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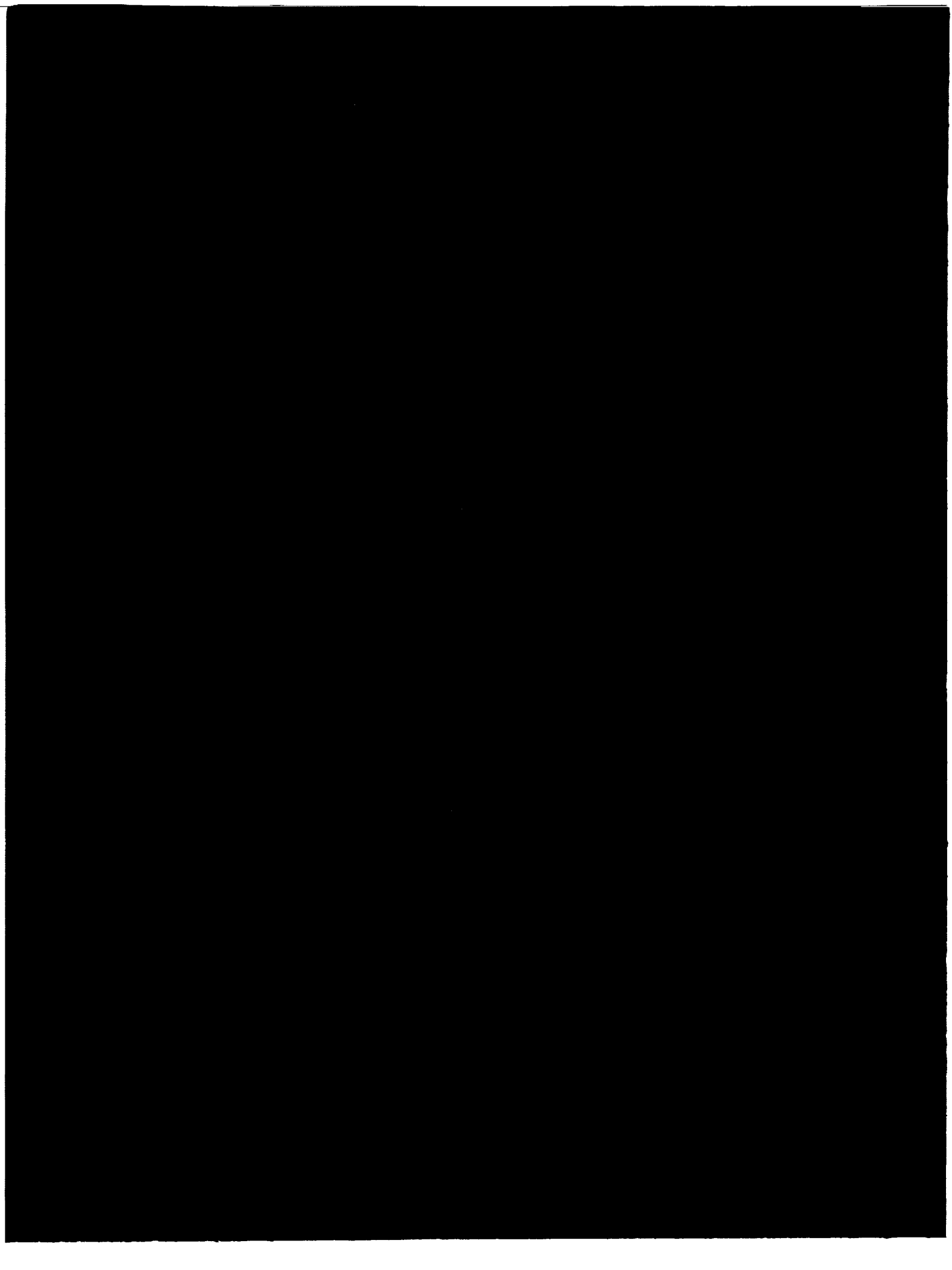
Nebraska at Omaha Center for Teaching and Learning



THE UNO AVIATION MONOGRAPH SERIES

UNOAI Report 2000-4

The University of Nebraska at Omaha Center for Space Data Use in Teaching and Learning

Neal Grandgenett

July 2000

UNO
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University of Nebraska at Omaha
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The University of Nebraska at Omaha
Center for Space Data Use in Teaching and Learning

The Vision: A New Center for Teaching and Learning

Within the context of innovative coursework and other educational activities, we are proposing the establishment of a University of Nebraska at Omaha Center for the Use of Space Data in Teaching and Learning. This Center will provide an exciting and motivating process for educators at all levels to become involved in professional development and training which engages real life applications of mathematics, science, and technology. The Center will facilitate innovative courses (including online and distance education formats), systematic degree programs, classroom research initiatives, new instructional methods and tools, engaging curriculum materials, and various symposiums. It will involve the active participation of several Departments and Colleges on the UNO campus and be well integrated into the campus environment. It will have a direct impact on pre-service and in-service educators, the K12 students that they teach, and other college students of various science, mathematics, and technology related disciplines, in which they share coursework.

