AriZona Teacher Excellence Coalition (AZTEC): A Statewide Partnership

Lead Partner

Arizona State University

Additional Partners:

Northern Arizona University Center for Excellence in Education

Northern Arizona University College of Arts and Sciences

University of Arizona College of Education

University of Arizona College of Science

Amphitheater Public Schools

Flowing Wells Schools

Sunnyside Unified School District

Pima Community College

Office of American Indian Programs

Din❑ College

Ganado School District

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ABSTRACT

This proposal details a partnership between the three **Regents' Universities** in the state of Arizona, local Community Colleges, and partner school districts to provide coherent and consistent teacher preparation experiences statewide in science and mathematics. With the financial support of the US Department of Education, the AZTEC project is designed to: (1) Increase the number and quality of initial recruits to teacher education programs in state institutions; (2) Increase the consistency and quality of mathematics and science content courses and clinical experiences as measured by baseline to completion program evaluation--triangulated across local evaluation teams, outside evaluators, and student ratings of satisfaction with courses and clinical placements; (3) Increase the quality of graduate's performance as new teachers, measured in collaboration with their State-level performance examination, to include videotaped evidence of teaching practice; (4) Increase the percentage of new mathematics and science teachers prepared by state institutions and concomitantly reduced the shortage of qualified mathematics and science teachers in the three target ECs; (5) Increase the rate of retention of quality new teachers hired in EC districts, baseline to completion of funding cycle; (6) Demonstrate higher mathematics and science achievement for Arizona students directly attributable to the impact of AZTEC; and (7) Establish sustainability of the partnership through institutional agreements, shared scope of work, and common certification programs.

To accomplish these goals, AZTEC will coordinate the recruitment, preparation, and retention of highly qualified teachers of mathematics and science statewide, and focused on the EC's where the need is highest. New/reformed science and mathematics courses will be developed at the Universities and the Community Colleges to align with our best understanding of how students learn and retain powerful

scientific and mathematical concepts and skills (e.g., Bransford, Brown, & Cocking, 1999). These courses will be aligned methodologically with education courses and field placements.

PROJECT NARRATIVE

I. BRIEF OVERVIEW

The Arizona Teacher Education Coalition (AZTEC) is a coherent plan to improve mathematics and science teacher preparation statewide through a major partnership between Colleges of Education and Colleges of Arts and Sciences at all three public universities, the Community Colleges that provide early post-secondary content instruction in science and mathematics for prospective teachers, and schools districts in all three high need, Enterprise Communities (ECs) identified in the state. By applying Federal Title II HEA funds to the difficult, but necessary task of coordinating recruitment, content and methods instruction, and support through the difficult induction period, each year this partnership will reform the experiences of over 90% of the new teachers prepared in the state. Moreover, by leveraging the value-added of other Federal and non-federal projects, AZTEC will be institutionalized statewide by the end of the 5-year funding cycle.

II. CHALLENGES TO TEACHER PREPARATION IN THE STATE OF ARIZONA

State Demographics

Why A Statewide Partnership?

Arizona exists simultaneously as one of the most **urban** and one of the most **rural** states in the US. The majority of its 4.7 million inhabitants live in the Phoenix Metropolitan area, which contained in the last census 2.6 million people, and is listed as the 6th largest city in the US. 3.1 million live in the three urban areas served by the state's three **Regents' Universities**: Phoenix, Tucson, and Flagstaff. In contrast, the remaining 1.6 million inhabitants live in rural communities ranging from small clusters of towns in Northwest Arizona to the extremely isolated communities making up the **Arizona Border** and **Four Corners Enterprise Communities** (ECs). This diversity represents a challenge to coherent statewide teacher education in mathematics and science. In a coincidence of geography, the State's three **Regents' Universities** are situated in regions immediately proximal to the three ECs, train the majority of teacher candidates from these communities, and make it a major part of their service mission to provide instruction and staff development to teachers in these communities. All three universities have partnerships with school districts in the ECs they most closely serve to train prospective teachers, utilize EC schools as sites for methods course instruction and ongoing field experiences, and for student teaching. This provides strategic **Points-of-Presence** by which teachers statewide can be trained to deal effectively with the needs of all students, including those that come from traditionally underserved populations. Lastly, over 90 percent of teachers prepared in Arizona come from one of the three **Regents' Universities**. Coordination of a statewide partnership for teacher preparation targeted towards the three ECs must, therefore, be

administered through the **Regents' Universities**. Because of the geographic distribution of its population, the proximity of three major public institutions of higher education to areas of highest need, and their respective missions, AZTEC can literally "throw a loop" around the state of Arizona in terms of mathematics and science teacher preparation.

Figure 1 shows the **Points-of-Presence** we intend to exploit in this partnership. It must be stated that these **Points-of-Presence** represent only a subset of the strong, ongoing relationships between the universities, Community Colleges, and local school districts in the state. To the extent to which these other relationships augment the scope of work proposed by AZTEC, we will include them as appropriate in the project narrative.

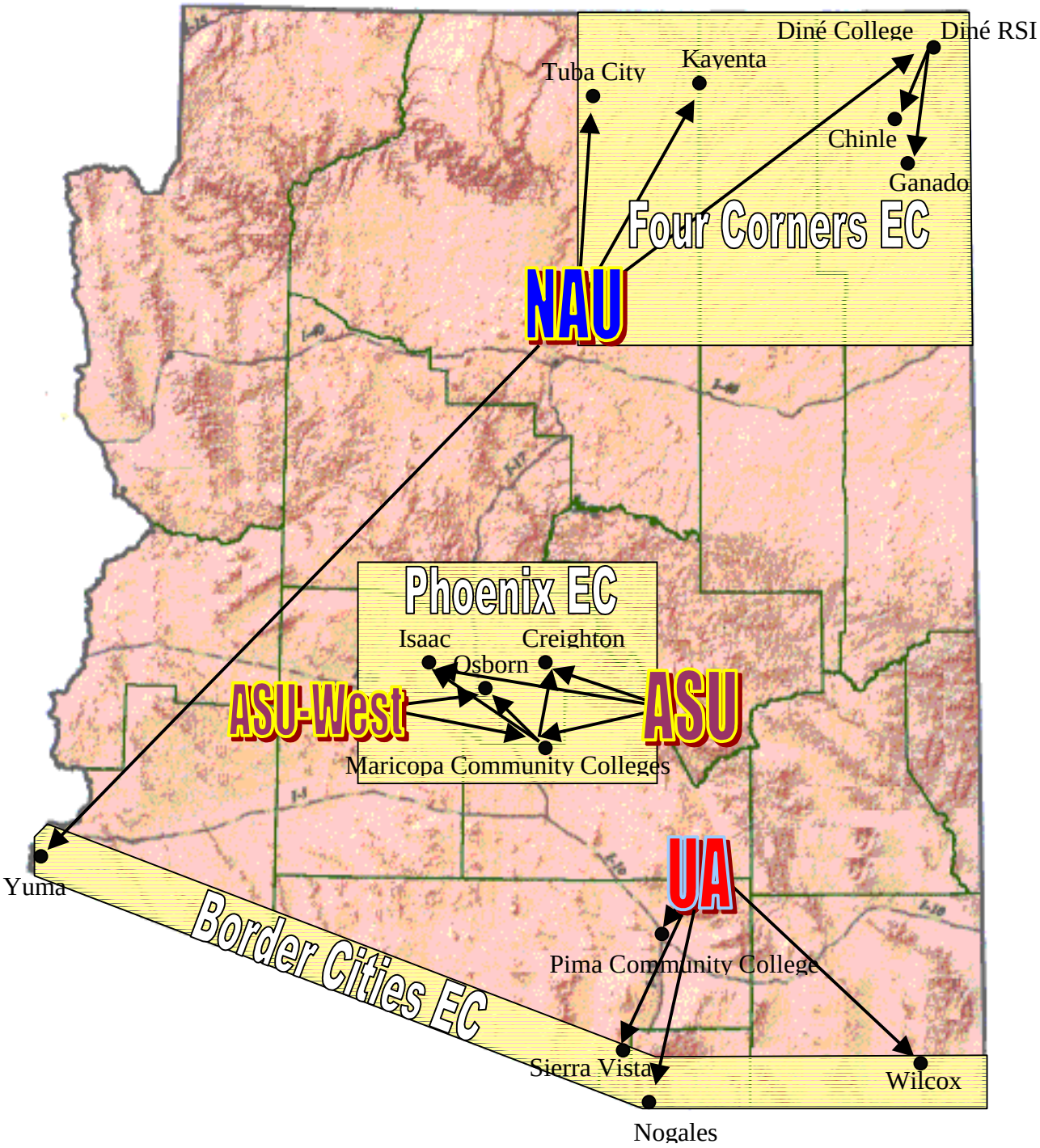
Diné College
Diné RSI
Tuba City
Kayenta
Chinle
Ganado
Four Corners EC
NAU
Phoenix EC
Isaac
Creighton
Osborn
ASU-West
ASU
Maricopa Community Colleges
UA
Yuma
Border Cities EC
Pima Community College
Sierra Vista
Wilcox
Nogales

