

**About the Cover:**

Kennedy Space Center (KSC): Against a black moonless sky, Space Shuttle Endeavour lights up the night as it blazes into space after an on-time liftoff at 7:49:47 p.m. EST, Saturday, November 23, 2002. The launch is the 19th for Endeavour, and the 112th flight in the Shuttle program. Mission STS-113 is the 16th assembly flight to the International Space Station, carrying another structure for the Station, the P1 integrated truss. Also onboard are the Expedition 6 crew, who will replace Expedition 5. Endeavour is scheduled to land at KSC after an 11-day journey. (Photo by Scott Andrews)

**Photo Inset:**

JOHNSON SPACE CENTER, HOUSTON, TEXAS -- (JSC2000-E-21740) Official portrait of astronaut John B. Herrington, mission specialist. Astronaut Herrington is the first Tribally Enrolled Native American astronaut to fly in space and the first Native American to perform a space walk.

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)  
FISCAL YEAR 2001 ANNUAL PERFORMANCE REPORT  
TO THE WHITE HOUSE INITIATIVE OFFICE ON  
TRIBAL COLLEGES AND UNIVERSITIES**

**TABLE OF CONTENTS**

	<b>Page</b>
<b>EXECUTIVE SUMMARY</b>	<b>ii</b>
<b>SUMMARY OF AGENCY AWARDS BY CATEGORY</b>	<b>1</b>
<b>DISCRETIONARY AND LEGISLATED AWARDS TO TCU's IN FY 2001</b>	<b>2</b>
<b>SUMMARY OF AWARDS TO TCU INSTITUTIONS</b>	<b>3</b>
<b>SUMMARY OF AWARDS BY NASA CENTER AND ENTERPRISE</b>	<b>4</b>
<b>FY 2001 PERFORMANCE DATA</b>	<b>5</b>
<b>AWARDS BY CATEGORY</b>	<b>8</b>
Research and Development	8
Training	9
Fellowships, Internships, Traineeships, Recruitment, and Arrangements under the Intergovernmental Personnel Act (IPA)	10
Student Tuition Assistance, Scholarships, and Other Aid	10
Third-Party Awards	11
Private-Sector Involvement	12
<b>AWARDS AND EXEMPLARY PROJECTS</b>	<b>13</b>
Faculty Awards for Research	13
Mathematics And Science Education (MSE) Awards	15
Partnership Awards	19
<b>NASA ENTERPRISE INVOLVEMENT</b>	<b>23</b>
Aerospace Technology Enterprise	23
Biological and Physical Research Enterprise	23
Earth Science Enterprise	23
Office of Space Flight	26
Space Science Enterprise	26
<b>NASA CENTER INVOLVEMENT</b>	<b>28</b>
Ames Research Center	28
Dryden Flight Research Center	28
Glenn Research Center	28
Goddard Space Flight Center	29
Jet Propulsion Laboratory	29
Johnson Space Center	30
Kennedy Space Center	30
Langley Research Center	30
Stennis Space Center	31
<b>APPENDIX A: NASA ORGANIZATION</b>	<b>32</b>
<b>APPENDIX B: LIST OF ACRONYMS AND ABBREVIATIONS</b>	<b>34</b>

## **EXECUTIVE SUMMARY**

The Fiscal Year (FY) 2001 Performance Report to the White House Initiative Office on Tribal Colleges and Universities (TCU) is the National Aeronautics and Space Administration's (NASA) response to Executive Order 13270, Tribal Colleges and Universities, signed by President George W. Bush on July 3, 2002. It includes fiscal data on all NASA projects that are designed to provide support to Tribal Colleges and to increase educational opportunities for Native American students. NASA's commitment to supporting TCU's dates back to the early 1990's with a summer institute at Diné College. Shortly thereafter, several precollege outreach and undergraduate student support projects were initiated at Northwest Indian College, Turtle Mountain Community College, and D-Q University.

Since the first performance report in 1998 to the White House Initiative Office on TCU's, NASA's TCU initiative has grown from \$2,306,000 to \$4,731,824 in FY 2001.

It is the mission of the NASA Minority University Research and Education Programs (MUREP) to integrate support of TCU's with NASA's Strategic Enterprises. To this end, all of the TCU projects reported herein incorporate NASA's mission themes, make use of NASA-driven technologies, emphasize partnerships with the NASA Centers, and/or support TCU efforts to strengthen and expand their institutions' Mathematics, Science, Engineering, and Technology (MSET) educational opportunities.

In FY 2001, NASA created a new initiative with the American Indian Higher Education Consortium (AIHEC) through a grant entitled, "Building Bridges to Excellence in Mathematics, Science, Engineering and Technology." The purpose of the AIHEC-NASA partnership is to outreach to all 32 TCU's to strengthen NASA-sponsored MSET programs, and to increase opportunities for TCU's to build infrastructure and participate in and benefit from NASA and other Federal agencies' research and education programs.

NASA looks forward to continued collaboration with TCU's and all of its partners to promote educational excellence for Native Americans.

## SUMMARY OF AGENCY AWARDS TO TRIBAL COLLEGES AND UNIVERSITIES BY CATEGORY: FY 2001

Agency: National Aeronautics and Space Administration

1. Agency Representative: Adena Williams Loston \_\_\_\_\_ (Signature)  
Associate Administrator  
for Education
2. Total Funds for Institutions of Higher Education (IHE): **\$1,118,241,050**
3. Total Funds for Tribal Colleges and Universities: **\$ 4,731,824**

### DISCRETIONARY AWARDS

CATEGORY	AWARDS TO IHE's	AWARDS TO TCU's	AWARDS TO TCU's AS % OF TOTAL AWARDS TO IHE's
Research & Development	\$942,505,966	\$569,400	0.06%
Program Evaluation			
Training	\$36,654,017	\$605,381	1.65%
Facilities and Equipment	\$15,149,691		
Fellowships, Internships, Traineeships, Recruitment, and Arrangements under the Intergovernmental Personnel Act (IPA)			
Student Tuition Assistance, Scholarships, and Other Aid			
Third-Party Awards		\$2,645,043	
Private-Sector Involvement		\$912,000	
Other	\$123,931,376		
<b>TOTAL</b>	<b><u>\$1,118,241,050</u></b>	<b><u>\$4,731,824</u></b>	<b><u>0.42%</u></b>

Sean O'Keefe  
Administrator

\_\_\_\_\_  
(Signature)

**DISCRETIONARY AND LEGISLATED  
AWARDS TO TRIBAL COLLEGES  
AND UNIVERSITIES IN FY 2001**

	Institutions of Higher Education		Tribal Colleges and Universities
DISCRETIONARY AWARDS:	\$1,118,241,050		\$4,731,824
LEGISLATED AWARDS:	\$0		\$0
TOTAL AWARD:	\$1,118,241,050		\$4,731,824

## FY 2001 SUMMARY OF NASA AWARDS TO TCU's BY INSTITUTION

STATE	AWARDS TO TRIBAL COLLEGES	R & D	TRAINING	TPA	PSI	TOTAL
Arizona	Dine College	\$218,000	\$136,900	\$4,504		\$359,404
Kansas	Haskell Indian Nations University			\$14,250		\$14,250
Minnesota	Fond du Lac Tribal and Community College			\$2,000		\$2,000
Montana	Salish Kootenai College	\$153,646	\$266,981			\$420,627
Montana	Blackfeet Community College			\$34,776		\$34,776
Nebraska	Little Priest Tribal College			\$750		\$750
Nebraska	Nebraska Indian Community College			\$750		\$750
New Mexico	Southwestern Indian Polytechnic Institute		\$160,000	\$25,000		\$185,000
South Dakota	Oglala Lakota College		\$41,500			\$41,500
Washington	Northwest Indian College	\$97,754		\$15,000		\$112,754
Wisconsin	Lac Courte Oreilles Ojibwa Community College	\$100,000				\$100,000
	<b>Tribal College Total</b>	<b>\$569,400</b>	<b>\$605,381</b>	<b>\$97,030</b>		<b>\$1,271,811</b>
<b>CENTER</b>	<b>AWARDS TO OTHER INSTITUTIONS</b>					
KSC	All Points Logistics, Inc.				\$375,000	\$375,000
GSFC	American Indian Higher Education Consortium			\$1,197,159		\$1,197,159
JSC	College of Santa Fe			\$100,000		\$100,000
GSFC	EduTech Limited				\$217,000	\$217,000
HQ	Global Science and Technology				\$320,000	\$500,000
JSC	Las Cruces Community Unidad Park			\$10,000		\$10,000
HQ	Support for 9 Native American graduates and undergraduates			\$129,000		\$129,000
GRC	National Action Council for Minorities in Engineering			\$34,000		\$34,000
GSFC	National Association for Equal Opportunity in Higher Education			\$365,440		\$365,440
JSC	Ruidoso Center of Eastern New Mexico University			\$25,000		\$25,000
JSC	Sierra Middle School			\$25,000		\$25,000
GSFC	Society for the Advancement of Chicanos and Native Americans in Science and Engineering			\$50,000		\$50,000
GSFC	United Negro College Fund Special Programs Corporation			\$314,334		\$314,334
LaRC	University of Cincinnati			\$120,000		\$120,000
JPL	Wapato Indian Reservation			\$28,080		\$28,080
JPL	World Hope Foundation			\$150,000		\$150,000
	<b>Other Institutions Total</b>			<b>\$2,548,013</b>	<b>\$912,000</b>	<b>\$3,640,013</b>
	<b>GRAND TOTAL</b>	<b>\$569,400</b>	<b>\$605,381</b>	<b>\$2,645,043</b>	<b>\$912,000</b>	<b>\$4,731,824</b>