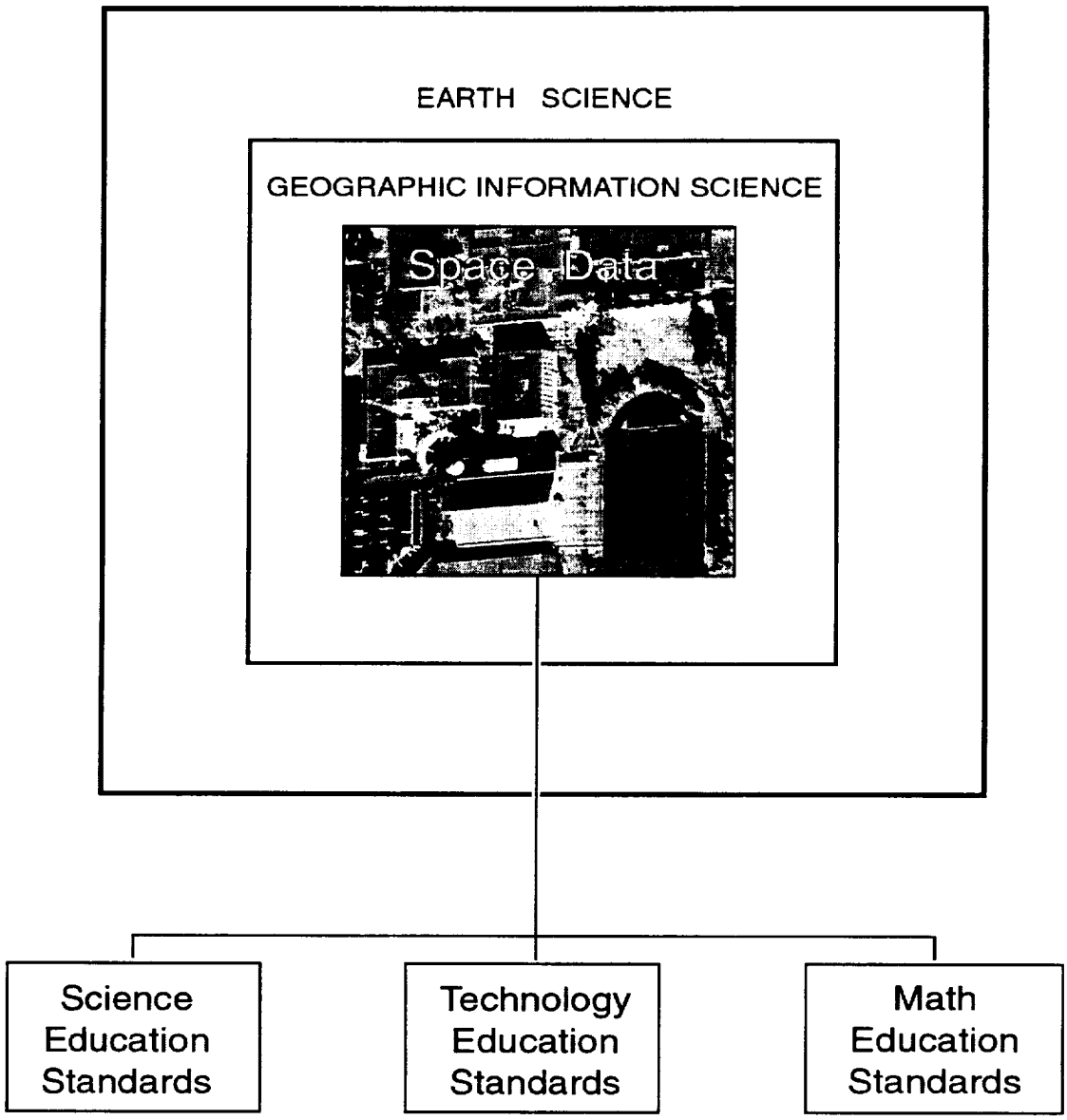
It is our belief that there are many exciting opportunities represented by space data and imagery, as a context for engaging mathematics, science, and technology education. For example, as an elementary, middle, or high school student, imagine the excitement of partnering with a practicing scientist to help do real science, such as mapping snow and glaciers, gathering evidence of environmental change due to global warming, or even assessing the water resource potential of an area from space. In

addition, imagine the dynamic mathematics that can be learned in such a context, including the active use of mathematical problem solving, reasoning, and modeling. The use of space data can also help facilitate an engaging use of educational technology, particularly in such areas as geographic information systems, image processing, numerical analysis, and virtual reality. Such student engagement is believed to be a critical component within the context of science and mathematics instruction (Miller, 1989; Schauble & Lehrer, 1999). Most importantly, the use of space data within integrated curricula is a convenient and interesting way to address new initiatives and standards for science, mathematics, and technology education. It is also a rich context for use of technology within a particular discipline, which has been shown to be of key importance in the successful educational technology learning environments (Carrol, 1997; Cooley, 1997; Dugger 1997; Polka, 1997).

The UNO Center for Space Data Use in Teaching and Learning being proposed in this document will encompass a comprehensive training and dissemination strategy that targets the improvement of K-12 education, through changes in the undergraduate and graduate preparation of teachers in science, mathematics and technology education. This is compatible with the call for such comprehensive and collaborative strategies of teacher preparation by many researchers (Darling-Hammond, 1994; Ingersoll, 1999). Our Center, with its use of advanced educational technology and resources, will take full advantage of various multidisciplinary topics and teaching strategies that are facilitated with the use of space data in the classroom. In essence, we will use space data to help provide a thread and context for various programmatic activities consistent with strong curriculums in mathematics and science (Mundry &

Loucks-Horsley, 1999; Meichtry, 1992). Thus images and data from space will be used as a foundation for teacher training and student learning and will help facilitate a rich environment for teaching and learning which integrates important standards in science, mathematics, and technology education (Figure 1).

Figure 1.


EARTH SCIENCE
GEOGRAPHIC INFORMATION SCIENCE
Space Data
Science Education Standards
Technology Education Standards
Math Education Standards

This educational approach would cut across disciplines and grade levels to facilitate scientific inquiry, technical skills, and problem solving. For example, an elementary student might simply view a satellite image and count the number of glaciers or mountain peaks depicted in an image. They could begin to understand the spatial relationships between glaciers and their topographic setting, and attempt to predict where other glaciers might form. At the secondary level, students could delineate and map land-cover characteristics such as water, vegetation, snow and ice, and relate these spatial distributions to topographic characteristics in an attempt to understand the relationships between topography, land-cover, and climate. Such activities are in line with calls for instructional activities that support general scientific literacy (National Research Council, 1996), and are very compatible with the constructivist and problem based learning environments which are particularly powerful in the learning of mathematics and science (Savery and Duffey, 1995; Wilson, 1995; Cox, 1989). Undergraduate and graduate students could use the same images accessed at different times to document the active surface processes responsible for the changing patterns on the landscape. In this way they can begin to understand the active system and attempt to determine the factors causing environmental change. In all the aforementioned examples, students would also learn about technology, as it is used to observe, manipulate, and analyze data.