Figure 1. Points-of-Presence for Reforming Mathematics and Science Teacher Preparation in the State of Arizona.

Ill-defined and Complex Programmatic and Recruitment Links between the Community Colleges and the Regents' Universities. The majority of prospective teachers entering into teacher education programs at the three Board of **Regents' Universities** matriculate from the state's Community Colleges. Currently, the programmatic links between the Community Colleges and the Colleges of Education and Liberal Arts and Sciences at the 3 **Regents' Universities** are complex for potential teacher education students to navigate. The cost of this weak link may be the loss of high quality mathematics and science students from the Community Colleges to traditional tracks in the sciences and engineering instead of into education. This problem is likely compounded for qualified students of color who may have particular difficulty navigating the labyrinth of Community College and University requirements for becoming a teacher. Coordination of experiences across institutions is vital to achieving high quality mathematics and science content for prospective teachers (National Science Foundation, 1998). The hard sciences at the three universities have initiated extensive recruiting and bridge programs to support prospective teachers through this transition. Because the Colleges of Education normally do not have contact with prospective teachers until they declare education as their major in their junior year, they have not yet initiated effective bridge programs on a large scale. See Luft & Ebert-May (1999) for a detailed analysis of Arizona Initial Certification Programs in Science and Mathematics.

Statewide Teacher Shortage in Mathematics and Science. Quite frankly, there is a shortage of qualified teachers in mathematics and science at all levels in the state, and in the three ECs in particular. This shortage is particularly acute for mathematics and physics at the secondary (departmentalized) level. For example, high schools in the Four-Corners EC, on average, have only one mathematics teacher, and many have only one teacher who teaches both mathematics and science. Because of this teaching load, the schools cannot offer a full preparatory curriculum each year. Statewide, the demand for qualified mathematics and science teachers currently exceeds what the Universities are able to produce. Augmenting this problem, 40% of new teachers in the State come from outside Arizona. While there is sufficient capacity of teacher education resources in the state, these resources are not coordinated to support new teachers who enter the state with insufficient backgrounds in mathematics and science teaching (Luft & Cox, 1998). This makes coordinating University teacher preparation with LEA-sponsored staff development in mathematics and science a crucial need statewide if the programs are to be responsive to their particular needs. A strong base of support for beginning teachers must be put in place to insure adequate preparation in University programs, and subsequent placement in public schools.

Currently, the nation's teachers, including Arizona's, are not adequately prepared to teach mathematics and science. Of the nation's 200,000 secondary school teachers of mathematics, for example, over half do not meet current professional standards for teaching mathematics (e.g., Council of Chief State School Officers, 1996). No more than 10% of the nation's elementary school teachers currently meet contemporary standards for their mathematics and science

teaching responsibilities (AAAS, Project 2061). Figure 2 illustrates the intense need for more and more qualified teachers in a sample of Arizona districts.

County	District	Underqualified	All	% Of Teachers
Greenlee	Blue Elem.	1	1	100
Navajo	Pinon Unified	48	84	57.1
Apache*	San Fernando	1	2	50
La Paz	Salome Elem.	3	8	37.5
Mohave	Valentine Elem.	1	3	33.3
Mohave	Topock Elem.	3	12	25
Santa Cruz*	Santa Cruz El.	2	8	25
Maricopa	Paloma Elem.	1	4	25
Maricopa	BuckeyeElem.	13	55	23.6
Maricopa*	Murphy Elem.	23	102	22.5
Apache*	Sanders Unified	14	65	21.5
Maricopa*	**Creighton Elem.****	62	302	20.5
Maricopa*	Wilson Elem.	18	90	20
Pinal	Stanfield Elem.	7	35	20
Yuma*	Hyder Elem.	2	10	20
Maricopa	Maricopa Co.	1	5	20
Yavapai	Yarnell Elem.	1	5	20
Maricopa	**Tolleson Elem. ****	11	58	19
Maricopa	Fowler Elem.	14	75	18.7
Navajo	Holbrook Unif.	16	88	18.2
Maricopa*	Roosevelt Elem.	89	498	17.9
Santa Cruz*	**Nogales Unif**.**	35	199	17.6
Pinal	Picacho Elem.	1	6	16.7
Maricopa*	**Osborn Elem.****	33	213	15.5
***Enterprise Communities** ****Partner Districts**				

Figure 2 . Percentage of Underqualified Teachers in Selected Arizona Districts

Barriers to Quality Content and Clinical Teacher Preparation in Mathematics and Science. While notable changes are taking place (e.g., Arizona Collaborative for Excellence in the Preparation of Teachers, 1999), currently, coordination of content instruction and clinical experiences across the Community Colleges, **Regents' Universities**, and LEA clinical sites has been haphazard (Luft & Ebert-May, 1998). Some of this is due to the difficulty of reorganizing the mission of University units to support intensive, mentored clinical experiences in teaching.

Much, however, is due to the limited number of master teachers available and trained for **quality** clinical placements, particularly in EC schools (Luft & Cox, 1998). Currently, modeling of **poor** pedagogy in mathematics and science is the rule rather than the exception. Collaboration with strategic school sites in ECs is critical for seeding the communities with expert mentors necessary for quality teacher preparation. Quality teachers must be in place, and some coordination of AZTEC funds with projects focused on staff development must be fostered to support new and prospective teachers in their field experiences.

Another barrier to quality clinical experiences is poor University-school communications. It is not uncommon for cooperating teachers in the field to have little notion of the teacher preparation program's goals (Goodlad, Soder, & Sirotnik, 1990). Compounding this miscommunication, University faculty tend to treat practical issues from an overly esoteric perspective, divorcing their empirical data from the lived reality of teachers. This disjointedness leads some prospective teachers into believing that their education coursework has little to do with the reality of schools. Obviously, this disconnect must be addressed through improved communications, mutual cooperation, delivery of instruction from University faculty and cooperating teachers that bridge the rift between theory and practice (McIntyre, Byrd, & Foxx, 1996).

Loss of High Quality New Teachers from EC Schools. The highest rate of new teacher attrition is in EC schools (Arizona Report Card). At these sites, teaching conditions are harsh and support for quality professional development is sparse. In the Phoenix EC, in particular, competition from affluent districts attracts many of the most qualified personnel to teach in

schools with more desirable conditions. In the nation at large, approximately 40% of new teachers leave the profession within 5 years of certification (Haris, 1992, 1993). New teachers in EC schools need mentoring and professional support to countermand this high attrition rate.

Immediate Economic Need. Lastly, the technology industry in the state is concerned with the quality of mathematical and science knowledge held by incoming workers (Carlene Moore-Ellis, Vice President, Intel Corporation, personal communication, 5/24/99). Improvement in student achievement in mathematics and science is an immediate and pressing economic need statewide.