See Appendix B for Acronyms

**FY 2001 SUMMARY OF AGENCY AWARDS TO TCU's BY NASA CENTER AND ENTERPRISE**

<b>NASA CENTER</b>	<b>OAT</b>	<b>OE</b>	<b>OES</b>	<b>OHRE</b>	<b>OSF</b>	<b>OSS</b>	<b>GRAND TOTAL</b>
GRC	\$120,000	\$184,000					\$304,000
GSFC		\$2,120,238	\$154,129	\$105,595		\$607,852	\$2,987,814
HQ		\$364,000		\$201,030			\$565,030
JPL						\$178,080	\$178,080
JSC		\$245,360					\$245,360
KSC					\$375,000		\$375,000
SSC		\$76,540					\$76,540
<b>GRAND TOTAL</b>	<b>\$120,000</b>	<b>\$2,990,138</b>	<b>\$154,129</b>	<b>\$306,625</b>	<b>\$375,000</b>	<b>\$778,652</b>	<b>\$4,731,824</b>

*See Appendix B for Acronyms*

## FY 2001 PERFORMANCE

In FY 2001, NASA provided \$4.7 million, the most funding ever awarded in support of TCU's. Included in this amount was \$1.4 million in direct awards to six Tribal Colleges and \$3.3 million in awards to all 32 TCU's through third parties. The direct funding to TCU's was comprised of seven education and training awards to four TCU's and five research and development awards to four TCU's. Through NASA awards, many TCU's developed significant outreach programs for encouraging and assisting Native American students in pursuing education and careers in science, mathematics, engineering, and technology fields.

A major new initiative in FY 2001 reached all 32 TCU's through a Cooperative Agreement between NASA and the American Indian Higher Education Consortium (AIHEC) to enhance NASA-related math and science infrastructure and programs at the TCU's.

For FY 2001, NASA accomplished each of the four goals established in support of TCU's:

**GOAL 1:** Focus attention on identifying and removing barriers to TCU participation in areas designated by the White House Initiative Office on TCU's (WHITCU) as the top priorities for Federal Agencies' support in the areas of technology, science, and mathematics.

**OUTCOME:** One of the barriers identified by WHITCU was the digital divide or lack of technology infrastructure at TCU's. To address this barrier, WHITCU established the "Circle of Prosperity, A vision for the Technological Future of Tribal Colleges and American Indians," as a way to develop a plan for TCU's to use information technology. WHITCU invited industry and government partners to work with the TCU's. NASA Ames Research Center technical staff participated in the development of the plan for TCU's to strengthen mathematics, science and technology infrastructure at the Tribal Colleges.

Another barrier NASA identified and eliminated was the requirement that proposals for MUREP solicitations be submitted by tenure-track Principal Investigators. This had the effect of eliminating Tribal Colleges, since most TCU's did not have a tenure track. The result was the first NASA Faculty Award for Research (FAR) grant awarded in FY 2001 to Salish Kootenai College for the project, "Relativistic Dissipative Fluid Theories of Neutron Stars," described further in this report.

**GOAL 2:** Expand outreach activities to improve the relationships between TCU's and NASA, coupled with systematic modification of existing NASA programs, with particular attention paid to activities designed to increase familiarity of TCU's with NASA.

**OUTCOME:** This goal has been achieved as the NASA Centers have outreached to Native American communities and Tribal Colleges to expand NASA's knowledge of Native American programs and to bring NASA mathematics, science and technology to Tribal Colleges and Native American students. Programs accomplishing this goal are listed below. Other programs towards this goal are described under "NASA Center Involvement."

NASA Glenn Research Center created a partnership with Leech Lake Tribal College and the University of Cincinnati for a course entitled, "Fundamentals of Remote Sensing" to be taught from the University of Cincinnati via a televideo conferencing facility to the Leech Lake Geographical Information System (GIS) Laboratory in Cass Lake, Minnesota. As part of the collaboration, the Native American Remote Sensing, Inc. and the Water Resources Office at the Leech Lake Reservation will develop a custom GIS

with five applications: increase the wild rice harvest, maple syrup tapping, fish and wildlife management, water resource management, and digitizing maps for reservation boundaries.

The Jet Propulsion Laboratory (JPL), in collaboration with the World Hope Foundation and the Space Science Institute, hosted a "Making Relations Symposium" with Diné and Lakota community leaders. In 10 major Native American community events, JPL-supported programs reached 250 college students, 1,300 K-12 students, 500 teachers and over 1,000 Native American community members. JPL also hosted 3 Native American college students as summer interns.

NASA Ames Research Center hosted three Native American scholars at the 10-week summer experience program for undergraduates, marking the first successful efforts to attract Native American students to Ames through a NASA-sponsored scholarship program. Ames staff participated in the Native American Science Bowl- Far Western Region, planning activities for 50 teams of Native American high school students competing for berths into the National Science Bowl. Ames also hosted a 2-week teacher workshop for twenty-five educators from rural settings who teach students of Native American heritage. This workshop reaches educators who would not typically hear of, compete for, or be selected for other NASA programs. At the conclusion of the workshop, attendees serve as leaders in their educational communities to use NASA's content to enrich their curricula and help bring about systemic improvement in the teaching of mathematics, science, technology and geography.

NASA Headquarters Staff from and the Centers chaired job workshops at the 2001 American Indian Science and Engineering Society National Conference to recruit Native American students for cooperative and internship programs.

In FY 2001, NASA Headquarters staff conducted Technical Assistance Workshops for TCU's to discuss research and educational opportunities and how to write winning proposals. As a result, one attending TCU, Diné College, submitted a proposal and was awarded a grant.

GOAL 3: Work with the Minority University-Space Interdisciplinary Network (MU-SPIN) and other NASA computer and network technology programs to explore avenues for assisting TCU's with their goal of bringing Internet resources to TCU campuses and to train TCU faculty, staff, and students in their usage. NASA TCU programs will explore the possibility of involving TCU's in NASA technology transfer efforts.

OUTCOME: The following shows a successful example of NASA and several entities collaborating to benefit from the NASA Technology Transfer Program. In FY 2001, NASA's American Indian Science and Education Consortium (AISTEC) collaborated with the Johnson Space Center Technology Transfer Office to obtain a license on NASA technology that absorbs and neutralizes small spills of hydrazine. Subsequently, AISTEC learned about the capabilities of Assiniboine and Sioux Tribal Industries on the Fort Peck Reservation that has the capability of fabricating the container for the hydrazine kit.

GOAL 4: Increase the amount of funding in support of TCU's by \$0.2 million per year, so that during the 5-year period from FY 1998 to FY 2003, the amount of funding will increase by \$1 million over the FY 1998 baseline of \$2.3 million.

OUTCOME: The following table shows that overall NASA funding for TCU's has steadily increased far beyond the original plan of a \$0.2 million increase per year. NASA's goal was to increase funding in support of TCU's by \$1 million over 5 years, but actual awards have increased by \$2.4 million in only 3 years.

<b>Awards to TCU's (\$M)</b>	<b>FY 1998 Actual</b>	<b>FY 1999 Planned</b>	<b>FY 1999 Actual</b>	<b>FY 2000 Planned</b>	<b>FY 2000 Actual</b>	<b>FY 2001 Planned</b>	<b>FY 2001 Actual</b>	<b>FY 2002 Planned</b>
<b>Total Awards</b>	<b>\$2.3</b>	<b>2.5</b>	<b>\$2.9</b>	<b>2.7</b>	<b>\$3.4</b>	<b>2.9</b>	<b>\$4.7</b>	<b>\$3.1</b>

Although awards to the Tribal Colleges through AIHEC provide an efficient avenue for reaching all the Tribal Colleges, direct funding to the TCU's continues to be a NASA objective.

## AWARDS BY CATEGORY

### RESEARCH AND DEVELOPMENT

Research and Development (R&D) includes all direct, indirect, incidental, or related costs resulting from or necessary to R&D performance by private individuals and organizations under grant, contract, or cooperative agreement. Demonstration projects designed to test or prove whether a technology or method is, in fact, workable are considered to be within the scope of R&D if they are designed to produce new information and are accomplished within a given time period.