The use of space data will serve as a foundation in our education approach because it characterizes and contains rich information regarding the spatial and temporal complexities of our world. It also offers the ability to engage the teaching and learning of multidisciplinary topics. In this context, curriculum related to geographic information

science and earth system science can be systematically used with the data to address science, technology, and math standards on multiple levels. This approach has been recognized by researchers and educators to have tremendous potential (Grandgenett, Clark, Topp, Pawloski, Kassebaum, & Ostler, 2000), although it is extremely difficult to implement for schools and universities because of a variety of issues involving technology, infrastructure, curriculum development, teacher training, and information dissemination. This has prompted national initiatives funded by NASA and NSF to further develop areas of excellence that focus on enhancing and promoting science and technology education with data (for example, Digital Earth Initiatives, the Earth System Science Education Alliance, and the NASA Student Involvement Program). The problem in achieving the complete potential targeted by these national programs has been, and still is, one of effective teacher training, integration of data, curriculum, technology, and dissemination of results which truly impact student learning (Bishop et al., 1995, 1993; Darling-Hammond, 1994). Consequently, there is the need for the development and evaluation of a centralized model that addresses these issues in an integrative fashion, maximizes the utility of space data, and has a significant impact on teachers, students, and other education professionals.

The Center Organization

The Center for the Use of Space Data in Teaching and Learning at UNO will be a virtual organizational structure which cuts across campus departments and colleges. The Center will maintain very close ties with organizations providing data and imagery, such as the EROS Data Center, and with other institutions providing resources and

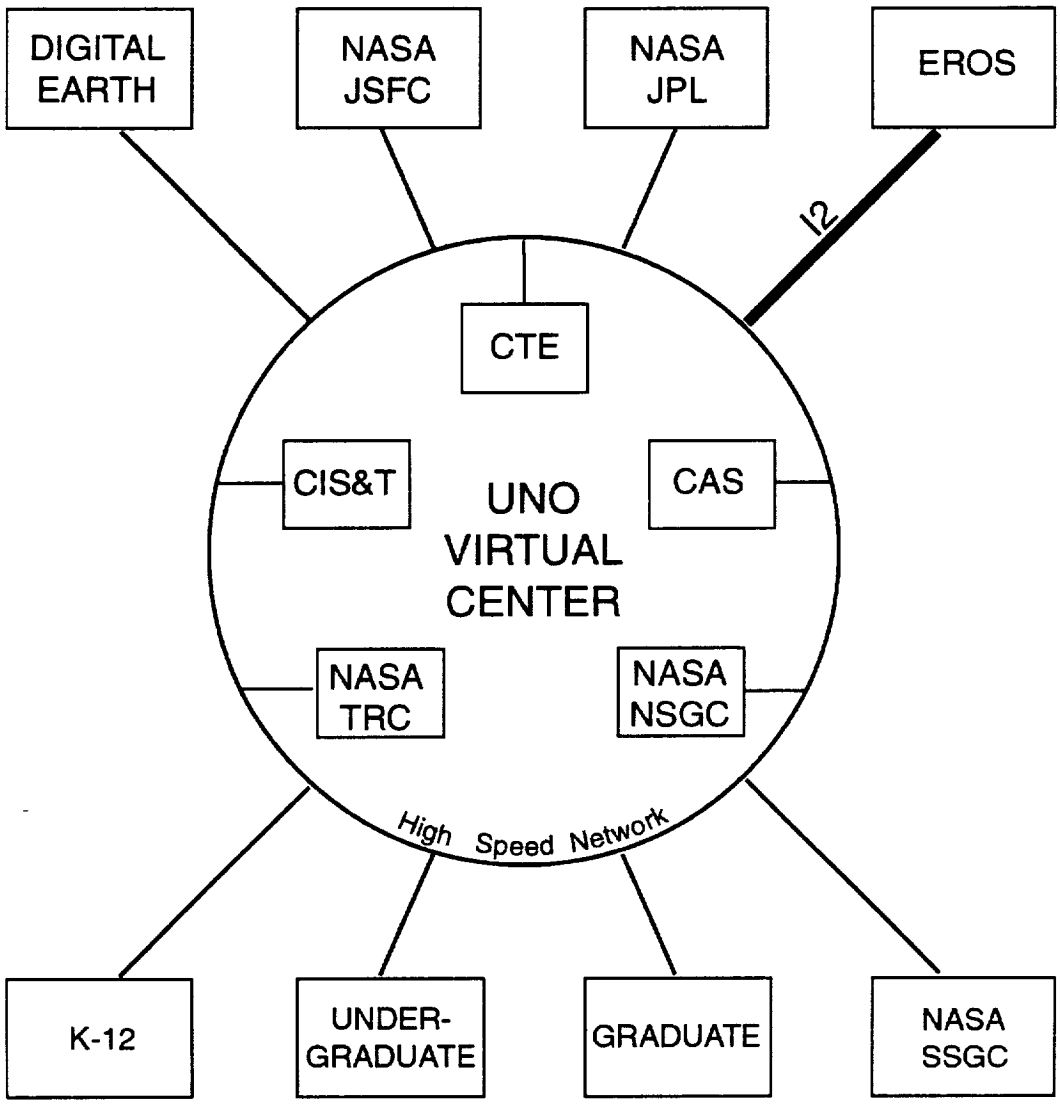
software, such as the Jet Propulsion Laboratory. There is a strong potential for success in such an endeavor at UNO. Building upon our unique strengths and active involvement in national education and research projects using space data, we have collectively integrated our facilities, expertise, and activities to establish the foundation of a UNO virtual center for teacher education and training. From an infrastructure perspective, this foundation for success has been accomplished with our new campus network that permits the College of Teacher Education (CTE), the College of Arts and Sciences (CAS), the College of Information Science and Technology (CIS&T), NASA's Teacher Resource Center (TRC), and NASA's Nebraska Space Grant Consortium to all work together to accomplish the objectives of this proposal. This collaboration is feasible because of a high-speed gigabit network that enables us to share data and information, and use our advanced technology facilities, to promote teacher education. With advanced processing, display, and transfer of information via high-speed networking, we are able to effectively distribute data and information anywhere on campus, and throughout the state, and have effective outreach at the national level. Furthermore, given our computational facilities we will be able to effectively integrate complex analysis and scientific visualization into our educational approach to motivate and train teachers and students in innovative ways.