Arizona Certification Rules and Regulations

The state of Arizona has recently developed new standards for teaching and teacher preparation. In October 1995, a team of 40 education professionals and constituents met to discuss the professional development of teachers in Arizona. The Professional Development Task Force recommended that the State Board of Education establish standards for "teacher and administrator knowledge, skills, and attitudes which would serve as the basis for University education programs and licensure or certification within Arizona."

A Skills Review Committee was then formed, representing teaching professionals, school administrators, deans of Colleges of education, educational associations, parents, and businesses. The result of this committee's work included performance and knowledge standards for new Arizona teachers. The standards were adopted by the State Board of Education in November 1997 (Appendix A). These standards became the basis of approved teacher preparation

programs, including a statewide assessment, the Arizona Teacher Proficiency Assessment (ATPA) content knowledge portion and professional knowledge portion, in December 1998.

The process of teacher certification now involves a two-stage process. In the first stage, prospective teachers must engage in a rigorous undergraduate (or post-baccalaureate) training program. Upon graduation, the candidate must then take the state-administered ATPA examination assessing their knowledge of content (e.g., science and mathematics) and knowledge of professional practices (e.g., pedagogy, classroom management theories).

Upon successful completion of the ATPA, the teacher candidate receives a provisional certificate, which is valid for a two-year probationary period, similar to the internship and residency requirements of other professions. During this second stage, the candidate must successfully demonstrate acceptable performance on the performance portion of the ATPA, which includes written lesson plans, a videotaped record of the candidate's practice, and a critique of that tape. Only upon successful completion of the performance portion of the ATPA will the teacher receive a Standard Certificate, which is valid for six years. Upon successful completion of 12 semester hours or 180 professional development hours, the teachers' Standard Certificate must be renewed every six years.

While the Regents' Universities are in general support of these new teacher certification regulations, there are questions and many unresolved implementation issues, especially with the performance portion of the ATPA. Through the AZTEC collaborative, the three Regents' Universities will be able to provide new teachers with clear steps for creating and submitting a performance assessment video. Further, AZTEC will assist prospective teachers in better understanding the criteria for effectiveness in this assessment.

III. THE RESPONSE: THE ARIZONA TEACHER EXCELLENCE COALITION (AZTEC)

By linking and coordinating the unique resources of Universities, Community Colleges, the Technology Industry, and Local Education Agencies (LEAs) across the state, but utilizing **Points-of-Presence** to be responsive to the ECs' local needs and conditions, AZTEC intends to simultaneously:

1. Strengthen and streamline the links among Community Colleges, Universities and LEA clinical sites in terms of teacher support and development.
2. Scale up the **Regents' Universities**' teacher preparation and staff development programs to meet the State's growing need for quality mathematics and science prepared teachers;
3. Retain high quality new teachers in areas of highest need; and
4. Enhance the quality of mathematics and science instruction statewide.

The Vision of AZTEC

Mathematics and science education is undergoing tremendous change in Arizona. As stated earlier, Arizona has established new nationally recognized state-level Standards for curriculum and instruction, and teacher preparation and induction. The three **Regents' Universities** have all established centers for mathematics and science education with collaborative and non-competitive agendas. A number of fruitful partnerships have been established to institute reform in teacher education at the University and district levels and across institutional boundaries. As yet, however, the potential impact of these partnerships has been weakened somewhat, because of their isolation to each other: Specifically, the mutual impact of

these partnerships has not been pursued. Moreover, a number of potentially beneficial partnerships, particularly with the Community Colleges and school districts have not yet been established. This Statewide Partnership will coordinate efforts across Arizona for the systematic reform of teacher preparation in mathematics and science education K-12, building on existing partnerships and establishing new linkages where appropriate.

Combating History

Throughout this proposal, the partners in AZTEC will argue for the development of a **consistent** and **coherent** model of mathematics and science teaching. This motivation stems from our fundamental belief that two years in a teacher preparation program, of which only 2 semester-long courses focus on pedagogical principles specific to mathematics and science content, is inadequate for the production of **high quality** mathematics and science teachers. The argument goes like this. We currently expect prospective teachers who have had for the most part, 1) consistently bad mathematical and science pedagogy for eighteen years (e.g., TIMSS, 1997), and 2) another two years of similar lecture-and-test instruction, to radically alter their 20 years of consistent experience and teach in a manner that is quite different than they, themselves, learned from after only two methods courses? This is a fool's errand. Current research suggests that teachers' personal histories, by which we mean their prior experiences as students in K-12 observing teachers, greatly overshadow their education coursework in determining the ways in which they teach (Carter & Doyle, 1996; Middleton, et al., 1990).

We have collectively developed a structure of teacher preparation that enables prospective teachers to have more than 2 semesters of consistent and coherent **pedagogically sound** experiences. By increasing the time spent in **quality** mathematics and science, coupled

with **effective pedagogy**, over the course of **four to six years**, through support by exemplary Mentors through teacher preparation and into their first two years of induction, we expect new teachers trained through AZTEC to teach mathematics and science in more effective ways. If, as research suggests, it takes from 4 to 7 years for teachers to gain of feeling of confidence and stability to the extent they can feel comfortable exploring alternatives and experimenting with new ideas and practices, we must lengthen the time they spend becoming socialized into the teaching profession. This is best done, we feel, through field-based, mentored programs where prospective teachers can learn from experienced teachers as they struggle in real day-to-day teaching situations, gain confidence as they practice teaching with supervision, and gradually move towards independence. This is the basis of our proposal.

In other words, if the most promising prospective teachers are recruited and supported through high school; receive high quality, reformed content instruction in mathematics and science; build on this in their methods courses and field experiences in education; and then are well supported through the first two years of their provisional certification, we expect to see a fundamentally better and more prepared teacher as a result of our efforts. The implications of these core features for teacher preparation and induction drive our vision of a coherent **statewide partnership for the improvement of science and mathematics teaching**.

In an organizational meeting of the principal partners in this proposal held on March 10, 1999, a vision of teacher preparation was established and agreed upon. The participants at this meeting included representatives from the Colleges of arts and sciences and education from each of the three **Regents' Universities**, Community Colleges, school districts, and the Arizona Board of Regents. At that meeting, following extensive discussion of what the participants agreed upon

collectively, a set of necessary and sufficient conditions for successful teacher preparation in mathematics and science were drawn up. As a unit, the project partners plan to implement:

1. A vision of teacher preparation that begins **before** prospective teachers enter their methods courses in the College of education. The reform of science and mathematics teacher education must begin with prospective teachers' own experiences learning science and mathematics content. To accomplish this vision, undergraduate content courses in science and mathematics will be reformed in ways that, pedagogically, reflect best practices, so that prospective teachers construct:
    - An understanding of central concepts and theories in mathematics and science;
    - An understanding of the nature of mathematics and science as intellectual and historical endeavors;
    - The ability to think mathematically and scientifically; and
    - An intuitive "feel" or gut-level understanding of exemplary teaching practices. These experiential understandings can then be developed into principled knowledge of teaching in subsequent methods courses.
2. A vision of teacher preparation that **coordinates** methods instruction with solid content in mathematics and science, and intensive, consistent, and coherent clinical experiences throughout a prospective teacher's program of study. To accomplish this vision:
    - Aggressive recruitment will target highly qualified mathematics and science majors and returning students to enter the teaching profession;
    - Extensive and intensive field-based programs in which teacher candidates experience a rich array of fieldwork across grade levels and intensive teaching

experience in areas of specialization will be developed (Burstein, Kretschmet, Smith, & Gudoski, 1999; Darling-Hammond & McLaughlin, 1995). These clinical experiences in schools will take place in the classrooms of exemplary teachers;

- Methods courses in the Colleges of Education will be coordinated with reformed content courses in Colleges of Liberal Arts and Sciences and in the Community Colleges;
- University/School liaisons will coordinate **preservice** methods with **inservice** support systems to build a consistent picture of best practices for all prospective teachers during their clinical field placements;
- Student Teaching will be carried out in the classrooms of exemplary Mentor Teachers (McIntyre, Byrd, & Foxx, 1996); and
- Mentor Teachers will undergo extensive and intensive training on how to support novice teachers in the development of best practices and have scheduled, structured time to work with prospective teachers (e.g., Burstein, et al., 1999).