STATE	INSTITUTION	DESCRIPTION	AWARD
AZ	Diné College	Internet-Based Education and Research with Robotic Telescopes for Native American and Hispanic Students	\$218,000
MT	Salish Kootenai College	Earth System Science Student Research Experiences at Salish Kootenai College	\$105,595
MT	Salish Kootenai College	Relativistic Dissipative Fluid Theories of Neutron Stars	\$48,051
WA	Northwest Indian College	Assessing Agricultural Land Conversion Impacts to Tribal Fisheries Using NASA Satellite Imagery	\$97,754
WI	Lac Courte Oreilles Ojibwa Community College	Renewable Energy and Sustainable Development Institute Project	\$100,000
<b>RESEARCH AND DEVELOPMENT TOTAL</b>			<b>\$569,400</b>

## AWARDS BY CATEGORY

### TRAINING

Training grants at NASA include those programs that are directed primarily toward the development and maintenance of scientific and technical staffpower.

<b>STATE</b>	<b>INSTITUTION</b>	<b>DESCRIPTION</b>	<b>AWARD</b>
AZ	Diné College	Expanding the Pool of GIS Professionals for the Navajo Nation	\$76,540
AZ	Diné College	Science Enrichment Activities	\$60,360
MT	Salish Kootenai College	NASA Native Earth Systems Science Curriculum Project (NESCP)	\$154,129
MT	Salish Kootenai College	Northern Rocky Mountain Tribal Pathway to Academic Excellence Program	\$100,000
MT	Salish Kootenai College	Astronomy and Astrophysics Course Development at Salish Kootenai College	\$12,852
NM	Southwestern Indian Polytechnic Institute	Stars on Earth, Providing Underrepresented New Mexico High School Students with Research Experience	\$160,000
SD	Oglala Lakota College	NASA/Oglala Lakota College Summer Institute and Research Institute. NASA Honors Supplemental Success	\$41,500
<b>TRAINING TOTAL</b>			<b>\$605,381</b>

## AWARDS BY CATEGORY

### FELLOWSHIPS, INTERNSHIPS, TRAINEESHIPS, RECRUITMENT, AND ARRANGEMENTS UNDER THE INTERGOVERNMENTAL PERSONNEL ACT (IPA)

<b>DESCRIPTION</b>	<b>AWARD</b>
Graduate Student Researchers Program (GSRP)	\$44,000
<b>FELLOWSHIPS TOTAL</b>	<b>\$44,000</b>

### STUDENT TUITION ASSISTANCE, SCHOLARSHIPS, AND OTHER AID

<b>CENTER</b>	<b>INSTITUTION</b>	<b>DESCRIPTION</b>	<b>AWARD</b>
HQ	National Action Council for Minorities in Engineering	NASA USAR Scholarship Program	\$85,000
<b>SCHOLARSHIPS TOTAL</b>			<b>\$85,000</b>

## AWARDS BY CATEGORY

### THIRD-PARTY AWARDS

Third-Party awards are made to non-Native American-serving colleges, universities, non-profit organizations and companies to use for outreach programs to Native American-serving colleges and universities or to Native American students.

CENTER	INSTITUTION	DESCRIPTION	AWARD
GSFC	American Indian Higher Education Consortium	Building Bridges to Excellence in Mathematics, Science, Engineering, and Technology for NASA Outreach to all the Tribal Colleges	\$1,197,159
HQ	Blackfeet Community College	Space Grant Award	\$34,776
JSC	College of Santa Fe	Mobile Science Project PACE/MSET for the Pueblos in New Mexico	\$100,000
HQ	Diné College	Space Grant Award	\$4,504
HQ	Fond du Lac Community College	Space Grant Award	\$2,000
HQ	Haskell Indian Nations University	Space Grant Award	\$14,250
JSC	Las Cruces Community College	Space Shuttle Rocket in Unidad Park for Native American and Hispanic Students	\$10,000
HQ	Little Priest Tribal College	Space Grant Award	\$750
GRC	National Action Council for Minorities in Engineering	NASA Undergraduate Scholars Awards for Research (USAR) Program – for Native American Students at D-Q University and other non-TCU's.	\$34,000
GSFC	National Association for Equal Opportunity in Higher Education	For the Participation of all TCU's in the NASA Research Park at Ames Research Center	\$365,440
HQ	Nebraska Indian Community College	Space Grant Award	\$750
HQ	Northwest Indian College	Space Grant Award	\$15,000
JSC	Ruidoso Center of Eastern New Mexico University	Summer SMET Camp for Rural Minorities and Girls including students from the Mescalero Apache-Reservation	\$25,000
JSC	Sierra Middle School	Magnet School SciAid Program of Mathematics and Science Serving Native American and Hispanic Students in the Las Cruces, NM School District	\$25,000
GRC	Society for the Advancement of Chicanos and Native Americans in Science and Engineering	NASA K-12 Teacher Workshop for Native American and Hispanic Teachers	\$50,000
JSC	Southwestern Indian Polytechnic Institute (SIPI)	(SIPI) Upward Bound Program	\$25,000
GSFC	United Negro College Fund Special Programs Corporation	Three-Year Effort to Create Innovative Curriculum Improvement Partnership Program for Bay Mills Community College, Keweenaw Bay Ojibwa Community College, Si Tanka College, and Stone Child College	\$314,334
GRC	University of Cincinnati	OhioView Undergraduate Distance Learning Prototype with Leech Lake Tribal College	\$120,000
JPL	Wapato Indian Reservation	JPL Teachers Program at Salish Kootenai	\$28,080
JPL	World Hope Foundation	From the Sun to the Star Nations: Science Programs for Navajo Students	\$150,000
<b>THIRD PARTY AWARDS TOTAL</b>			<b>\$2,516,043</b>

## AWARDS BY CATEGORY

### PRIVATE-SECTOR INVOLVEMENT

<b>CENTER</b>	<b>INSTITUTION</b>	<b>DESCRIPTION</b>	<b>AWARD</b>
KSC	All Points Logistics, Inc.	Native American owned business providing administrative and clerical support to KSC	\$375,000
GSFC	EduTech Limited	Minority University Program Outreach and Research Support for Tribal Colleges	\$217,000
HQ	Global Science and Technology	NASA Peer Review Services outreach to Minority Universities to Tribal Colleges	\$320,000
<b>PRIVATE-SECTOR INVOLVEMENT TOTAL</b>			<b>\$912,000</b>

## AWARDS AND EXEMPLARY PROJECTS

Four different programmatic award categories were established that apply equally to Tribal Colleges and Universities (TCU), Historically Black Colleges and Universities (HBCU) and Hispanic-Serving Institutions (HSI). These programmatic initiatives are carried out in close collaboration with NASA Strategic Enterprises and Centers/JPL with support through direct funding, use of their facilities, and commitment of their personnel to serve on Technical Review Committees (TRC) and assist in other facets of program implementation. As a result of the involvement of the Strategic Enterprises and NASA Centers/JPL in the Minority University Research and Education Programs (MUREP), numerous students, faculty, and Principal Investigators from Minority Institutions (MI) are knowledgeable about and make significant contributions to the Nation's space program.

### FACULTY AWARDS FOR RESEARCH

The Faculty Awards for Research (FAR) provide new faculty, and those who have limited NASA experience, the opportunity to integrate the research and education components of their careers with the unique mission requirements of a specific NASA Center/JPL. The FAR program provides merit selection of proposals from outstanding and promising science, engineering, and technology-tenured and tenure-track faculty who are capable of contributing to the Agency's research and education objectives. This award provides faculty members with research support and exposure to the NASA peer review process to enable them to demonstrate creativity, productivity, and future promise in the transition to achieving competitive awards in the Agency's mainstream research processes.

During FY 2001, the FAR program continued funding of one research project at Salish Kootenai College.

#### **A Model FAR Project**

##### **Salish Kootenai College**

##### *Relativistic Dissipative Fluid Theories of Neutron Stars*

##### *Introduction*

A physically realistic theory of viscous and thermally conducting relativistic fluids is being applied to neutron stars. The Israel-Stewart fluid theory has many properties required for models of relativistic astrophysical fluid flows: the equilibrium fluid states are stable against perturbations from equilibrium, perturbations propagate causally (with a speed less than light speed), and perturbations obey hyperbolic systems of equations so that a well-posed initial value problem exists. The thermodynamic functions describing the fluid (such as the equation of state and relaxation times) must satisfy a set of constraints for the fluid to be stable, causal, and hyperbolic. The relaxation times ("second-order coefficients") of the Israel-Stewart theory are being calculated for neutron star matter using relativistic kinetic theory. The stability, causality, and hyperbolicity constraints will be applied to several proposed neutron star equations of state under the conditions of high density found in neutron star interiors. The constrained equations of state will be used to construct neutron star models. The expected results of this work include an improved understanding of the nuclear equation of state at high density, tighter theoretical upper limits on neutron star masses, insight on neutron star structure,

and substantial research experiences in astrophysics for two Native American students each grant year.

### *Accomplishments*

Salish Kootenai College is performing the activities to accomplish the two main objectives of this grant: establishing a theoretical astrophysics research program at Salish Kootenai College, and involving undergraduate Native American students in astrophysical research. One peer-reviewed publication resulted from the first year research efforts. Three oral presentations of this work were given by the Principal Investigator, one at the American Physical Society Northwest Section meeting, an invited talk at the Laser Interferometer Gravitational Wave Observatory at Hanford, Washington, and one at the Laboratory for High Energy Astrophysics at NASA Goddard Space Flight Center (GSFC). Two significant findings have resulted from this research: (1) the maximum mass of non-rapidly rotating neutron stars is likely no more than 2.6 times the mass of the Sun (the old theoretical limit, resulting from restricting the speed of sound to be less than the speed of light, was 2.9 solar masses), and (2) full consideration of all the relevant stability, causality, and hyperbolicity constraints provides insight into the properties of the equation of state of neutron star matter at high density.