A steering committee composed of the project PIs, Center Specialists, and other key personnel will meet twice each month. This steering committee will be chaired by the Lead PIs. In addition to the steering committee, an advisory committee of the College Deans and key partners associated with the project (such as the Strategic Air Command Museum) will meet monthly. Subcommittees will consist of the following: 1)

formal education, 2) informal education, and 3) consortium outreach. Each of these committees will be chaired by a full time center specialist from the respective focus area.

Our Center would be working with several national agencies that will provide data and software for teacher and student use. These organizations will be connected to UNO with the high-speed network (Internet II). Campus departments and colleges participating in the Center will then take advantage of the imagery and resources within formal and informal educational activities, including K12 education, undergraduate teacher education, graduate preparation of educational specialists, and curriculum development to be shared within the NASA Space Grant Consortium (see Figure 2).

Figure 2.


DIGITAL EARTH
NASA JSFC
NASA JPL
EROS
12
CTE
CIS&T
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UNO VIRTUAL CENTER
NASA TRC
NASA NSGC
High Speed Network
K-12
UNDER-GRADUATE
GRADUATE
NASA SSGC

The Digital Earth Library project, which has the mission of facilitating earth system science education, will provide a rich source of environmental data that will be used for earth science training and education. Similarly, we will be receiving digital camera data from the International Space Station via NASA Johnson Space flight Center (JSFC). We have close connections with NASA's Jet Propulsion Laboratory (JPL), and teachers and students will be utilizing specially designed software for image display and change detection. Furthermore, with our Internet II connectivity, we will have access to the National EROS Data Center where we will receive satellite imagery on a regular basis. The participation and integration of these nationally recognized agencies into our UNO virtual center infrastructure will effectively facilitate an operational basis to data acquisition, which will drive the development of very specific products for teacher and student education. Our center will also facilitate periodic educational outreach for these institutions. Our model also includes extensive educational outreach components that will target K-12 schools, undergraduate and graduate programs, and various NASA State Space Grant Consortiums around the country.

The Goals and Objectives of the New Center

University of Nebraska at Omaha (UNO) Center for the Use of Space Data in Teaching and Learning will focus on six goals, each of which will include various operational objectives.

Goal 1) To Facilitate Educational Curriculum

The development of educational curricula which uses space data and imagery as a powerful context for the learning of mathematics, science, and technology topics will be a key goal of the new Center. These curricula will be integrated as both self-contained modules and within various university courses, so that pre-service and in-service teachers can directly experience the potential of this emerging resource on campus, and so that other institutions can incorporate the developed modules into their own coursework as desired. The university courses include instructional methods courses, as well as core science courses, in the preparation of teacher specialists.

It is important to note that UNO has successfully led the development of science curriculum on a national level in various projects and has worked with a wide variety of partners in curriculum development such as the NASA Jet Propulsion Laboratory and the Consortium for the Application of Space Data in Education (CASDE). Curriculum developed by the project will use the concept of a curriculum "building block" (Grandgenett, et. al, 2000). An important feature of building blocks is the direct reference to published curriculum standards in science education (National Research Council, 1996) and in the newly revised mathematics education standards (National Council of Teachers of Mathematics, 2000) within the building block links and structures. Student assessments, through carefully structured classroom activities, are also a key part of the curriculum building block format. Some prototype curriculum building blocks, involving space data use in the teaching of various science, mathematics, and technology topics have already been developed at UNO and are accessible at www.ois.unomaha.edu/casde.

Curriculum building blocks are very technology intensive and thus coincide with national efforts to enhance the technology literacy of both teachers and students (see Dugger, 1997; Niederhauser, 1996; Quinn, 1996; Means, Olson, Singh, 1995). The building block curriculum structure was conceptualized by CASDE, in which UNO has been the lead education partner. The curriculum building blocks also incorporate cutting-edge image processing software called DataSlate, developed by engineers at the Jet Propulsion Laboratory, which will be freely distributed by the Center in the developed curriculum activities.

Three distinct objectives will then support the potential realization of Goal 1 which targets educational curriculum.

Objective 1.1. The Center will provide a strategic forum for the planning of interdisciplinary coursework which strives to take full advantage of space data imagery, tools, and resources in the instruction of science, mathematics, and technology education.

Objective 1.2. The Center will facilitate the development of new certificate and teacher preparation programs, which involve flexible sequences of professional experiences for science, mathematics, and technology educators.

Objective 1.3. The Center will develop web based curriculum activities, for use with the integration of space data in teaching and learning, which will be made available to educators around the world over the World Wide Web.

Goal 2) To Link with National and International Projects.

The Center for the Use of Space Data in Teaching and Learning will closely link with national and international projects that have a strong potential in science, mathematics, and technology education. For example, within the rich context of the international GLIMS (Global Land Ice Measurements from Space) Project, teachers would work closely with scientists to help develop curriculum activities and become involved in the related classroom applications of space and data projects. The GLIMS project is designed to assess and monitor the world's glaciers using satellite imagery from sensors such as ASTER (Advanced Spaceborne Thermal Emission and reflection Radiometer) instruments aboard the Earth Observation Systems Terra spacecraft (see wwwflag.wr.usgs.gov/GLIMS). UNO is working closely with NASA and the United States Geological Survey (USGS), as a regional center, and has begun the development of extensive web-based tools and applications, with considerable potential for mathematics, science, and technology education.

Two objectives will then support the potential realization of Goal 2, which focuses on the Center's linkage with national and international projects.

Objective 2.1. The Center will facilitate the creation of virtual communities of scientists, teachers, and students, who work on real science projects as they learn fundamental concepts in science, mathematics, and technology.

Objective 2.2. The Center will facilitate the use of real science projects such as GLIMS, in the development of realistic curriculum materials available for use in a variety of disciplines and grade levels.