3. A vision of teacher preparation that **continues** through initial certification and supports beginning teachers through the difficult first 2 years as they begin to build expertise. Teacher development must be considered as a case of life-span development. Without proper support and follow-through, most teachers fall back on styles of teaching that reflect how they were taught (Stigler, & Hiebert, 1997), or leave the profession altogether (Darling-Hammond & Sclan, 1996). To accomplish this vision:

- Teacher Certification candidates will be provided with a support structure for preparation for the Arizona Teacher Proficiency Assessment content knowledge and professional knowledge portions;
- Novice teachers will be placed in a support structure that pairs them with an exemplary Mentor Teacher for at least one full year, and continues through two full years in their initial job placement;
- Follow-up observations and advisement by University personnel will focus on the unique needs of first- and second- year novice teachers;
- Novice teachers will be assisted in the creation of a personal professional development plan to insure continued growth in best practices related to mathematics and science instruction;
- Novice teachers will be provided with technical assistance in the creation, editing, and evaluation of the video for the performance portion of the ATPA.

4. A vision of teacher preparation that **supports** inservice teachers needing further development in mathematical and scientific content, and in best practices related to that content (Coble & Koballa, 1996; Grouws & Schultz, 1996). To accomplish this vision:

- Induction support systems will be put in place to retain good new teachers in schools in urban and rural enterprise communities, and grow new Mentor Teachers from this population (Darling-Hammond & Sclan, 1996);
- Graduate-level courses will be created in mathematics and science content that are tailored to the needs of inservice teachers;

- Networks of teachers and teacher educators across the state will be established and a mechanism for continuation of these networks will be put in place;

5. A vision of teacher preparation that, at all levels, is **technologically rich** and geared towards the authentic use of computational media in the ways in which they are used by scientists, mathematicians, and technologically advanced workers in business and industry (e.g., Middleton, Flores, & Knaupp, 1997; Willis & Mehlinger, 1996).
    - The authentic integration of technologies into **preservice** coursework will be established as an everyday aspect of best practice;
    - Teachers will be trained for the future with respect to technological integration, with an eye for the present conditions of public schools;
    - A common set of powerful tools for thinking will be established in prospective teachers' mathematics and science coursework, and developed into powerful tools for teaching in prospective teachers' education coursework; and
    - Technology specialists who are exemplary teachers in mathematics and science will be developed to support novice and experienced teachers as they struggle to integrate technology authentically.
6. A vision of sustainable collaboration and statewide structure for teacher preparation that is coherent, consistent, and coordinated by understandings of best practice. To accomplish this vision:
    - The **Key Components** of AZTEC will be subsumed and institutionalized by the mathematics and science education centers at the three **Regents' Universities**, and the State K-12 Improvement Center.

Key Components of AZTEC

AZTEC will effect statewide change in teacher preparation by linking the three **Regents' Universities** with local Community Colleges, high need school districts, businesses, and with State Government in a consistent and coherent network of preservice education, inservice staff development, and clearinghouse of best practices. We present these **Key Components** roughly in a timeline from when students begin to think of teaching as a profession in high school, through their collegiate experiences, and into their inservice profession. See Appendix B for a Table showing major activities over the 5-year life of the project

Partners will establish a well-coordinated campaign for recruiting high quality EC High School Seniors into the teaching profession

While many high school students begin to think about their future with regards to career, the teaching profession is not typically considered a top option. Low prestige and salaries in teaching have diverted prospective students and have led to a limited pool of quality teacher candidates. The problem of a limited pool of quality teaching candidates is amplified in poorer districts in the State's ECs. Highly qualified students tend to seek higher paying, more prestigious careers. This trend is exacerbated in the minority population. The net effect in EC schools is a growing K-12 minority student population taught by fewer and fewer qualified teachers and teachers of color.

While the Colleges of Arts and Sciences and Engineering in Arizona's Universities heavily recruit candidates from the high schools, the Colleges of Education have not yet

developed a coordinated campaign to recruit highly qualified high school graduates into the teaching profession. In Arizona, the **Regents' Universities** have little or no contact with prospective Education students before their application to the program. The only exception to this has been the participation of University academic advisors in Community College information seminars for prospective students. Through the Title II Grant, AZTEC will use the following two-pronged approach to groom and recruit highly qualified seniors in Arizona EC High Schools.

1. **Supervised Teaching Practicum**: Qualified high school seniors will earn elective credit for completing a 4-6 week supervised teaching practicum in targeted EC K-12 schools. During the practicum, exemplary students will provide one-on-one and small group tutoring and/or serve as a classroom teacher's aide. The practicum experience will be overseen by Mentor teachers at the school sites and by teacher advisors from the EC High School's Future Teachers Club Organization.
2. **Recruitment Visitation to EC High Schools**: On a monthly basis, faculty from the **Regents' Universities**, EC Community Colleges and master teachers from EC K-12 schools will visit high school students potentially interested in becoming teachers. These visits will be intended to inform and inspire high school students about becoming teachers. In addition, high school seniors will be brought to visit EC Community College campuses, **Regents' Universities**, and PDS site programs to learn more about teacher preparation in Arizona.

Partners will establish well-articulated Pre-Education Programs in EC Community Colleges and Clear and Standardized Links and Requirements between Community College and Regents' University Teacher Education Programs.

The National Science Foundation, in 1998, published a report on the role of Community Colleges in the preparation of science and mathematics teachers. In that report, the recommended actions for the preparation of teachers include the recruitment of perspective teachers, strengthening undergraduate courses in science, mathematics, engineering, and technology, developing pre-teaching programs where students tentatively interested in teaching can experience teaching in a small, sheltered environment, developing inservice activities for certified teachers, and creating liaisons between two-year Colleges and 4-year institutions.

Most students in the Community Colleges are undecided on their major. It is not uncommon for students in Community College to feel "lost" in terms of their academic and career goals. Institutionally, students' lack of occupational clarity may be amplified by a large, bureaucratic system that may seem to provide few clear answers or direction. Additionally, the programmatic requirements between Community Colleges and the **Regents' Universities** may confound even the savviest academic advisor. In sum, many Community College students are unaware of their academic direction and, at times, the system doesn't provide the assistance needed to help them explore and clarify their path (National Science Foundation, 1998). In many cases, because of the lack of programmatic focus, Community College students simply do not know how or who to talk to about beginning their preparation for teaching, and receive no experience teaching until they matriculate into their field experiences in their junior and senior year of College. Working together, and with the help of Title II funds, we will develop well-

articulated Pre-Education Programs in EC Community Colleges to ensure high quality content and clinical training in the first two years of preservice teacher preparation—the first two years of College. Additionally, we will streamline and clarify links and requirements between the Community College and University level education programs. In our initial planning, a number of essential features of EC Community College Pre-Education programs have been identified. The features we will develop include:

1. **A high prestige, education curriculum** designed to foster knowledge of mathematics and science content, in conjunction with knowledge of pedagogy, student services mentoring (e.g., tutoring, writing skills supports, computer training, annual retreat), and mentoring, which includes supervised, mandatory clinical experiences (a minimum of 120 hours over the 4 semesters). Prospective teachers will be organized into a cohort structure to build a sense of identity and community support in their Community College experience.
2. **A clear and precise 4-yr academic pathway for education majors.** As AZTEC begins to reform content courses in the Community Colleges and Universities, academic advisement protocols will be developed to steer prospective teachers into sections that are most conducive to their career choice, and that afford the greatest probability of high quality success. These courses will be coordinated with the Pre-Education Program in the Community Colleges, and will be articulated through memoranda of agreement between Community Colleges and the **Regents' Universities** with regards to admissions to the Colleges of Education.