### *Relevance to NASA Strategic Enterprises*

A better understanding of the high-density equation of state for compact stars aids in the interpretation of data from several current and future NASA scientific satellites operated by the Office of Space Science. For example, neutron stars are studied with x-ray telescopes on satellites such as the Rossi X-ray Timing Explorer. The NASA Technical Officer for this grant and other collaborators are using Rossi data and the mass limits from the research under this grant to determine the mass, radius, and spin of neutron stars. NASA has plans for a space-based gravitational wave observatory to observe emission from individual and binary compact stars. Better understanding of the equation of state of compact stars will improve the likelihood of successfully detecting these gravitational wave sources.

### *Benefits to Society*

NASA support of this research makes possible a better understanding of the properties of neutron stars, one of the main final states of stars at the end of their life. In addition, support of this research has the potential to increase the ethnic diversity of space scientists working in the United States by attracting Native Americans to careers in astrophysical research.

### *Student Achievements*

The plan for the first year was to have two Native American students complete research internships. This objective was met. Two students worked full-time in the summer providing computer support for the published research previously mentioned. They were responsible for performing the Java computer programming for the numerical integration of the neutron star structure equations, managing the computer program, and utilizing a scientific graphing program to make the graphs for the paper presentation. Both students presented their work on the Salish Kootenai College campus. Four Native American students have been recruited as research interns for the second grant year and have recently begun work.

## **MATHEMATICS AND SCIENCE EDUCATION (MSE) AWARDS**

MSE awards build upon the institutions' outstanding ability to provide excellence in MSET training while increasing the participation and achievement of socially and economically disadvantaged and/or disabled students in MSET fields at all levels of education. Awards are made in the following three areas: undergraduate and graduate, teacher preparation and enhancement, and precollege activities.

MSE awards contribute to the national education goals by integrating the contents from the NASA mission into the educational outreach projects at MI's. As a result, NASA contributes to the increase in the number and the strengthening of the skills, knowledge, and interest of students and teachers in MSET-based academic programs. To address NASA's future human resources requirements, new competitive peer review and merit selection awards were given in the following areas during FY 2001:

Undergraduate and Graduate Awards provide scholarships, fellowships, internships, and research opportunities in NASA-related fields, and other services to enhance retention and increase graduation rates.

Teacher Preparation and Enhancement Awards provide opportunities for MI's to develop diverse and exemplary research-based mathematics, science, technology, and geography teacher education curricula that are integrated with content from NASA's mission. It is the Agency's desire that the results will contribute to the participating states' efforts to increase the numbers and percentage of state-certified mathematics, science, technology, or geography teachers employed in hard-to-staff elementary, middle, and secondary schools not normally served by NASA.

Each Mathematics, Science, and Technology Awards for Teacher and Curriculum Enhancement Program (MASTAP) award recipient receives up to \$200,000 per year for a maximum of 3 years based on performance and availability of funds under the program.

Precollege Awards offer opportunities for MI's, in collaboration with NASA and local school districts, to provide informal educational opportunities that will enhance the number and percentage of students enrolled in mathematics and science college preparatory courses. As a result of participating in these awards, students will gain awareness of career opportunities in MSET fields and exposure to NASA's mission and scientific and technical personnel role models, and will enter college pursuing NASA-related careers.

The primary purpose of the Precollege Awards for Excellence (PACE) is to encourage the implementation of innovative projects with collaborative strategies to ultimately increase the pool of talented scientists and researchers in MSET fields. PACE is designed to include any combination of outreach projects such as Saturday Academies, Summer Science Camps, In-School Mathematics and Science Academies, and After-School Enrichment Programs. The program targets hard-to-staff public elementary, middle, and high schools, in which 50 percent or more of the students are disadvantaged and have a large number and/or percentage of uncertified mathematics and science teachers. Salish Kootenai College received continued PACE/MSET funding during FY 2001.

## **A Model PACE/MSET Project**

### **Salish Kootenai College**

#### *Northern Rocky Mountain Tribal Pathway to Academic Excellence (NRMT PACE) Program*

##### *Introduction*

In partnership with Salish Kootenai College located in Pablo, Montana, and the Nez Perce Tribes Environmental Restoration and Waste Management (ERWM), the NASA Preparation for Academic Excellence Math and Science Camp was hosted at Lewis-Clark State College in Lewiston, Idaho.

Preparation for Academic Excellence is a highly challenging Mathematics and Science Program Camp with the primary goal of preparing students for their first high school algebra course. In addition, the students engaged in daily hands-on science activities and field trips. Thirty-five Native American students were selected to participate based on their academic achievement and interest in both mathematics and science. Twenty-eight of these students successfully completed the intensive 2-week program.

The goal of Preparation for Academic Excellence is to increase the number of Native American students in mathematics and science high school college preparatory courses by strengthening their mathematics and science skills. Junior high students, currently in regular or honors academic courses, were eligible and the following are the pre- and post-test results and other relevant student data reflecting student program success.

The summer pre-algebra camp held at Lewiston, Idaho, for Nez Perce, Salish and Kootenai 7<sup>th</sup>, 8<sup>th</sup>, and 9<sup>th</sup> grade students resulted in significant improvements in their understanding of algebra. Testing the results of the pre-test scores in the Preparation for Academic Excellence program on the Nez Perce Indian Reservation against the results of the post-test, proved that the summer pre-algebra program has a significant effect on student performance. The algebra training given to the Nez Perce and Salish Kootenai students raised their test scores by an average of 3.39 out of a possible 20 points. With a mean difference of +3.39 from the test given to the students at the beginning of the camp, it is clear that the vast majority of students benefited from the experience at the pre-algebra camp.

Salish Kootenai College is pleased with the overall and individual student success of the Summer Preparation for Academic Excellence Program. One major change is planned to the program next summer. Salish Kootenai College will increase the overall number of student participants from 35 to 50, which will allow the retention of the optimum student to cadre ratio even if a number of students choose to leave the program. The carryover funds will allow the opportunity to increase the number of deserving students served.

Salish Kootenai College is now involved in the planning stages of the next Summer Preparation for Academic Excellence Program, which will be a resident program held on the shores of Flathead Lake at the Blue Bay Tribal Campground facility. They are simultaneously working with the Nez Perce partners to stretch available dollars to allow a repeat of the successful program jointly hosted at Lewis-Clark State College, which may double the amount of students served with the same NASA funding. In addition, Salish Kootenai College has employed tutorial assistants to work both on the Flathead and Nez Perce Reservations, with the Summer PACE participants.

Salish Kootenai College was also able to make a \$2,500 contribution to the week-long Sixth-Grade American Indians Math and Science Camp that served 50 students representing all schools on the Flathead Indian Reservation. Through the collaborative efforts with the Nez Perce partners, Salish Kootenai College's PACE Program was successful and the same successful accomplishment is anticipated in future years as a result of NASA funding.

## **A Model Undergraduate Mathematics and Science Education Project**

### **Diné College**

#### *Science Enrichment Activities for Navajo Students*

##### *Introduction*

Diné College's goals for the NASA grant project, "Science Enrichment Activities for Navajo Students," are to increase the number of students attending and completing mathematics and science programs at the Shiprock Campus of Diné College through two specific activities: 1) bridging students into college course work with a science honors scholarship program by consolidating some successful innovations that have been developed by the college, and making activities relevant to Earth/space science, and 2) providing active learning experiences for students and faculty through summer research internships for Earth/space science areas. Emphasis is placed on meeting three objectives:

- Motivate and assist scholars in maintaining an interest in science and transfer to a 4-year university or college to finish a Bachelor of Science degree program (minimum).
- Provide research experiences for scholars in national laboratories, universities, and industry to expose scholars to scientific careers and actual scientific applications.
- Provide traditional cultural experiences to reinforce the existing strengths of the Native American scholars and expose talents that were not visible before.

##### *Enrollment Data*

#### **Ethnicity: 100% Native American**

	<b>Male</b>	<b>Female</b>
<b>Science Honors Scholarship Program</b>		
Summer Bridge 2000	1	6
Academic Year – August 2000–May 2001	3	3
Summer Bridge 2001	1	6
<b>Summer Research Internships</b>		
Summer 2000	2	1
Summer 2001	2	3
<b>YEAR 2 Total Participants</b>	<b>4</b>	<b>8</b>

**Note:** The numbers in the table give a breakdown of student gender per activity. The same students were counted in the academic year and summer internship. The total number of students for Year 2 was 12.

### *Outcomes*

The Science Honors Summer Program at Diné College, Shiprock Campus, was implemented 10 years ago to encourage and assist in inspiring gifted Navajo students to pursue careers in engineering-, science-, and technology-related fields. The program has been highly successful. Of the 84 students who started with the program, 50 percent are currently enrolled in colleges and universities and are still studying in the fields of engineering, science, and technology. A total of 17 students have graduated with Bachelor of Science degrees and are applying for graduate and professional schools.