Goal 3) To Provide Access to State-of-the-Art Technology

Educators at the Center for the Use of Space Data in Teaching and Learning will have considerable opportunity to use and become familiar with state-of-the-art educational technology. UNO has an extensive web-based computing facility for the training of teachers in simulated space activities called the UNO Space Shuttle Simulation Laboratory (see http://ois.unomaha.edu). This laboratory has been recognized in publications such as the New York Times, and NASA's publication "Technology Today." This facility also showcases the impressive image analysis software, called DataSlate, developed by the NASA Jet Propulsion Laboratory. UNO's Complex Systems Simulation Lab would also be used in teacher development and has high-end computing equipment which supports data processing and modeling, scientific visualization, and virtual reality applications. In addition, other advanced processing facilities and equipment at UNO's new College of Information Science and Technology will enable us to establish a complex computing infrastructure to support the project and facilitate innovations in both teaching and student learning.

Two objectives will support Goal 3, and the Center's endeavors to provide access to State-of-the-Art Technology.

Objective 3.1. The Center will facilitate the ongoing access to space imagery data, resources, and tools within model educational environments, such as the UNO Complex Systems Laboratory and Space Shuttle Simulation Laboratory.

Objective 3.2. The Center will facilitate the free distribution of innovative imaging software, such as the Jet Propulsion Lab's DataSlate package, to interested teachers and educational institutions.

Goal 4) To Extend the Support of Professional Partnerships

With the new Center for the Use of Space Data in Teaching and Learning as a strong advocate for partnerships, UNO will take full advantage of its many regional, national, and international collaborations which are focused on space data and its potential use in education. For example, in addition to NASA and USGS, UNO already works closely with various managers and engineers at the Jet Propulsion Laboratory in initiating a K16 international Special Interest Group related to educator participation in the Digital Earth. In addition, UNO's Aviation Department hosts the NASA Nebraska Space Grant Consortium. UNO also partners closely with select NASA educational initiatives such as EarthKam, which has K12 students control cameras during NASA shuttle missions. Furthermore, UNO is working closely with universities in a variety of countries, such as England, Afghanistan, and Australia, that are interested in distance learning and technology transfer.

Three distinct objectives will then support the potential realization of Goal 4 and the support of professional partnerships within the Center's support of teaching and learning.

Objective 4.1. The Center will facilitate an international special interest group for organizations and individuals interested in K16 education and the Digital Earth.

Objective 4.2. The Center will facilitate the collaboration of teachers and students within targeted national programs and educational opportunities related to space data.

Objective 4.3. The Center will facilitate participation in distance learning coursework and activities related to space data use in teaching and learning.

Goal 5) To Promote Innovative Classroom Research

The establishment of a Center for the Use of Space Data in Teaching and Learning at UNO will help ensure that teacher professional development is closely linked with actual K-12 classrooms. For example, UNO will continue to work closely and expand its shared curriculum development with the Omaha Public Schools (OPS). UNO and OPS are already working together extensively within the NSF Banneker Project, and UNO has been designated as a NSF Center for Excellence in Teaching and Learning. The Banneker Project is focused on the enhancement of mathematics

and science for minority students in urban settings, and has been nationally recognized for its progress, strong evaluation, and innovative approaches to instruction.

Two objectives will then support the potential realization of Goal 5 and the Center's promotion of classroom research.

Objective 5.1. The Center will help facilitate formal dissertation and thesis educational research related to the use of space data in the teaching and learning process.

Objective 5.2. The Center will help organize and conduct teacher classroom and action research studies on the effectiveness of various curricular approaches in the use of space data in the teaching and learning of science, mathematics, and technology education.

Goal 6) To Extend Informal Education Opportunities.

A Center for the Use of Space Data in Teaching and Learning at UNO will also have a comprehensive informal education program. UNO already coordinates extensive informal educational activities which compliment its many strong formal education programs. For example, the UNO Physics Department coordinates a NASA Teacher Resource Center, an 83 seat Planetarium (with 3 liquid crystal display projectors), a roof based observatory (with five 8 inch and one 10 inch telescope), and an educational resources store. One of the telescopes on the roof observatory is also robotic, which permits remote picture taking and transfer of images over the Internet.

In addition, each year UNO runs approximately 60 summer camps in science, mathematics, and technology for local students in grades 4-12. The summer camps are particularly impressive and involve over 9 weeks of camps for more than 1200 students. At these camps, pre-service and in-service teachers have the opportunity to get valuable field experience in teaching with new curriculum materials and approaches.

The UNO College of Education is also partnering in a new outreach initiative with the Strategic Air Command Museum, located in nearby Ashland, Nebraska. A privately funded new facility is planned for this initiative, which will bring students and teachers onsite to the museum to participate in engaging space data related instructional activities and educational experiences.

Four objectives will then support the potential realization of Goal 6, and the Center's promotion of informal education opportunities.

Objective 6.1. The Center will offer model science, mathematics, and technology related camps for K-12 students.

Objective 6.2. The Center will facilitate the involvement of pre-service and in-service teachers in such camps, providing professional development and field experiences for these teachers.

Objective 6.3. The Center will facilitate the direct involvement of informal education agencies, such as the Strategic Air Command Museum, in outreach camps related to space data use in teaching and learning.

Objective 6.4. The Center will facilitate the development and operation of model outreach activities, illustrating the utility of formal and informal education partnerships in the teaching and learning process.

The University of Nebraska at Omaha Advantage

A Center for the Use of Space Data in Teaching and Learning is well positioned for success at UNO. The University of Nebraska at Omaha is a comprehensive, public, and doctoral granting institution located in the heart of Omaha, the state of Nebraska's largest city. UNO has more than 400 faculty members, and offers 95 baccalaureate degree programs, and 66 graduate degrees. The students at UNO are a diverse group. One third of the student population represents each state in the United States and more than 60 countries. It has a broad and distinguished faculty, and has excelled in science, mathematics, and technology education programs. The College of Education and the College of Arts and Sciences, as well as other colleges on campus, work closely together in the preparation of teachers. UNO also enjoys a close working relationship with community schools, agencies, health care providers, businesses, and government, and has a strong connection to technology based corporations through its Peter Kiewit Institute of Technology. This institute is a truly collaborative and intellectual linkage between academe, industry, and state government. This connection

has led to substantial and extraordinary financial commitment from industry to the University, including a $37.5M Information Science, Technology, and Engineering building on the University of Omaha south campus, substantial laboratory and computing support, and four interactive distance learning facilities.