3. **Strong recruitment activities** for under-represented student populations, returning students, and undecided Community College students including outreach activities to student organizations (e.g., Black Students Association), returning students, and teachers' aides in area EC schools, high school recruitment visitations, and, training of high school counselors and Future Teacher Club Mentors.
4. **Transition support to the Regents' Universities** including completion of portions of students' clinical work during participation in the Community College Pre-Education program at University sponsored sites (e.g., PDS) to give prospective teachers a head start in their methods experiences, a peer mentoring program where Pre-Education students at the Community Colleges are paired with prospective teachers in the University programs, conducting University sponsored orientation activities for Community College students, and, having Community College and University faculty co-teach selected education courses. The latter activity has already been piloted through the ACEPT summer workshops at ASU-Main campus.

Establish new/reformed courses in the Colleges of Liberal Arts and Sciences in the Community Colleges and Regents' Universities that are coordinated pedagogically with reformed methods courses in the Colleges of Education

Rigorous curriculum, ongoing clinical experiences, and extensive student support services will hallmark these courses. The content and pedagogy for these courses will be shared across institutions and will revolve around inquiry science (Lawson, 1996) and teaching for understanding in mathematics (e.g., Vacc & Bright, 1999). Under a grant from the Flinn

Foundation, the Department of Biology at NAU has already initiated a project to reform the undergraduate biology curriculum encountered by elementary education majors. The project is now in its second year and will include a new hire that will be responsible for developing kits for use in the introductory biology classes. Funding for this project is in the amount of about $600,000. (Contact Lee Drickamer, Chair, Dept of Biology for more information). The ACEPT program, a partnership between the College of Liberal Arts and Sciences and Education at ASU-Main has worked extensively for five years in the hard sciences and mathematics to reform the general education courses that the majority of teacher education students take. Susan Wyckoff, co-PI of the AZTEC project is Principle Investigator of the ACEPT project.

Methods courses in the Colleges of Education will be redesigned to train teachers in mathematics and science pedagogy using powerful technological tools in the ways in which they are used by scientists and mathematicians. Currently, only minimal training in technology is accomplished in the undergraduate methods curriculum. The use of data probes (Microcomputer- and Calculator-based Laboratories) that collect data from the environment and allow the data to be analyzed using spreadsheets, database programs and mathematical modeling will be a key component of this authentic integration (see Middleton, Flores, & Knaupp, 1997). The Center for Research on Education in Science, Mathematics, Engineering, and Technology (CRESMET) at ASU-main is currently embarking on a project in conjunction with one of Aztec's partner schools, the Creighton School District, to reform methods instruction by eliminating the stand alone technology course for prospective teachers, and instead, integrating the course across the three semesters of methods instruction. Graduate students who normally work in the technology course will work closely with methods faculty and Mentor Teachers (in

AZTEC and the technology initiative), to integrate computational media authentically. The Creighton School District is also the lead organization for Project Venture, a Technology Innovation Challenge Grant program designed to address the needs for comprehensive staff development and curriculum integration of computers and technology by assisting our teachers to become pioneers in the use of technology, and then to become guides for others seeking to venture into the new frontier of teaching and learning. The Creighton School district has committed part of its cost sharing for this grant to technology purchases to bolster Project Venture and support their already upgraded facilities.

Establish a set of University/school liaisons between participating higher education institutions and schools in the three ECs served by our partnership

Liaisons will come from **both** Colleges of Liberal Arts and Sciences, and Colleges of Education. All three **Regents' Universities** have established some liaisons working with preservice methods courses and clinical internship placements. This partnership will expand the number, and coordinate the network of, higher education/school liaisons.

At the University of Arizona, several clinical lines have been established with the intent of linking local schools and the University. These lines provide practicing teachers with the opportunity to work in education and content classes, which are taught in the field or at the University. Some of the duties associated with the clinical lines include: supervision of student teachers, instruction of methods courses, teaching of various content courses, and directing the development of programs that are housed in local districts. Clinical faculty typically last from one to three years and target both elementary and secondary teachers.

In this project, the role and training of clinical faculty will be examined across the three universities. Currently, the use and training of clinical faculty is inconsistent from University to University (Luft, Ebert-May, Eslamieh, & Buss, 1997). This project will examine the current status of clinical faculty, then develop a plan that coordinates efforts across the universities to improve the training of clinical faculty, to coordinate them within a network - electronically and through established meetings, and to expand the number of clinical faculty at each University. Through the cost-sharing commitment of the grant, many of these clinical lines will be supported immediately by non-federal funds.

Develop a statewide Mentor Teacher network across each of the 3 ECs in our state

Initially, these Mentor Teachers will be identified through solicitation of recommendations by district administration and peers. Observation of Mentor Teachers' practice will confirm the quality of practice and whether they will be considered for inclusion in the final pool. These Mentor Teachers will serve as in-building staff developers and placements for prospective teachers. Three days per week Mentor Teachers will work with teachers at their building to reform mathematics and science education and grow best practices at the building level. Two days per week, Mentor Teachers will engage in graduate courses in mathematics and science content and pedagogy, and in coaching/mentoring methods to support preservice teachers. Research on teacher development programs shows that successful opportunities for change share several core features: (a) They involve ongoing (measured in years) collaboration of teachers in purposes of instructional planning with the explicit purpose of improving students achievement of clear learning goals; (b) They are driven by teachers' understanding of, and attention to, students' thinking and how that relates to curriculum and pedagogy; and (c) They have access to observation of best practices in action and opportunity to reflect on the reasons best practices are effective (Fennema, Carpenter, Franke, Levi, Jacobs, & Empson, 1996; Hiebert, 1999). These core features will drive our staff development efforts. Every day, Mentor Teachers will mentor student teachers and/or prospective teachers in their classrooms.

Each year, Mentor Teacher teachers will attend two 2.5-day institutes to train them in new techniques for mentoring student teachers. In addition, two days per month, Mentor teachers in each EC will meet with University/school liaisons to evaluate students' progress and to suggest individualized instruction to support each mentored student.

Establish "Full Service" Professional Development School Collaboratives in the Enterprise Communities to maximize the Quality of Clinical Preparation

Conceptualized by the Holmes Group and concretized by the recent NCATE Draft Standards, a professional development school (PDS) is a vehicle for the concurrent improvement of both participating schools and Colleges of Education. The EC PDS sites supported by the Title II Grant are and will be full service sites. This means that the sites will not simply be on-site preservice teacher training programs but instead will be pursuing all four of the goals that distinguish a true PDS:

1. Maximizing students' learning and achievement through the development and implementation of exemplary practice,
2. engaging in sustained, applied reflective inquiry on practice for the purpose of enhancing exemplary practice and student achievement,
3. engaging in meaningful, ongoing professional development for school and University faculty, and,
4. preparing effective new teachers (Abdal-Haqq, 1998).

In a full service PDS these goals are viewed as interdependent. If the PDS site is achieving success with the first three goals, it is likely an outstanding environment for the preparation of new teachers. Unfortunately, lack of commitment to all four goals, typically by Colleges of Education, have led to marginal success or lack of the longevity at some PDS sites (Teitel, 1997). At the full service EC PDS sites, AZTEC will work to develop the following indicators of quality:

1. School-wide staff commitment to and participation in the PDS goals,
2. Collaborative governance, strong school staff leadership in PDS direction, integration of PDS goals and the school's comprehensive school improvement plan,
3. High level of data-based accountability for student achievement through formative and summative assessment and review,
4. Structured grade-level common planning time,
5. High degree of teacher participation in action research on their classroom practice,
6. Focused professional development activities, tied to action research, with classroom supports (e.g., resources for observation, feedback, mentoring),
7. Opportunities for Mentor Teachers to earn graduate credit through on-site Masters program courses tailored to the specific professional development needs of the teachers, and,
8. On-going mentor and supervision training for cooperating teachers.

In addition to focused support for specific PDS sites, AZTEC will sponsor an annual EC PDS Conference & Teacher Action Research Showcase. The goal of this conference will be to disseminate best practices from the PDS sites and to provide teachers with a local forum for sharing their action research. In sum, through these full service EC PDS sites, AZTEC intends to "grow" the outstanding mentor teachers needed to prepare effective new teachers.