The Science Honors Program begins with a summer institute, which provides a 10-week summer academic preparation program for entering freshmen at Diné College. The institute provides a variety of activities designed to assist students to achieve a successful transition from high school to college.

One of the main focuses of this program is a course in discrete mathematics, centered on logic and set theory. The major goal of the course is to engage students in deductive reasoning used in mathematical proofs. At the close of the program, students had acquired skills that allowed them to develop a mathematical presentation. Presentations were made to students and faculty at the University of New Mexico, New Mexico School of Mining and Technology, and New Mexico State University.

Seven students participated in the 2000 Summer Institute and 5 students participated during the 2001 summer institute. Students have the option of continuing at Diné College for their freshman year of studies or transferring to a 4-year university.

### *Summer Research Internships*

As part of the Science Honors Program Scholarship, students are encouraged to participate in a summer internship. Summer placements for students were based on their career interests. Placements for the student internships for the summer 2000 and 2001 sessions included five students conducting research at Lawrence Livermore National Laboratory, two at New Mexico State University, and one student at San Francisco State University.

## **PARTNERSHIP AWARDS**

Partnership Awards include the Partnership Awards for Innovative and Unique Research and Education Projects (IUREP) and the Partnership Awards for the Integration of Research (PAIR) into MSET Undergraduate Education. These funds were also used to extend the Networks and Research Training Sites (NRTS) awards for 3 additional years. To better measure program outcomes, beginning in FY 2001, the Partnership Awards for IUREP (Research) were offered under the Principal Investigators Award category and the IUREP (Education) under the Mathematics and Science Education Awards category previously described.

The PAIR awards provide opportunities for minority colleges and universities to build upon their NASA-sponsored research across disciplines by creating innovative approaches to interdisciplinary MSET studies.

Partnership Awards have been made in three categories: education, research, and a combination of education and research. This section summarizes the research and education/research Partnership Awards. Research awards are made to cover a wide spectrum of research that is of interest to NASA. Combination awards are made to projects that skillfully combine activities in both the research and education areas.

During FY 2001, Lac Courte Oreilles Ojibwa Community College and Northwest Indian College received Partnership Awards.

### **A Model Research Partnership Project**

#### **Northwest Indian College**

#### *Assessing Agricultural Conversion Impacts to Tribal Fisheries Using NASA Satellite Imagery*

##### *Introduction*

The initial goal of this project is to determine to what extent satellite remote-sensing can be used to quantify the impacts on Tribal shellfish and salmon fisheries in the Nooksack River and in Portage Bay from agricultural land conversions.

This project is assessing the impacts of:

- Forestry land conversions on Nooksack River Basin salmon streams
- Agriculture cover crop changes on Portage Bay shellfish
- Hybrid poplar conversions on Tribal shellfish and salmon resources

##### *Accomplishments*

NASA Landsat Thematic Mapper imagery is being used to develop Geographic Information System (GIS) coverage of the Nooksack Basin. Clear sky images from August 1986, August 1991, July 1999, and July 2000, have been selected and acquired. GIS computer equipment and software have been acquired and installed and tribal students trained in their use.

Supervised classifications are being accomplished on the 1986, 1991, 1999, and 2000 images after geo-referencing them to a common Universal Transverse Mercator coordinate system. Supervised classifications are using Forest, Second Growth, Clearcut, Agriculture, Water, and Urban as dominant land use types. These classifications have been refined, delineated, and

spatially subset for Agriculture and Forestry land conversions in the Nooksack watershed for all four images.

Long-term records are being compiled that include meteorological data, hydrological data, and fecal coliform data, as well as numbers of dairy farms and dairy cattle over time. These records are being compared to the land-use pattern changes from the satellite data in order to ascertain the water quality regime of the Nooksack River and Portage Bay.

#### *Relevance to NASA Strategic Enterprises*

The research project was consistent with the goals and objectives of NASA's Earth Science Enterprise. Project work contributed to one of the major goals of NASA's Earth Science Enterprise: expanding our knowledge of the causes and consequence of land-cover/land-use change, in this particular case, on the Tribal fisheries of the Nooksack River and Portage Bay. The results will aid the Lummi Nation and other natural resource managers, land-use planners, and other decision-makers with management of the Nooksack River Basin resources.

The work is a collaborative effort between the Northwest Indian College and the Hydrological Sciences Branch of NASA Goddard Space Flight Center. This project is innovative and unique in that no Tribal College or University has successfully developed a partnership with NASA that utilizes NASA remote-sense data to classify an entire basin. Development of such a project will serve to strengthen the partnership with NASA Centers and TCU's.

#### *Benefits to Society*

An innovative and unique aspect of this project is that the Northwest Indian College is the only Tribal College in the State of Washington. As such, it is the only Tribal College that serves the 19 Treaty tribes in Puget Sound, which have a federally authorized treaty right to half the salmon and shellfish in Puget Sound. Land use impacts that affect these Tribal fisheries are significant. Historically, Tribal natural resource departments have been understaffed. Attempts to monitor land conversions on a parcel-by-parcel basis within a basin-wide scope are beyond the capabilities of Tribal natural resource departments. As a result, development of basin-wide satellite imagery land classification capability may be the only way for Tribal natural resource departments to track changes in land use. This project could serve as a model of a NASA/Tribal partnership that could be extended to all the Treaty tribes in Puget Sound. The deployment of a rapid and efficient procedure to model basin-wide land use would have a high potential for long-term support from each of the Treaty tribes in Puget Sound, which shares these resources and the land use concerns that impact them.

#### *Student Achievements*

Tribal student interns are acquiring skills in processing Landsat imagery as well as developing GIS coverages. This skill will be applied in refining image coverages as well as in conducting instructional workshops in remote-sensing techniques.

Tribal student interns are also acquiring skills in database management and environmental monitoring. Students are actively involved in water quality monitoring and analysis and have assisted in the development of numerous presentations in FY 2001, both locally and nationally.

## **A Model Education Partnership Project**

### **Lac Courte Oreilles Ojibwa Community College**

#### *Renewable Energy and Sustainable Development Institute Project*

##### *Mission*

Coordinate and lead the education, research, and outreach efforts associated with developing careers and opportunities in this important emerging industry.

To accomplish this mission, the College has identified three major objectives:

- Conduct a Resource Survey to assess and map potential renewable resources in the local area.
- Enhance faculty expertise and develop curricula in renewable energy and sustainable development and serve as a community resource.
- Host demonstration and research projects in various renewable energy and sustainable development areas.

##### *Accomplishments in FY 2001*

A Resource Survey to assess and map potential renewable resources in the local area of the Lac Courte Oreilles Reservation has been completed. The land capability analysis was completed by the Lac Courte Oreilles Ojibwa Community College's GIS lab for wind, solar, water, and biomass. The project has identified and is utilizing existing research in these areas as background for the analysis. This analysis was completed by the end of the first year and provided a basis for location and utilization of demonstration and research projects.

A Project Director was hired to lead and administer the activities of the Renewable Energy Sustainable Development Institute (RESDI) and has been collaborating with NASA Glenn Research Center (GRC) to host or initiate research and demonstration projects that GRC supports. One of the demonstration projects was the construction of a RESDI Facility that demonstrates the equipment and functioning of biomass heating, passive solar design and greenhouse, composting toilet, and a superinsulated construction design utilizing natively grown lumber. One project involved the purchase of a mobile "Education Station" for renewable energy training. It will serve in the demonstration and collection of renewable energy resource data. Another demonstration project on biofuels demonstrated the planting and harvesting of rapeseed at the Lac Courte Oreilles Ojibwa Community College farm site.

##### *Student Achievements*

As a result of the funding of this grant, Lac Courte Oreilles Ojibwa Community College has purchased additional renewable energy/sustainable development educational assets that are housed within the Lac Courte Oreilles Ojibwa Community College library. They will serve as a resource center for the community. This grant provided faculty training through participation in the Consortium for Alternative and Renewable Energy Technologies for both years and enabled a faculty member to receive course instruction in Sustainable Energy Systems. A committee was organized to work on curriculum development for programs in the area of Sustainable Communities. The committee is utilizing the existing resources and curriculums that NASA, the Native American Renewable Energy Education Project, and others have already developed to plan for new degrees and certificates. Grant staff developed a curriculum for a 1-year Renewable Energy Certificate program that was offered for the first time in the fall of 2001. This

Certificate has been approved by the College's curriculum committee and consists of seven new courses in the area of renewable energy. Twenty-seven students were enrolled in the four new courses offered in the fall of 2001. The first training workshop offered was a Solar Technician /Installer training based on the Institute for Sustainable Power's Certification program. Renewable energy-based activities were implemented in several precollege programs serving Native American youth in the summer of 2001. Lac Courte Oreilles Ojibwa Community College has submitted two grant proposals to further support the curriculum development efforts of this project. One of these proposals was funded and completed through the Department of Energy. The project staff has also generated a Web page link (Institutes-R.E.S.D.I.) from the institution's Web page ([www.lco-college.edu](http://www.lco-college.edu)) for publicity and updates.