Within the Center concept, UNO will work closely with the Metropolitan Omaha Education Consortium (MOEC) in the preparation of teachers, and in other educational specialist related activities. MOEC is a collaborative organization that unites the talents and energies of seven metropolitan Omaha area public school districts and the UNO College of Education. MOEC includes almost 100,000 K-12 school children, 7,500 school personnel, and 2,300 undergraduate and graduate students in education, which will be directly impacted by their participation in the new UNO Center. MOEC has received wide recognition, having been featured at national conferences and in publications distributed internationally. The innovative preparation of teachers is a strong emphasis at UNO, and within its work with the MOEC schools. It is fully accredited by National Council for Accreditation of Teacher s (NCATE), and has continually received an exemplary review from that organization. UNO has a particularly excellent teacher preparation program in science, mathematics, and technology, which is coordinated by the Content and Pedagogy Committee facilitated jointly by the College of Arts and Sciences and the College of Education.

The teacher preparation program is also building upon a strong base of experience and interest in the use of space data in the teaching and learning process. UNO has strong and formal connections to NASA, and several UNO programs are already taking curricular advantage of space data. For example, all elementary

methods students and secondary methods students in science, mathematics, and educational technology participate in an instructional unit focused around the UNO Space Shuttle Lab. This facility and its online curriculum have been recognized by NASA as a premier teacher preparation program, through a site visit by NASA lead administrator Dan Goldin, and in NASA publications such as NASA Technology Today. UNO is also working closely with engineers at the Jet Propulsion Laboratory for curriculum development involving new JPL imaging software. UNO is also one of the few institutions which participates routinely in student targeting of Shuttle cameras in the current NASA EarthKam program. In addition to these various curriculum programs, UNO also supports a comprehensive NASA Teacher Resource Center, which provides teachers with space data resources and materials on a walk-in basis. UNO also has an extensive planetarium program, routinely offers summer space activities, and is the lead institution in the NASA Nebraska Space Grant Consortium. These UNO collaborative programs and resources provide an exciting and interesting approach to teacher and specialist preparation, which recently resulted in the NASA Mission Home Award in 1998, awarded to only six cities within the United States.

Institutionalization of the Center

UNO expects a solid and systematic institutionalization of its new Center for the Use of Space Data in Teaching and Learning during the three years of the grant proposal period. As new courses and programs are developed, they will be processed as formal and official additions to the UNO schedule. Center products such as web based courses, learning modules, and instructional tools will be refined for continual

use by our institution, other institutions and interested educators. In addition to the institutionalization of these formal education activities, the project will strive to also be self-supporting through its many outreach partnerships and activities, such as with student summer camps, work with the Strategic Air Command Museum, and outreach activities of the Nebraska Space Grant Consortium. All requested costs and budget items are focused on the systematic building of a successful educational center, which will be solidly in place after NSF funding ends.

The Emerging Interest of a K16 Approach

A UNO Center for the Use of Space Data in Teaching and Learning will take full advantage of the potential success represented by a wide base of collaboration in the training of teachers. Many national initiatives related to the use of space data in K16 education for the improvement of science, mathematics, and technology education are now emerging. For example, The UNO Center will have a close working relationship with various NASA Digital Earth education initiatives. The Digital Earth is a project targeted by NASA to be a "virtual representation of our planet that enables a person to explore and interact with the vast amounts of natural and cultural information gathered about the Earth" (see http://www.digitalearth.gov). The University of Nebraska at Omaha is already collaborating substantially in the education aspects of this international effort and has agreed to lead an international Special Interest Group (SIG) related to K16 Education which is being funded by the NASA Jet Propulsion Laboratory. This international SIG is charged with initiating an international dialogue in determining how best to engage formal and informal education stakeholders in the Digital Earth. In

addition, UNO is collaborating with other Digital Earth Organizations, such as the Digital Library for Earth Science Education and the Open Geographic Information Systems Consortium (OGC). The proposed UNO Center for the Use of Space Data in Teaching and Learning will then have considerable impact in the international Digital Earth effort and, in particular, the integration of these new initiatives in the preparation of future science, mathematics, and technology educators.

The University of Nebraska at Omaha already uses a successful application of science, mathematics, and technology education within a K16 collaboration process. As a previously funded NSF Center for Teaching and Learning (CERTL), high school students within the Omaha Public Schools (OPS) work routinely with UNO scientists. Some of their activities include helping conduct research activities, and working on campus in various community outreach endeavors. College students preparing to be teachers also help with the more than 60 summer camps per year, giving them valuable field experiences with students. Another part of this formally recognized NSF Center for Excellence has been the University of Nebraska at Omaha Space Shuttle Simulation Laboratory, part of an extensive curriculum and teacher in-service process, involving students and teachers from Skinner Elementary School, Hale Middle School, North High School, and the University of Nebraska at Omaha. As part of the Banneker program within the Omaha Public Schools, this multi-level approach to teacher professional development has been recognized by the NSF as one of exceptional quality and progress. This new Center for the Use of Space Data in Teaching and Learning would build upon and formalize the model K16 approach already existing on the UNO campus.

A Unique Opportunity for Specialization

The UNO Center for the Use of Space Data in Teaching and Learning will provide an engaging and flexible approach for the training of educational specialists in the teaching of science, mathematics, and technology. Since space data and imagery cuts across disciplines, it is easily integrated into a variety of degree and certification programs. In addition to formal course work, there is considerable opportunity for the support of graduate thesis and dissertation research to investigate the potential impact of these new resources and educational strategies in the classroom. At UNO, specialists will have a wide variety of degree and certification program opportunities, as illustrated by Table 1.

