replaced with a large moving van. Previously, Leonardo relied on donated trucking services for moving the trailer throughout the region, often causing unacceptable, but unavoidable delays. Donation of a twenty-four foot moving van is being sought and will be modified to transport the improved exhibits. By shortening the set up time through exhibit redesign and decreasing

transportation delays, Leonardo will now be able to visit an increased number of sites. This also addresses another concern identified by teachers. Previously, Leonardo required schools to bus students to a central location within a community over a one or two week period.

With these changes, Leonardo can now visit individual schools, staying only a few days and then moving on, eliminating the need for busing students from neighboring schools. During the 1997 traveling year, Leonardo will visit two schools per week, with the intention that a minimum of 500 students per school would have the opportunity to experience the Leonardo exhibits. Opportunities for public attendance are scheduled in nearly all locations during evening hours.

It is imperative that Leonardo's exhibits be continually expanded and upgraded. The staff, teachers, advisors and students all provide suggestions and advice on the improvement and enhancement of exhibits. We also need a sufficiently large repertoire of activities to be able to emphasize certain topical areas, depending upon the needs of the site and teachers being served. We are constantly obtaining ideas and even prototype exhibits/activities from the University of Utah's engineering, science and art students. Dr. Andrade, co-PI, regularly offers a University of Utah course called Science Activities for Leonardo on Wheels: Utah's Mobile Science Center. Indeed, about a quarter of Leonardo's exhibits originated through the University of Utah students.

III. Project Design Plan and Methods

Exhibit Design

The first year of this two year project phase focuses upon the design, construction and incorporation into Leonardo, exhibits to enhance all four of the current clusters with the addition of 7 new exhibits. These new exhibits include: Rocks and Minerals, Natural Balance, Radiometer Earth, Bernoulli Blower, Stellar Orbiter, Structure of Matter, and Lightening -an Electrifying Experience. The plan for each of these is based on areas of the state core curriculum not currently addressed by Leonardo exhibits. All of these will be planned and developed in conjunction with the Utah State Office of Education's Science Curriculum Specialist. Many of these exhibits may be commercially purchased. It is intended that the construction or purchase of these will be completed and incorporated into the traveling Leonardo exhibit by the end of the first project year.

Also during the first year, design work for 11 new exhibits will be started to develop a new cluster entitled "The Science of Human Performance". Developed in conjunction with the University of Utah Institute for Biomedical Engineering and the Department of Bioengineering, these will not be added to the traveling show until the end of the second project year. Exhibits currently planned include:

The Body Electric--body surface potentials generated by the heart (EKG) and by other muscle activity (EMG). The student applies several electrodes which transfer the signal to an amplifier and computer, allowing direct visualization and mapping of surface potentials.

Leonardo's Muscles--an instrumented exercycle which directly monitors various parameters as a function of time on the bicycle. Utilizing a full array of instrumentation, each cyclist will be able to monitor such physiological parameters as pulse rate, blood pressure and respiratory ratios that are impacted by his/her cycling activity. Using projected graphics, the student's performance can be compared with that of local and national celebrities and displayed in real time on a large screen visible to a small audience.

Sweat Chemistry--connected to the exercise bicycle, a sensor headband (disposable) allows the user to sample lactate (an indicator of aerobic and anaerobic respiration) while gently sweating. This relates to principles of chemistry and biochemistry.

Internal Imaging--wherein the visitor views the skeletal structure of his or her own hand non-invasively. Using a set of manually scanned ultrasound transducers with one hand, the visitor generates an ultrasound image of the other hand immersed in water which may be viewed on a monitor as a function of the hand's position and the rate at which the transducers are operated.

Evaluation Plans

While Leonardo now has two years of expertise in the design and construction of traveling, hands on exhibits, all new exhibits will be planned, constructed and implemented with front end, formative and summative assessment using external experts. In fact, many of the current Leonardo exhibits have been built based on exhibit plans published by the San Francisco Exploratorium. Previous assessment has relied upon teacher/student surveys and critique by the State Science Curriculum Specialist to help direct exhibit planning and design. However, the PI has developed a close working relationship with faculty and staff of the Space Science Institute in Boulder, Colorado who have extensive experience in the design, construction and exhibition of hands-on science materials. Additionally, Leonardo staff have developed working relationships with several other science centers through regular participation in the Association of Science and Technology Centers, including those in the Utah area such as The Children's Discovery Foundation of Rock Springs, Wyoming, the local Hansen Planetarium, the Museum of Western Colorado and the Children's Museum of Utah. External consultants will be used on a contractual basis for all phases of this project.