Develop a wide-reaching 2-year induction program

Teachers graduating from the three **Regents' Universities** will be supported for two years following graduation through pairing with a Mentor Teacher, observation and consultation, and

through the development of staff development experiences tailored towards new teachers. Induction will be coordinated at the PDSs, which will serve as regional professional development centers for the ECs. The need for the support of beginning teachers is well-documented (Atkinson & Delamont, 1985; Gold, 1996; Henry, 1989; Loughran, 1994). In Arizona, induction programs are left to districts and only 20% of the districts in the state have a mechanism to support beginning teachers (Luft & Cox, 1998). Of the existing programs, only 68% extend beyond a teacher's first year.

The development of this program, in conjunction with formative assessments of statewide induction support systems sponsored by the Arizona K-12 Center, will begin with the formation of a committee who exams the existing programs in the state (e.g., BEST, ASIST, and district programs). This examination will reveal programs that are successful, unique aspects of existing programs, and program components that should be examined. The committee (which includes representatives from the **Regents' Universities**, local school districts, and state policy makers) will then expand upon or reframe existing programs into a pilot state program. All efforts will be made not to disrupt existing programs but to extend and connect current induction programs. We have support and pledged collaboration from the Beginning Educators Support Team, which, under the direction of Dr. Billie Enz has been supporting teachers for over two years now with exceptional success.

The developed program will consist of cohorts of prospective teachers, University faculty, and mentor teachers. Throughout the program, participants will experience observations with feedback about their practice, large group meetings, individual consultation sessions, electronic

communications, and participation in a local or national conference. The induction programs will be coordinated through LEAs, PDSs, or universities - depending upon regional needs.

The proposed program will be implemented in conjunction with the activities of the Arizona K-12 Center. This entails targeting different regions within Arizona and various aspects of the program. For example, the program may begin in the Southern Region of Arizona with large group meetings, individual consultations, and electronic communications. The program will be scaled up as resources and mechanisms are established that ensure support. Throughout the process of implementation, policy makers at the state-level will be apprised of the progress of the 2- year induction program in order to ensure on-going state support of the program.

To direct the on-going development of the induction program, an embedded evaluation program will be put in place. This evaluation effort will provide feedback to the program and collect data that can be used to influence policy, while assessing the effectiveness of the program.

Produce video cases of best practice

Twenty AZTEC-trained teachers will be videotaped on 5 occasions per year. Each will be followed up successive project years to gain a longitudinal trajectory of growth as a mathematics and science teacher. Through these longitudinal records, we will evaluate the success of the project, pinpoint areas of concern that we need to address in subsequent years, and capture cases of best practice that will be developed into pre- and **inservice** teacher education packages to be used throughout the state system. Incentives for agreeing to be videotaped include technical assistance in producing professional quality videos for use in AZTEC teachers' performance portion of the ATPA. These videos will further serve as models for prospective teachers in the

AZTEC partnership to use in developing their own portfolios for the performance portion of the ATPA—the State-administered practicum examination. As initial teachers move beyond their second year of induction, additional teachers will be added to the pool. Comparison of the new pool of prospective teachers with the original pool will afford lagged cross-sectional comparison to assess growth of the project.

This library of longitudinal cases will be produced through our collaboration with Technology-Based Learning and Research (TBLR). TBLR is an independent research and development entity founded at Arizona State University that provides a unified structure to coordinate various technology-based research and development projects. As an integral part of the College of Education, TBL&R focuses on research and large-scale delivery of educational materials as well as technology training and integration using computers and other information and communication technologies. TBLR facilities are state-of-the-art in terms of video production and web-based delivery.

The Arizona K-12 Improvement Center will be heavily involved in the design of the cases in terms of staff development, distance education, and delivery over the statewide network. The clearinghouse function of the K-12 Center (see below) will institutionalize these products and deliver them to schools state- and nationwide.

Develop a Clearinghouse of Best Practices

This digital (and analog) library will make available the videos of best practices developed by the project, and package staff development materials and experiences after the funding for this project ends. The Arizona K-12 Center will develop and house these products.

Part of the mission of the K-12 Center, the development of such a clearinghouse, will be made possible through AZTEC funds. In addition to delivering video cases, this function of the Center will also provide educators with a synopsis of new or available materials that represent "best practice" so that adoption decisions are facilitated. Active canvassing of Arizona districts will result in the development of an Arizona best practice file. The Center will serve as a source of information regarding training materials and strategies for Mentor Teachers. Additionally, the Center will develop and provide customized training programs at district request. A model for "best practice" would be incorporated throughout all training and professional development activities. The Associate Dean of the Center for Excellence in Education (the NAU equivalent of the College of Education), Dr. Patty Horn, who is co-PI of AZTEC, is also the Executive Director of the Arizona K-12 Center, and will spearhead the development of this clearinghouse.

Expand the Statewide Advisory Board for Mathematics and Science Education:

This Board will report to the Board of **Regents'** and the Department of Education to effect education policy statewide. The Board will be made up of professors from Colleges of Liberal Arts and Sciences and Education at each partner institution including the Community Colleges, representatives from EC school districts, Mentor Teachers, and the technological business community. The current Advisory Board for Mathematics and Science Education consists of select district and University representatives. The role of the Advisory Board has historically been to advise the Eisenhower Mathematics and Science Program Director. This project expands the role of the advisory Board in order to impact policy in Arizona regarding mathematics and science education, to serve as a guide to several state agencies, and to

coordinate large reform events related to mathematics and science education in Arizona. This will be accomplished by 1) including additional members on the Advisory Board, such as, a Arizona Department of Education member, a member of the Board of Regents, a business representative, Mentor Teachers, additional school district and University representatives; 2) holding quarterly meetings that address mathematics and science issues; 3) developing by-laws and policy that guide the board; and 4) supporting Advisory Board members to contact policy makers and to disseminate pertinent information related to mathematics and science education electronically, verbally, and in writing.

Create a Specialists in Residence program where leading professors of mathematics and science education at the three Regents' Universities travel to empowerment zones to teach institutes with local teachers

There are several talented mathematics and science educators in Arizona. Unfortunately, these experts are not supported to travel outside of their school districts/universities to work with teachers and faculty who would benefit from their expertise. The Specialists in Residence Program specifically improves the transfer of knowledge by providing various mathematics and science education experts with opportunities to work throughout the state.

This program is more cost effective than transporting numerous participants to a site, as it supports leaders in mathematics and science education to conduct courses and classes throughout the state. A Specialist in Residence is sent to a community after the recommendation of a local mathematics and science authority, or when a community applies. The visit is arranged by the directors of AZTEC. The programs offered include: summer workshops and follow-up sessions,

telecourses, and weekend courses. One-shot workshops will not be supported through this program.

The Specialists in Residence Program will initially be funded through AZTEC. Over time, external funds and district resources will be used to support the program. The only cost to participants will be the charge of district credit.

Create an evaluation team to study systemic change within each partner institution, and across the statewide partnership

Teams from each University/EC region, led by the a co-Principal Investigator, will form to study the case of each teacher preparation program. Teams will consist of co-PIs, graduate research assistants, faculty in both the Colleges of Liberal Arts and Sciences and Education, Community College faculty, Mentor Teachers, and AZTEC students. Four times each year, the teams from each University/EC region will meet together to consolidate data, abstract general principals regarding successful strategies for teacher preparation and induction, and revise strategies that need improvement.

Five major reports will be generated in addition to regular annual reports to the US Department of Education: 1) Principles and Practices for the Design of Large-scale, Collaborative Partnerships for Teacher Education (coPI Wyckoff lead); 2) The Professional Development School as a Model for Teacher Preparation (coPI Ridley lead); 3) Best Practices in Science and Mathematics Teaching (coPI Horn Lead); 4) Teacher Education in High Need Communities (coPI Luft lead); and 5) The Development of Teachers from Inception through Induction (PI Middleton lead).