Table 1: Program Specialization Opportunities in the Proposed Center

Specialization:	Degree and Certificate Opportunities:	Location:
Elementary Science	B.S. in Education	UNO/UN System
	State Endorsement at Elementary Level	UNO/UN System
	Graduate Certificate of Specialization	UNO
	M.S./M.A (Thesis) in Education	UN System
	Ph.D. in Curriculum and Instruction	UN System
	Ph.D. in Educational Administration	UNO/UN System
Elementary Math	B.S. in Education	UNO/UN System
	State Endorsement at Elementary Level	UNO/UN System
	Graduate Certificate of Specialization	UNO
	M.S./M.A (Thesis) in Education	UNO/UN System
	Ph.D. in Curriculum and Instruction	UN System
	Ph.D. in Educational Administration	UNO/UN System
Secondary Science	B.S. in Education	UNO/UN System
	State Endorsements in Selected Area	UNO/UN System
	Graduate Certificate of Specialization	UNO
	M.S./M.A (Thesis) in Education	UNO/UN System
	M.S. and M.A. in Science Field	UNO/UN System
	Ph.D. in Curriculum and Instruction	UN System
	Ph.D. in Science Specialization	UN System
	Ph.D. in Educational Administration	UNO/UN System
Secondary Math	B.S. in Education	UNO/UN System
	State Endorsements in Selected Area	UNO/UN System
	Graduate Certificate of Specialization	UNO
	M.S./M.A (Thesis) in Education	UNO/UN System
	M.S. and M.A. in Mathematics	UNO/UN System
	Ph.D. in Curriculum and Instruction	UN System
	Ph.D. in Mathematics	UN System
	Ph.D. in Educational Administration	UNO/UN System
Technology	B.S. in Education	UNO/UN System
	State Supplemental Endorsements	UNO/UN System
	Graduate Certificate of Specialization	UNO
	M.S./M.A (Thesis) in Education	UNO/UN System
	M.S. and M.A. in Computer Science	UNO/UN System
	M.S. and M.A. in Information Science	UNO
	Ph.D. in Curriculum and Instruction	UN System
	Ph.D. in Computer Science	UN System
	Ph.D. in Information Science	UNO
	Ph.D. in Educational Administration	UNO/UN System

In addition to on-campus instructional opportunities, the modular approach used in the coursework (web based curriculum building blocks) will enable other campuses around the country will be able to use components within their own campus instruction. Such a component approach is also represented in UNO's innovative certificate program. This program has facilitated the development of flexible mini-programs of approximately 15-18 hours of coursework, which result in a formal certificate awarded by the University.

Some of the innovative coursework is planned for delivery through distance education so that the new UNO Center can also support external programs and efforts. The Center distance education effort will take full advantage of Nebraska Educational Telecommunications, which is a statewide agency that has extensive production facilities and distance learning technology. This agency is already working with each University of Nebraska campus to design and deliver instructional coursework within a distance education format. Through distance learning experiences, teachers and other professionals would be presented with examples of data, software, curriculum, technology, and student-teacher interactions through such activities as large screen displays and graphics, formal presentations, panel discussions, and curriculum planning symposiums. A variety of less formal teacher workshops will also use distance education technology and will provide teachers with hands-on-training using space data and software. These workshops would target specific science and technology concepts that could be taken back into the classroom and will also facilitate the development and evaluation of curriculum units, lecture materials and laboratory exercises. As another example of the use of distance technologies which will be integrated into workshops, teachers and their students using the Internet will be able to remotely control a

telescope on the roof of the UNO Durham Science Center, allowing them to download real time images freely over the Internet.

It is our vision that the preparation of science, mathematics, and technology education specialists at the UNO Center will indeed include a very comprehensive set of educational experiences. Some of these educational experiences will be integrated into university coursework, while other experiences will be focused on more informal educational opportunities. Table 2 illustrates a few examples of the wide variety of educational opportunities which will be available through the Center beyond formal coursework.

Table 2: Example Opportunities Beyond Coursework Supporting Specialization

Educational Opportunity:	Example of Context with the Center:
Virtual Science Communities	Scientists, teachers, and students work together within the context of a real science project, such as examining glacial changes.
Teacher Conferences	Teachers attend conferences on special interest topics, such as mountains, water resources, etc., involving space data use.
Teacher Workshops	Teachers are provided with hands-on training in designing interdisciplinary lessons using space data on specific topics, for example global warming.
Web Based Labs	Teachers participate in online laboratory exercises, which help teachers and students examine space images representing weather phenomenon such as hurricanes, droughts, and forest fires.
Tutorials	Teachers can access various tutorials, such as how to examine images using DataSlate software. Digitized video will also be used within the developed tutorials.
Interviews with Experts	Teachers will have access to individuals with demonstrated success in creating innovative learning environments based upon space data and imagery.

In order to facilitate a wide connection to projects that have interest in space data and imagery use within science, mathematics, and technology education, the Center will also hold a yearly conference to bring together interested professionals and educators. The yearly conference will include activities such as expert speakers, panel presentations, and meetings of special interest groups, taking full advantage of both the scientific and the educational expertise related to the use of space data and imagery in the classroom. A wide range of selected example topics might be included within the conference, from both the scientific and educational perspectives. For example, included topics might be related to: examining mountain environments, evidence of global warming with satellite imagery, digital image processing, geographic information systems, examining alpine glaciers, interpreting images in the elementary classroom, monitoring water resources, and measurement in the context of space data.

Recruitment and Diversity in the New Center

Since the new UNO Center for the Use of Space Data in Teaching and Learning will be strongly Internet based in its coursework and other educational experiences, equitable access by different populations of teachers and students will be more easily facilitated. Specifically, the project will establish a web page that calls for participation in various aspects of the project (in formal education experiences, informal education activities, and consortium outreach), and outlines how to become involved. Professional association web pages, listservs, and online newsletters, from organizations such as the National Science Teachers Association, NASA's Earth Science Enterprise, and International Society of Technology in Education, will be used

to build the diversity of the participation base as well as distribute these calls for participation. Calls for participation will particularly target the involvement of teachers and classes of students with different genders, race, national origin, color, disability, or age. UNO is already working closely with several organizations focused on such goals, and especially Project Banneker from the Omaha Public Schools. In addition, the Nebraska Space Grant Consortium has been especially successful at supporting the Native American minority population in its outreach endeavors, which will be further targeted in work within the new UNO Center. These collaborations will help provide a strong local base for minority participation as the Center grows and evolves.