IV. Proposed Budget

	<u>Total Project</u>	<u>NSF Funds</u>	<u>Other Funds</u>
Salaries and Benefits			
Principal Investigator	62,000	0	62,000
Project Director	35,000	25,000	10,000
Program Assistant	22,000	20,000	2,000
Special Programs Coordinator	20,000	0	20,000
Exhibit Technician	<u>18,000</u>	<u>18,000</u>	<u>0</u>
Total Personnel	157,000	63,000	94,000
Operational Expenses:			
Exhibit Design/Development	90,000	90,000	0
Education and Training	15,000	2,000	13,000
Education Materials	4,000	4,000	0
Printing/Supplies	10,000	4,000	6,000
Travel	35,000	3,000	32,000
Exhibit Maintenance	12,000	0	12,000
Insurance	3,000	0	3,000
Consultants	30,000	15,000	15,000
Truck/Trailer	15,000	0	15,000
Utilities/Rent	12,000	0	12,000
Misc.	<u>8,000</u>	<u>4,000</u>	<u>4,000</u>
Total Operation Expenses	234,000	122,000	112,000
Total Project Costs	\$391,000		
Percent of Budget	100.00%	47.30%	52.70%

V. Personnel

Suzanne Winters, Ph.D., Principal Investigator, currently serves as the Utah State Science Advisor and chair of the Science Center Authority Board. Dr. Winters has been involved with informal science education programs over the last four years, working directly with the State Office of Education and private industry in partnerships. She has coordinated many of the nearly 50 organizations within the state offering informal science education programs in order to more efficiently focus attention and resources to targeted areas of the state core curriculum. She will oversee all aspects of the project including planning, design, implementation of this project and all Leonardo activities. She will commit 15% of her time.

Joseph Andrade, Ph.D. co-Principal Investigator, has more than five years of experience in the design and construction of interactive activities/exhibits for science education. He and his students at the University of Utah, have prototyped 15 major exhibits, of which about one half are now parts of Leonardo's portfolio. Dr. Andrade works with students in the Department of Bioengineering, Materials Engineering and Mechanical Engineering. Dr. Andrade directs the U of U's Center for Integrated Science Education, working closely with science educators, teachers, and the informal

science education community. He will commit 15% of his time to this project.

Clint Eliason, M.S. Project Manager, has been managing all aspects of exhibit development, construction, travel and outreach since Leonardo began traveling. He will commit 100% of his time.

Jennifer Hood, B.S. Program Assistant, has been involved principally with curriculum development, school group scheduling, development of promotional items and acts as on-site activity guide. She will commit 100% of her time to this project.

Members of the Science Center Authority Board serve on a voluntary basis and meet during regular monthly meetings and as needed for advice and overall program direction.

Winter Horton, Chairman of the Board of Directors, Hansen Planetarium

Lynn Blake, Ph.D., VP for Research, Sorenson Development, Inc.

Joseph Andrade, Ph.D. (See above)

Suzanne Winters, Ph.D. (See above)

VI. Time line

Leonardo On Wheels - time line	
Grant Duration	Activities
Months 1 - 3	Travel to 8 - 12 outreach sites
	Create internet site where teachers and students can access information about Leonardo On Wheels, pre and post activity ideas, and other science curriculum topics
	Design four new exhibits in cooperation with University of Utah Engineering and Audiology Departments
Months 4 - 6	Travel to 10 - 14 outreach sites
	Begin construction of four exhibits co-designed with the U. of U.
	Design three new exhibits in cooperation with volunteer engineers
Months 7 - 9	Travel to 12 - 18 outreach sites
	Finish construction of the four U. of U. co-designed exhibits and begin traveling with them as part of the program
	Begin construction of three new exhibits designed by volunteer engineers
Months 10 - 12	Travel to 12 - 18 outreach sites
	Finish construction of volunteer engineer designed exhibits and begin traveling with them
Months 13 - 15	Travel to 12 - 18 outreach sites
	Focus group evaluation of program, compile and analyze feedback from educators accumulated over previous year. Implement suggestions accordingly.
	Design and begin construction of six new exhibits for the new cluster area "The Science of Human Performance"

Months 16 - 18	Travel to 12 - 18 outreach sites
	Design and begin construction of six new exhibits for the new "Human Performance" cluster area
Months 19 - 21	Travel to 12 - 18 outreach sites
	Finish construction of first six "Human Performance" exhibits and begin traveling with them
	Design and begin construction of five new "Human Performance" exhibits
Months 21 -24	Travel to 12 - 18 outreach sites
	Finish last five new "Human Performance" exhibits and begin traveling with them

This project supported, in part, by **Subaru of America, Inc.** through Educational Marketing Concepts, Inc. 435 Devon Park Drive, The 700 Building, Wayne PA 19087.]