Data that will be regularly collected include:

- Entrance demographics
- Entrance test scores
- Exit scores
- Course Grades
- Mentor Teacher Evaluations
- Classroom Observations
- Longitudinal video records of practice
- Student self-assessments
- Placement data in ECs
- Results of the Arizona Teacher Proficiency Examination
    - Content Portion (Mathematics and Science)
    - Professional Knowledge Portion (Education)
    - Performance Portion (Practice)

Each year, the annual report will include detailed analysis of the project outcomes using these data sources (see below). A more complete description of the evaluation process is provided below under **Project Evaluation.**

Summary

AZTEC is ambitious. We are fortunate to be situated in a state where the three major teacher education institutions are situated in geographically strategic locations. The proximity of the **Regents' Universities** to high need school districts in each of the Enterprise Communities

provides us with critical **Points-of-Presence** for effecting reform of school practice in science and mathematics education by being responsive to local needs and conditions. Moreover, the cultural and economic diversity of our state provides an ideal testbed for enacting our common philosophy of high quality mathematics and science for all.

In summary, over the five years of the project we will institutionalize the following **Key Components**:

1. Establish a recruitment campaign for promising students in mathematics and science teaching;
2. Develop Pre-Education programs in EC Community Colleges, and linkages between Community Colleges and **Regents' Universities**' teacher education programs;
3. Reform the undergraduate science and mathematics curriculum for education majors;
4. Establish liaisons between higher education and EC schools;
5. Develop a statewide Mentor Teacher Network;
6. Establish Professional Development School Collaboratives in ECs;
7. Develop a wide-reaching 2-year induction program for recent teacher education graduates;
8. Produce longitudinal video cases of best practice;
9. Develop a Clearinghouse of Best Practices;
10. Expand the Statewide Advisory Board for Mathematics and Science Education;
11. Create a Specialists in Residence Program; and
12. Create an evaluation team to study systemic change within each partner institution, and across the statewide partnership.

This project will be the only project of its kind, where all major higher-education institutions in a large state have joined together to mutually reform their programs, freely taking expertise from each other, and sharing financial and human resources with each other and with local schools. Our **Vision** is strong, our **Key Components** target the major recommendations for reforming teacher preparation at the curricular, political, and cultural levels (see Sikula, 1996), and our resources are coordinated to institutionalize the **Vision** we have created.

Through the application of granted funds, the high cost-sharing commitment from partner institutions, and value-added collaboration with other funded systemic projects (see Budget Section), we can leverage approximately $25 million for reform of teacher preparation, induction, and support in the State of Arizona.

IV. OUTCOMES

Through the creation of coherent and consistent support systems for teacher recruitment, preparation, induction and development, statewide, involving all of the major institutions charged with formal teacher education, as a function of achieving the process outcomes described in the 12 **Key Components**, AZTEC will achieve the following specific and measurable outcomes:

1. Increased the quality of initial recruits to teacher education programs in state institutions

Steering the highest quality undergraduate recruits away from traditional trade or professional programs in mathematics and science requires two conditions: Identification of the most promising students, and providing incentive and support to apply to a teacher education program.

Through recruitment activities in the high schools and Community Colleges, the **Regents' Universities** will attract and support a better crop of applicants to their programs. The Supervised Teaching Practicum initiated in EC high school's Future Teachers' Club organizations will provide an opportunity to identify prospective teachers who have that unique combination of excellent mathematics and science knowledge and skills, *and* the ability to relate effectively with children.

Site visits of promising recruits to the universities and Community Colleges will provide prospective recruits with information about the requirements necessary for successful application and performance in rigorous academic education programs. Pre-education programs in EC Community Colleges will bridge between the high school experiences, and upper-division work in the Colleges of Education. Clinical experiences in EC schools will provide recruits with

advanced experience to foster their admittance into teacher education programs, and give them "a leg up" as they move into the field experience portion of their education coursework.

Finally, the articulation of reformed coursework across institutions of higher education will smooth the transition for students coming from Community College programs and insure a high quality product.

This activity will result in more prospective teachers who have high quality content knowledge in mathematics and science, as measured by aptitude tests and academic achievement, applying, being accepted into, and graduating from ***Regents' Universities****' teacher education programs, than prior to AZTEC funding.*

2. Increased the consistency and quality of mathematics and science content courses and clinical experiences as measured by baseline to completion program evaluation--triangulated across local evaluation teams, outside evaluators, and student ratings of satisfaction with courses and clinical placements.

Each year, AZTEC is providing time through both granted funds and cost-share for faculty in the Colleges of Arts and Sciences to redesign their undergraduate general education courses to be consistent with the National Science Education Standards (1996?) in science, and the NCTM (1989, 1991, 2000) and AMATYC (YEAR HERE) Standards in mathematics. Travel money is built in to bring project personnel from across the state together to discuss the reforms they are creating, and supplies are budgeted to insure the proper materials are available for a high quality curriculum. Moreover, money is also targeted for faculty in the Colleges of Education to reform their courses to be more scientifically and mathematically

rigorous. The ACEPT project at ASU-Main has already begun such collaborative work and has developed a limited number of high quality, pedagogically sound courses in both Colleges. Both the Science and Mathematics Learning Center at NAU and the Science and Mathematics Education Center at UofA have also begun such reforms. All three sites have worked in conjunction with feeder Community Colleges to provide consistency of reforms.

While tremendous change is taking place already, much more is needed for the bulk of science and mathematics courses preservice teachers take to be reformed and coordinated across Colleges.

This activity will result in higher quality knowledge of science and mathematics content, as measured by performance rubrics, course examination scores, and Arizona Teacher Proficiency Assessment content knowledge portion, for teacher education students than prior to AZTEC funding. This will also, concomitantly, result in higher quality knowledge for all students. In addition, students will report greater coherence in their undergraduate experiences following AZTEC reforms than prior to AZTEC funding.

3. **Increased the quality of graduate's performance as new teachers, measured in collaboration with their ATPA performance portion, including videotaped evidence of teaching practice.**

Through intense clinical experiences in high school Future Teachers Association programs, Pre-education programs at Community Colleges, Service Learning (in conjunction with content courses in the Colleges of Arts and Sciences), Methods Courses in the Colleges of Education, Mentored student teaching supervision, and 2-year induction support, AZTEC

teachers will have more practical experience working with children in real schools in the ECs than any previous cohort of students. Moreover, because the design of their clinical experiences are to be coherent and compatible with content experiences, methods training, and the reality of EC schools, translation of coursework skills into actual practice will be smoother and more articulated.

This activity will result in higher scores on the ATPA performance portion for AZTEC-trained teachers than for previously trained teachers, or for new teachers coming from out-of-state. Moreover, through analysis of the videotaped portion of the ATPA, in conjunction with the videotaping done by AZTEC evaluation, we will be able to determine areas where teaching practice is incompatible with content and methods instruction, and make appropriate modifications.

4. **Reduced the shortage of qualified mathematics and science teachers in the three target ECs.**

Through recruitment of high quality students from EC regions, and support through their collegiate experiences, we expect to see a higher number of teachers returning to their home communities to teach. In addition, through our partnership with EC schools, prospective teachers from outside EC boundaries will gain considerable experience, through their clinical placements, teaching in EC schools. These experiences will better prepare prospective teachers for the reality of poorer districts, and provide them with an understanding of EC schools' conditions. Lastly, this partnership will give EC schools a first shot at recruiting teacher candidates.

This activity will result in an increase in the proportion of teachers in the state's poorest communities who are highly qualified to teach mathematics and science as measured by ATPA scores.

5. **Increased the rate of retention of quality new teachers hired in EC districts, baseline to completion of funding cycle.**

   Through follow-up and support of AZTEC teachers in their 2-year induction period, and because their training was heavily school-based and pragmatically oriented, AZTEC-trained teachers will be better prepared for the difficulties of working in poorer schools.

   This activity will result in a smaller proportion of AZTEC teachers leaving EC schools than leave EC schools in general in a given time period.