To also help encourage a wide base of equitable access and participation, from the local area and other regions in the United States, the project will use the following four general strategies. Strategy 1: The project will maintain and monitor a participation database that includes the relevant demographics of participating teachers and students. Strategy 2: One of the two lead PI's (Dr. Neal Grandgenett) will assume responsibility for carefully monitoring equity in access. Strategy 3: Participating educators will receive periodic electronic messages from the project requesting that they forward the electronic call for participation to others working with minority and special need populations. Strategy 4: The project will partner whenever possible with organizations focused on such equity issues.

Evaluation Strategy

The UNO Center for the Use of Space Data in Teaching and Learning will maintain careful formative evaluation records associated with each of the goals and

objectives associated with this proposal. Growth targets for each year of the program, of at least 10% per year, will be collaboratively set by the project steering committee and the National Science Foundation. The project will also work closely with Project Banneker to ensure that corresponding goals related to science, mathematics, and technology education outcomes with the K12 schools are targeted and reviewed by the Center.

In addition to a careful review of these internal goals, the Center's activities will also be reviewed each year by a team of external consultants for formative feedback and suggestions. These consultants will consist of the following individuals, which have a wide variety of expertise in science and mathematics education, and Center based activities. They will conduct a two-day visit to the Center to review its activities, outcomes, and progress. They will also submit a written report to both the University of Nebraska at Omaha and the National Science Foundation, providing a yearly external formative review of the Center.

Mr. Mike Timms, Evaluation Specialist, WestEd Laboratories, SanFrancisco, California
Dr. Denise Schmidt, Curriculum Specialist, Iowa State University, Ames, Iowa
Dr. Ann Thompson, Director of Educational Technology Center, Iowa State University, Ames, Iowa
Ms. Betty Sword, Education Manager, Jet Propulsion Laboratory, Pasadena, California
Other individuals as suggested or requested by the National Science Foundation.

A web-based portfolio for the Center evaluation activities will also be used to carefully summarize and document the numerous activities, partnerships, and progress underway in the project. This online portfolio will focus on the six project goals and their

related objectives. A wide cross-section of information will also be included, such as examples of online course modules, overviews of the individual classroom research studies, teacher and student self-reports, video-clips of students and teachers working, interviews, and the related articles and papers published by the project. This evaluation strategy has been used in various projects and evaluation endeavors undertaken by the University of Nebraska at Omaha and has been recognized nationally for its innovation by the U.S. Department of Education (see examples at http://ois.unomaha.edu).

Dissemination through Partnerships

The UNO Center for the Use of Space Data in Teaching and Learning will in essence be a formal partnership of partnerships. These many ongoing and already successful partnerships will play a considerably large role in the dissemination process for the project. For example, the Nebraska Space Grant Consortium will help the Center's learning modules and other developed curriculum resources to be distributed to other space grant consortiums and formal educational institutions within the United States. The model partnership related to informal education, with the Strategic Air Command Museum, will be disseminated and grow through its extensive connections to many other informal education agencies. Within an international context, UNO leadership of the K16 Digital Earth Education Special Interest Group, initiated by the Jet Propulsion Lab, will allow the center to collaborate internationally, on a regular basis, and with institutions from around the world. Presentations will also be made at a variety of national and international conferences, such as the National Science Teachers

Association Conference. Dissemination through this new UNO Center will thus be dynamic, and a source of ongoing strength, revenue, and energy for the project.

Key Personnel

The UNO Center for the Use of Space Data in Teaching and Learning will build upon the already successful collaboration between colleges at the University of Nebraska at Omaha, as well as national and international partnerships. Brief biographical sketches of each of the key personnel are provided as attachments. As reflected by these biographical sketches, the key personnel are all well experienced, and bring considerable expertise, energy, and enthusiasm into this project.

Success with Prior NSF Support

Two of the project leaders have had prior NSF support and successful NSF projects during the last 5 years. Dr. Neal Grandgenett is currently a collaborating PI on a NSF proof-of-concept project "Affinity Learning in Mathematics" (NSF#: DUE-9950349; $78,696; 10/1/99-9/30/2000). The project is resulting in an interactive learning process for the instruction of mathematical modeling, and has already produced three refereed papers related to curriculum development, which describe an innovative and flexible model of online curriculum. Full text of the papers, and a description of the full educational model are accessible from http://ois.unomaha.edu .

Dr. Jack Shroder is completing a NSF funded science project, entitled "Collaborative Research: Crustal Reworking During Orogeny: An Active System Himalayan Perspective"(NSF# EAR-9418839, $300,336, 5/1/95-4/30/00). Dr. Shroder's

project examined the magnitude and timing of surface processes responsible for unroofing the Nanga Parbat massif to see whether or not surface erosion was rapid enough to cause the decompression melting and high-grade metamorphism suggested by prior observations. Overall, observations indicated that surface processes have indeed been sufficiently rapid to produce the structures and lithologies suggested previously as evidence of rapid unroofing in the late Cenozoic. Erosionally induced failure and reworking of the crust as a kind of tectonic aneurysm is now seen as the primary origin of the Nanga Parbat massif. The research led to four undergraduate thesis, one master*s thesis, and one Ph.D. dissertation. Two post doctoral students also joined the project and conducted project related research. In total nine publications were produced from the research.

A Final Thought

With this proposal for an UNO Center for the Use of Space Data in Teaching and Learning, we intend to build upon a strong record of past experience, current activities, and formal partnerships. Our vision is that our new Center will provide for a dynamic and innovative education, for individuals who can carry that torch of excitement and leadership into their own classrooms. We see space data and imagery as a powerful interdisciplinary resource that cuts across grade levels and disciplines, is inherently motivating, and a context that is perfect for providing real life experiences that support specialization in science, mathematics, and technology education. We expect that our Center will become truly unique on a national and international scale, and that it will be something quite different from the educational institutions of the past. We are indeed

excited about this opportunity to outline our ideas related to the potential of this new Center within the context of this NSF 00-13 program solicitation, and we look forward to further work with the National Science Foundation in refining our ideas and concepts for this exciting venture into the future of educational reform.

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