#### *Relevance to NASA and Society*

Historically, Native American people have believed that the Earth is a living thing and must be treated with respect. The Lac Courte Oreilles Tribe continues this practice in present times by promoting various means to preserve natural resources. The Tribe is very conscious of its responsibility to protect the environment, not only for the good of its current members, but also for the generations to come. The Tribe's leadership is eager to explore and implement new ways to manage resources for a sustainable future. They are very receptive to partnering with NASA to couple remote-sensing/GIS and renewable energy technologies together to meet basic human needs in a more sustainable and ecological manner.

The Lac Courte Oreilles Ojibwa Community College is the Tribe's primary agent for preparing its members to meet present and future challenges. The college's degrees and courses of study are designed to "incorporate the wisdom and beauty of Ojibwa heritage with the knowledge and skills of our modern technological society." This is, in fact, the keystone of the college's mission statement. By partnering with NASA, the college enhances its ability to fulfill its own mission. This partnership project has helped to strengthen the college's curriculum in the mathematics, science, and technology areas and will expand its educational capabilities into the realm of performing research. By doing so, the project will help NASA fulfill its MUREP diversity and MSET goals as well. Students and faculty will continue to be exposed to cutting-edge technology, research methodologies, and cooperative interaction with NASA personnel, which will enhance the likelihood of students pursuing NASA-related careers.

## **NASA ENTERPRISE INVOLVEMENT**

### **AEROSPACE TECHNOLOGY ENTERPRISE**

Research and technology play vital roles in ensuring the safety, environmental compatibility, and productivity of the air transportation system and in enhancing the economic health and national security of the Nation. However, numerous factors, including growth in air traffic, increasingly demanding international environmental standards, an aging aircraft fleet, aggressive foreign competition, and launch costs that impede affordable access and utilization of space, represent formidable challenges to the Nation.

The mission of this Enterprise is to pioneer the identification, development, verification, transfer, application, and commercialization of high-payoff aeronautics and space transportation technologies. Through its research and technology accomplishments, it promotes economic growth and national security through a safe, efficient national aviation system and affordable, reliable space transportation.

The Enterprise also has Agencywide responsibility for technology transfer and commercialization. This function is provided to ensure wide, rapid transfer of NASA-developed technologies to U.S. industry for the social and economic benefit of all U.S. citizens. The Aerospace Technology Enterprise provided funding for a distance-learning project with Leech Lake Tribal College in collaboration with the University of Cincinnati. This distance-learning program is a prototype to provide educational opportunities to remote and underserved communities.

### **BIOLOGICAL AND PHYSICAL RESEARCH ENTERPRISE**

The mission of this Enterprise, formerly the Office of Life and Microgravity Sciences and Applications, is to conduct basic and applied research (including clinical research) to support human exploration of space and to take advantage of the space environment as a laboratory for scientific, technological, and commercial research. The Office oversees the effective use of the International Space Station facilities for scientific, commercial and technology research. The Biological and Physical Research Enterprise did not directly support projects at TCU's but it still plays an important role in TCU's through its collaborations with other NASA Enterprises.

### **EARTH SCIENCE ENTERPRISE**

NASA's Earth Science Enterprise is dedicated to understanding the total Earth system and the effects of natural and human-induced changes on the global environment. The vantage point of space provides information about Earth's land, atmosphere, ice, oceans, and biota that is obtainable in no other way. Programs of the Enterprise study the interactions among these components to advance the new discipline of Earth System Science, with a near-term emphasis on global climate change. These research results contribute to the development of sound environmental policy and economic investment decisions.

NASA's Earth Science Enterprise develops innovative technologies and applications of remote-sensing for solving practical societal problems in food and fiber production, natural hazard mitigation, regional planning, water resources, and national resource management in partnership with other Federal agencies, with industry, and with state and local governments. Earth Science discoveries are shared with the public to enhance science, mathematics, and technology education and increase the scientific and technological literacy of all Americans.

Earth Science combines the excitement of scientific discovery with the reward of practical contribution to the sustainability of planet Earth.

## **An Exemplary Earth Science Enterprise Project**

### **Salish Kootenai College**

#### *NASA Native Earth Systems Science Curriculum Project*

#### Project Overview

The Native Earth Systems Science Curriculum Project (NESCP) seeks to improve the education of Native American K-4 students in Earth systems science. To accomplish this, the project employs two basic strategies. The first is teacher training and curriculum development. The project's main participants are trios consisting of a secondary teacher and an elementary teacher of Native American students, and a Native American elder from each of three Northwestern reservations— the Nez Perce, Colville, and Flathead Reservations. In the training component of the project, participants are trained in the use of constructivist and inquiry-based methodology, educational practices that are deemed appropriate for teaching Native American students. They are further trained in Earth systems science content through on-site visits to NASA Goddard Space Flight Center and use of NASA educational resources.

The second component is based upon curriculum. The curriculum component of the project involves the development of culturally competent K-4 Earth Systems Science lessons by project participants. The lessons also incorporate NASA research and resources. This component melds with the training component as participants, with the aid of workshops and coaching, generate and pilot test 20 K-4 lessons that contain tribally specific content and employ the identified teaching methodologies and content. The result of the project will be a teaching workforce proficient in teaching Earth systems science to Native American students and also proficient in the development of appropriate curricula. In addition, at least 60 of these lessons will be generated and then disseminated nationwide via the Internet.

#### **Project Participants**

Project participants include the trios briefly described above as well as Native American elder committees, culture committees, tribal natural resource personnel, and/or Indian Parent Committees from each reservation. These groups of people serve as cultural consultants and educational resource people. In addition, the project provides valuable training and experience for a Native American, preservice teacher who participates in all project activities. Eventually, participants will also include all students impacted by the project as the teachers involved implement the methods and content they have obtained in the project in their classrooms. Specific information about trio participants is outlined below.

#### **Colville Trio**

- A Colville female, certified as a K-8 teacher, who is currently teaching 6<sup>th</sup> grade at Paschal Sherman School. The school's student population is 99 percent Colville.
- A Colville female, certified as a K-12 teacher, who is currently teaching 9<sup>th</sup> grade science at Paschal Sherman School. She is also a college instructor and serves as the trio's cultural consultant.
- A Caucasian female, certified as a K-8 teacher, who is currently teaching 3<sup>rd</sup> grade at Paschal Sherman School.

### **Nez Perce Trio**

- A Nez Perce female, certified as a K-8 teacher, who is currently teaching 3<sup>rd</sup> grade at Lapwai Elementary School. The Lapwai School District's student population is overwhelmingly Nez Perce.
- A Nez Perce female, certified as a K-8 teacher, who is currently teaching middle school at Lapwai Middle School.
- A Nez Perce male, certified as a K-12 teacher, who is currently serving as the Environmental Education Specialist for the Nez Perce tribes. He serves as the trio's cultural consultant.

### **Flathead Trio**

- A Salish/Anishinabe female, certified as a K-8 teacher, who is currently serving as Director of Indian Education in the Ronan School District, as well as adjunct faculty and curriculum specialist for Salish Kootenai College. The Ronan District's student population is 54 percent Native American.
- A Salish Kootenai female, who is currently serving as a director of the Kootenai Housing project. She is the cultural consultant for the Flathead trio.
- A Caucasian female, certified as a 6-12 teacher, who is currently employed as a curriculum specialist and associate faculty at Salish Kootenai College.

### **Project Achievements**

In preparing for trio training, the project staff prepared a handbook for distribution to trio members that covered aspects of the NESCP's goals, methods for research and development of culturally competent curricula, information about constructivist and inquiry-based methods, educational and cultural resources, administrative details of the project, the NASA review and evaluation process, and the lesson plan format. Six workshops with trio members were held in the first 6 months of the project. Early workshops focused on participants understanding the NESCP goals and strategies, training in inquiry-based and constructivist methodology, and training in the development of culturally competent curricula. Based on continual evaluation of the needs of trio members and the progress of the project, later workshops focused on specific aspects of lesson plan development, and included modeling, coaching, and feedback on trio lessons by the project's curriculum specialists. By the end of the reporting period, trios had each generated five lessons and were gaining proficiency in developing appropriate curricula in alignment with project goals. Additionally, an agenda for the summer workshop for trio members at GSFC had been approved.

### **Partnerships**

The trios have each formed informal partnerships with Native American elders, culture committees, and Indian Parent Committees, who provide assistance with the integration of cultural content in curriculum development. Also, the trios have worked extensively with tribal natural resource personnel on each reservation, which provides consultation, data, maps and images relevant to Earth systems science issues on each reservation. Additionally, trios have received assistance and resources from GSFC personnel in the form of satellite images, and educational products. The Flathead trio has also been working with experts at the Earth Observation Satellite (EOS) project at the University of Montana and the Remote-Sensing Project at Salish Kootenai College to obtain and effectively use satellite images of the reservation in addressing Earth science issues relevant to the tribes on their reservation.

## **OFFICE OF SPACE FLIGHT**

The goal of the Office of Space Flight (OSF) Enterprise is to open the space frontier by exploring, using and enabling the development of space. Our programs provide safe, assured transportation to and from space for people and payloads, and develop and operate habitable space facilities in order to enhance scientific knowledge, support technology development, and enable commercial activity. The four major goals of this enterprise are the following:

- Explore the space frontier
- Enable humans to live and work permanently in space
- Enable the commercial development of space
- Share the experience and benefits of discovery

Although OSF did not directly provide funds to TCU's or other Tribal Institutions, they allocated funds through the Kennedy Space Center (KSC) to contract with a Native American-owned business to provide programmatic support to several KSC organizations.

## **SPACE SCIENCE ENTERPRISE**

The Space Science Enterprise seeks to chart the evolution of the universe, from origins to destiny, and understand its galaxies, stars, planetary bodies, and life. The Enterprise asks basic questions that have eternally perplexed human beings such as: How did the universe begin and evolve? How did we get here? Where are we going? Are we alone? The findings from space probes, robotic explorers, observatories, and computer modeling strengthen our quest to answer these extensive questions of our past, as well as those that may shape our future.

In pursuing this mission, the Enterprise develops, uses, and transfers innovative space technologies that provide scientific and other returns to all of NASA's Enterprises, as well as globally competitive economic returns to the Nation. Its knowledge and discoveries are used to enhance science, mathematics, and technology education and the scientific and technological literacy of all Americans.

### **An Exemplary Space Science Enterprise Project**

#### **Southwestern Indian Polytechnic Institute (SIPI)**

#### **Stars on Earth, Providing Underrepresented New Mexico High School Students with Research Experiences**

*Stars on Earth* is one of three projects carried out in FY 2001 to develop academic and research capabilities in space science at Tribal Colleges. Under this project, SIPI provides a year-round academic and research-based program opportunity for underrepresented students to build a solid foundation in Earth and planetary sciences, mathematics, technology and communications. As a result of this project, SIPI now offers a space science concentration within its Liberal Arts Associate of Arts degree program and new astronomy lecture and laboratory classes designed to articulate with courses at the University of New Mexico. Space science content has also been integrated into science courses for preservice teachers. Collaboration with the University of New Mexico Institute of Meteoritics has resulted in the establishment of a Meteorite Identification Laboratory at SIPI that provides internship and research experiences for college and high school students. Work conducted by SIPI students in

this Meteorite Identification Laboratory resulted in a paper submitted to the 32<sup>nd</sup> Lunar and Planetary Science Conference.

Precollege students are supported under *Stars on Earth* through Saturday Academies in which high school students are actively engaged in sessions that integrate Earth and space science, mathematics, and English and participate in college and skill development sessions. Students also participate in a 6-week summer residential program that includes Earth and space, life, and environmental science classes and labs, in addition to developing research projects, presenting at poster sessions, and interacting with professionals in the field.

Complementary activities for the students' high school teachers and parents provide a source of support and reinforcement for choosing technical career paths.

## **NASA CENTER INVOLVEMENT**

NASA Centers and Enterprises are fully committed to assisting NASA in achieving the goals set by the Agency in support of TCU's. During FY 2001, the NASA Centers continued to implement programs to achieve the goals of strengthening the capability of TCU's to provide quality education, and to conduct first-rate research activities for faculty and students. Moreover, the NASA Centers perceived a need to initiate a more proactive policy in its role as technical monitor, seeking out opportunities to more closely link funded programs to the technical divisions and to broad education and public outreach efforts.

During FY 2001, the NASA Centers implemented numerous projects that helped to strengthen the infrastructure of TCU's. These projects better equipped students and faculty to pursue studies and careers in NASA-related fields. The following summaries are synopses of the accomplishments of the NASA Centers and Enterprises for FY 2001.

### **AMES RESEARCH CENTER (ARC)**

During FY 2001, ARC placed particular focus on the recruitment of Native American students for internships. ARC's 10-week "Summer Experience Programs for Undergraduates" recruited 3 Native American scholars. This marked the first successful efforts to attract Native American students to ARC through a NASA-sponsored scholarship program.

ARC staff continued to participate in technical conferences, workshops, career fairs, science fairs, and various educational outreach programs that target Native American students and TCU's. Conferences and workshops supported by ARC included the NASA Education Workshop for Teachers of Native American Students, the American Indian Science and Engineering Society National Conference, and the Native American Science Bowl of the Far Western Region.

### **DRYDEN FLIGHT RESEARCH CENTER (DFRC)**

Although, no new grants were awarded to TCU's during FY 2001, DFRC remains committed in developing relationships with TCU's. A Tribal College Workshop was hosted by DFRC in September 2001 that was attended by 26 faculty and staff representing 17 TCU's. The workshop was intended to provide an understanding of DFRC available research, education and funding. Participants engaged in large and small group dialogues with other DFRC offices and departments to inform TCU representatives about available opportunities such as student and teacher materials, distance learning, small disadvantaged business, and student intern programs. Following the workshop, the DFRC resident architect contacted DFRC management with a proposal to collaborate with interested TCU's to assist in construction technology education programs or specific projects.

### **GLENN RESEARCH CENTER (GRC)**

GRC awarded a \$100,000-grant to Lac Courte Oreilles Ojibwa Community College for a renewable energy and sustainable development institute project. This project conducted a resource survey to assess and map potential renewable resources in the local area, enhance faculty expertise, develop curricula in renewable energy and sustainable development and serve as a community resource. The project also hosted demonstration and research projects in various renewable energy and sustainable development areas. Funding in the amount of

\$84,000 was awarded to TCU's through the National Action Council for Minority Engineers. These funds are being used to support five Native American students from various TCU's.

### **GODDARD SPACE FLIGHT CENTER (GSFC)**

During FY 2001, GSFC initiated a more energetic outreach program to minority institutions. Staff participated in TCU-sponsored technical conferences to foster the building of relationships with faculty and students. The American Indian Higher Education Consortium student conference, a grant administered through GSFC, was held at the Oglala Lakota College in South Dakota. Opportunities were increased for technical monitors to make onsite visits to the universities with which they are affiliated. A GSFC Astrophysicist in the Space Sciences Directorate visited the Oglala Lakota College to attend the summer program for the Scientific Knowledge for Indian Learning and Leadership program for which he is the technical monitor. GSFC also hosted three student interns from Oglala Lakota College as well as a faculty member for various summer programs. A total of \$889,830 was awarded directly to TCU's from GSFC during FY 2001 and an additional \$2,093,933 was awarded to TCU's through Third-Party awards.

### **JET PROPULSION LABORATORY (JPL)**

JPL hosted a group of 17 elementary and secondary school teachers from Native American reservations in New Mexico and Arizona during the summer of 2001. The educators learned about some of NASA's most exciting missions during the 2-week educational workshop. Teachers from the four different school districts learned how to involve their students in the wonders of space exploration while preserving and celebrating their rich Native American traditions. The workshop brought together two different worlds that view the stars differently. For one, the stars are a source of spiritual guidance, and for the other they are a means to learn more about age-old questions such as, "Where did we come from?" and "Are we alone?" The primary goal of the workshop was to develop an action plan that supports standards-based teaching and learning in mathematics, science, technology and geography. During FY 2001, JPL supported TCU's through \$170,080 in Third-Party grants. These awards to the TCU programs represented an increased commitment to engage TCU's through K-12 pipeline efforts and undergraduate internships.

#### **Exemplary JPL Involvement**

##### **Diné College**

##### *From the Sun to the Star Nations*

From the Sun to the Star Nations is a Native American education and public outreach initiative led by the Europa Orbiter Project in collaboration with several Solar System Exploration efforts, including Mars, Stardust, Deep Impact and the Deep Space Network. This program has established an effective and culturally sensitive strategy of "making relations," building a track record of trust within the community, assessing needs, and responding to needs that are within the scope of work. From the Sun to the Star Nations works in five main geographical areas: with the Diné (Navajo) in Arizona/New Mexico, the Lakota (Sioux) in South Dakota/North Dakota, the Anishinaabe (Ojibway) in Minnesota, Hawaii (Native Hawaiian) and with several communities in California, including the Ajachemen (Juaneno). They maintain an exemplary community partnership with the World Hope Foundation, based in Boulder, Colorado, with extensive experience working directly with traditional community leaders, elders, and community members.

In FY 2001, the World Hope Foundation worked with the Space Science Institute to host a "Making Relations Symposium" engaging Diné and Lakota community leaders, NASA representatives, and award recipients of the Minority University Partnership Initiative. As a consortium, along with World Hope Foundation, they also engaged the Academic Research Lab, based in Arizona; Project Universe, based in Minnesota; and Telescopes in Education Foundation, based in California; to provide field coordination of community participation that engages a dialogue between Space Science and Star Knowledge. NASA presenters from JPL, Solar System Ambassadors, Solar System Educators, GSFC, the Arizona State University Mars Education Program, Diné College, and Northern Arizona University were also brought into a dialogue with Native American cultural practitioners, scholars, and star knowledge holders. The dialogue maintained a focus on the nature of science and related the long history of skywatching and practical astronomy. The dialogue resulted in new insights about how best to engage Native American students in science education. This often stimulates more effective approaches that influence the way curriculum support materials and classroom strategies are created. The Space Science and Star Knowledge dialogue is held in the context of K-12 classroom school visits, community skywatching events, educator workshops, and intercultural exchanges that occur in the community over a 2-3 day period. In 10 major Native American community events in FY 2001, *From the Sun to the Star Nations* reached 250 college students, 1300 K-12 students, 500 teachers, and over 1000 members of the community, including engaging three Native American college students as interns at JPL.

### **JOHNSON SPACE CENTER (JSC)**

During FY 2001, JSC accomplished significant measurable objectives in its goal to assist TCU's. JSC continued to emphasize the goal of inclusion of TCU's in its programs. The Space Shuttle, International Space Station (ISS), and Space and Life Sciences Programs were required to identify their TCU plans in their Program Operating Plan (POP) reviews. JSC provided support to Diné College in a high-level peer reviewed project. The total FY 2001 TCU funding was \$245,360, which represents a 40-percent increase over FY 2000 funding of \$174,731.

### **KENNEDY SPACE CENTER (KSC)**

Diné College - American Indian Network Information Center served as a member of the NASA Space and Life Sciences Training Project Academic Partner Alliance for the SLSTP 2001 summer course. Diné College served as the Lead Publications Coordinator and Lead of the Publications Team for the second year. Native American astronaut John Herrington gave a special presentation to the 75 students participating in the New Mexico Mathematics, Engineering, and Science Achievement Program at KSC during FY 2001.

KSC has contracted with All Points Logistics, Inc., a small, disadvantaged, Native American and Veteran-owned business to provide administrative and clerical support to several KSC organizations, including the Equal Opportunity Office. In FY 2001, the contract was funded for \$375,000.

### **LANGLEY RESEARCH CENTER (LARC)**

TCU programs aided LaRC's achievement of its goals and objectives by permitting new and existing minority university collaborations and partnerships that provided mutually beneficial endeavors for university students, faculty and researchers. One such exemplary program is the Langley Aerospace Research Summer Scholars (LARSS) Program. The LARSS Program was

established for the benefit of rising undergraduate juniors and seniors, and first-year graduate students who are pursuing degrees in aeronautical engineering or selected space disciplines of interest to LaRC. The LARSS Program is intended to encourage high-caliber college students to both pursue and earn graduate degrees and to enhance their interest in aerospace research by exposing them to the professional research resources and facilities at LaRC. The 2001 LARSS program was highly diversified with respect to participants' backgrounds that included 4 Native American students.

### **STENNIS SPACE CENTER (SSC)**

SSC supported a grant to Diné College entitled, "Expanding the Pool of GIS Professionals for the Navajo Nation." This grant allowed the Diné College GIS program to engage in a number of new activities, which included using aerial digital photos, teacher training in Global Positioning System (GPS)/GIS and hosting a GIS Conference. The digital images required new software and a revamped GIS Course. The conference and training brought new and lasting contacts with teachers and GIS professionals.

The study was to find the extent of the Tamarisk and Russian Olives along the San Juan River around Shiprock, New Mexico. The aerial photos were rectified to the local coordinates, and classified using the NVDI ratio. The Tamarisk showed up as a cluster of 2 nondistinct pixels but interestingly excluded many cluster types. The Russian Olive areas, in contrast, had approximately 5 clusters and excluded 3-5 other clusters. The Cottonwoods differed from both in having one distinct cluster and had surrounding pixels of many types.

A companion study on biodiversity also showed that Tamarisk lowers the biodiversity more than Russian Olive. Another disturbing result showed that the Russian Olive and Tamarisk both have many more pixels or area than the cottonwoods.

This study could result in the education of the community about the problems associated with Tamarisk and Russian Olives, and this in turn could lead to some community action to control these trees or save the cottonwoods. The training will allow Diné College to train others in future years so that community problems can eventually be solved with the help of GIS. The total FY 2001 funding for this program was \$76,540.

## **APPENDIX A**

### **NASA ORGANIZATION**

NASA Headquarters in Washington, DC, is the corporate headquarters, responsible for Agency-wide leadership and management, development of program strategies, and interfacing with Congress and the White House. Within NASA Headquarters, five Strategic Enterprises have responsibility for the Enterprise missions:

- **Office of Space Science**—lead responsibility for the Space Science Enterprise.
- **Office of Earth Science**—lead responsibility for the Earth Science Enterprise.
- **Office of Space Flight**—lead responsibility for the Space Flight Enterprise.
- **Office of Biological and Physical Research**—lead responsibility for the Biological and Physical Research Enterprise.
- **Office of Aerospace Technology**—lead responsibility for the Aerospace Technology Enterprise.
- **Office of Education**—lead responsibility for the education programs at NASA.

Funding for TCU's may originate from any of the offices listed above.

## **NASA CENTERS AND THE JET PROPULSION LABORATORY**

The NASA Centers and the Jet Propulsion Laboratory (JPL) are the primary sites from which the Enterprise missions are implemented. Each Center and JPL has Agencywide leadership responsibility for a specific Center of Excellence area (shown in italics) along with other roles and responsibilities for the Strategic Enterprises.

- **Ames Research Center**, Moffett Field, California—*Information Technology, Astrobiology, Aviation Operation Systems.*
- **Dryden Flight Research Center**, Edwards, California—*Atmospheric Flight Operations, Flight Research.*
- **Glenn Research Center** at Lewis Field, Cleveland, Ohio—*Turbomachinery, Aero-propulsion.*
- **Goddard Space Flight Center**, Greenbelt, Maryland—*Scientific Research, Physics and Astronomy, Earth System Science.*
- **Jet Propulsion Laboratory**, Pasadena, California—*Deep Space Systems, Planetary Science and Exploration, Instrument Technology.*
- **Johnson Space Center**, Houston, Texas—*Human Operations in Space, Astro Materials.*
- **Kennedy Space Center**, Kennedy Space Center, Florida—*Launch and Payload Processing Systems.*
- **Langley Research Center**, Hampton, Virginia—*Structures and Materials, Atmospheric Science, Airframe Systems.*
- **Marshall Space Flight Center**, Huntsville, Alabama—*Space Propulsion, Space Transportation Systems, Microgravity Research.*
- **Stennis Space Center**, Stennis Space Center, Mississippi—*Rocket Propulsion Testing, Commercial Remote-Sensing.*

## APPENDIX B

Throughout the narratives in this report, awards and projects are identified by the abbreviations given below for both the NASA Headquarters Office from which the funding originated and the Center (or JPL) from which the award was made.

### LIST OF ACRONYMS AND ABBREVIATIONS

AIHEC	American Indian Higher Education Consortium
ARC	Ames Research Center
CIPA	Curriculum Improvement Partnership Award
DFRC	Dryden Flight Research Center
EOS	Earth Observation Satellite
ERWM	Environmental Restoration and Waste Management
FAR	Faculty Awards for Research
FELLOWS	Fellowships, Internships, Traineeships, Recruitment, And Arrangements Under The Intergovernmental Personnel Act
FY	Fiscal Year
GIS	Geographic Information System
GLOBE	Global Learning and Observation to Benefit the Environment
GPS	Global Positioning Satellite
GRC	Glenn Research Center
GSFC	Goddard Space Flight Center
GSRP	Graduate Student Researchers Program
HBCU	Historically Black Colleges and Universities
HQ	Headquarters
HSI	Hispanic Serving Institutions
IHE	Institutions of Higher Education
IPA	Intergovernmental Personnel Act
IUREP	Innovative and Unique Research and Education Project
JPL	Jet Propulsion Laboratory
JSC	Johnson Space Center
KSC	Kennedy Space Center
LaRC	Langley Research Center
LARSS	Langley Aerospace Summer Scholars
MASTAP	Math, Science, and Technology Awards for Teacher and Curriculum Enhancement Program
MI	Minority Institution

MSE	Mathematics, Science, and Engineering
MSET	Mathematics, Science, Engineering, and Technology
MSFC	Marshall Space Flight Center
MUREP	Minority University Research and Education Programs
NASA	National Aeronautics and Space Administration
NESCP	Native Earth Systems Science Curriculum Project
NRMT PACE	Northern Rocky Mountain Tribal Pathway to Academic Excellence
NRTS	Network and Research Training Sites
OAT	Office of Aerospace Technology
OBPR	Office of Biological and Physical Research
OE	Office of Education
OES	Office of Earth Science
OHRE	Office of Human Resources and Education
OSF	Office of Space Flight
OSS	Office of Space Science
PACE	Precollege Awards for Excellence
PAIR	Partnership Awards for the Integration of Research
PI	Principal Investigator
PSI	Private-Sector Involvement
R&D	Research and Development
RESDI	Renewable Energy and Sustainable Development Institute
SIPI	Southwestern Indian Polytechnic Institute
SMET	Science, Mathematics, Engineering, and Technology
SSC	Stennis Space Center
STA	Student Tuition Assistance, Scholarships, and Other Aid
TCU	Tribal Colleges and Universities
TPA	Third-Party Awards
TRC	Technical Review Committees
USAR	Undergraduate Student Awards for Research