   Unfortunately, competition from more affluent districts in the state is increasing, with districts resorting to the use of "signing bonuses" to attract the highest qualified candidates. It is unclear how the economics of EC partner districts are prepared for this competition. AZTEC is committed to studying this phenomenon to ascertain how quality teachers *can* be retained in poorer districts.

6. **Demonstrated higher mathematics and science achievement for Arizona students directly attributable to the impact of AZTEC.**

Because AZTEC-trained teachers will have superior mathematics and science training, and because this training is consistent, coherent, and integrated with pedagogical models, AZTEC-trained teachers will be better equipped to teach modern mathematics and science. Moreover,

through AZTEC's longitudinal support system, AZTEC-trained teachers will show less trepidation towards teaching mathematics and science in ways that might be different than many of the teachers with whom they share a building.

This activity will result in higher achievement scores on the Arizona Instrument to Measure Standards, and on district- and school-based assessment for students of AZTEC trained teachers than other teachers in AZTEC teachers' districts.

7. Established sustainability of the partnership through institutional agreements, shared scope of work, and common programs.

By the end of the five-year funding cycle, AZTEC partners will have established sustainable, institutionalized agreements at both the local and state levels. At the local level, each University will have established a full-service PDS, and structures for providing intense clinical experiences in EC schools. In addition, the culture of partner schools in the ECs will have changed dramatically to be focused on continued professional development. Moreover, the network of Mentor Teachers supported by the grant will have grown in their own ability to mentor and work with young teachers to an extent that the 25% release AZTEC has provided will be less necessary in the future. The use of clinical faculty by University programs will have increased, and reformed content courses will have become the norm rather than the exception in science and mathematics departments in the state's institutions of higher education.

A professor-in-residence program will have been established, and common courses will be held across the three **Regents' Universities** to capitalize on the State's pool of talented science and mathematics educators.

As a result of this activity, the structures and systems will have been put into place to continue the work of AZTEC at the same level of service following the removal of federal funds.

V. PROJECT MANAGEMENT

The management structure of AZTEC is illustrated in Figure 3 below. As can be seen, the management structure of AZTEC emphasizes central coordination with local control. Because each Enterprise Community has its own unique needs and available resources, each will be managed as a unique **Point-of-Presence**. The co-PI from each Regents' University will be responsible for allocating resources, articulating the vision and **Key Components** of AZTEC, and ensuring that the interests and needs of each partner is represented in the larger statewide structure. Each co-PI has a budget for local operations (See Budget Narrative). Partner institutions, including EC school districts and Community Colleges are also allocated a budget for their local operations (See Budget Narrative).

In addition to management of project activities, each co-PI is responsible for structuring the local evaluation team (see Project Evaluation, Appendix C). The co-PI will oversee the data collection per the evaluation plan submitted in this proposal and will insure that the activities of their local site are documented and this information is abstracted and reported to the Principal Investigator.

The role of the Principal Investigator is to coordinate the activities undertaken across **Points-of-Presence** to form a set of coherent, policies and practices statewide. The Principal Investigator, while also working as a participating faculty member in the ASU-Main College of Education, will direct the statewide project through his office as Associate Director of the Center for Research on Education in Science, Mathematics, Engineering and Technology. Because CRESMET exists outside of the two partner Colleges at ASU-Main, the Principal Investigator

can take a reasonably unbiased position when arbitrating the needs of one partner in the project, with the needs of another.

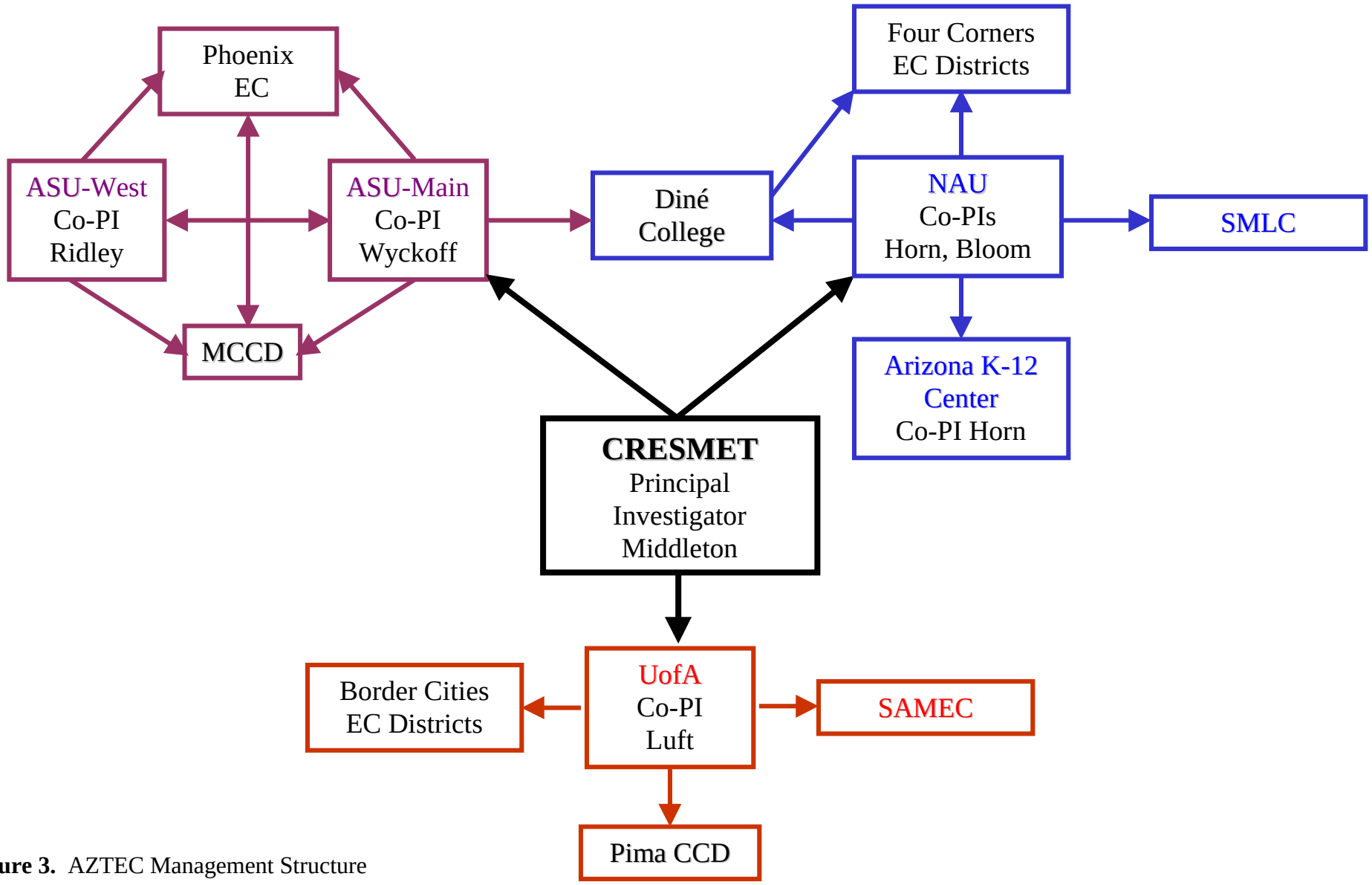

Figure 3. AZTEC Management Structure

Four times each year, all co-PIs and representatives from each partner institution will meet as a whole to coordinate activities, report on evaluation progress, consolidate data, and plan future activities. An EMAIL distribution list will be developed to facilitate immediate communication among all project co-PIs.

Project (co) Principal Investigators have extensive experience in the fields of teacher education ranging from teaching reformed content and methods courses to directing multimillion dollar collaboratives for teacher preparation. Each is imminently qualified to direct activities at their local **Point-of-Presence** (see Appendix D. PARTNERS).

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APPENDIX A.

BUDGET NARRATIVE

BUDGET NARRATIVE

Because of the complexity of the budget in bringing together such a wide variety of partners, in addition to the required form 524, we have included detailed budgets for each of the project partners (see below). The narrative that follows is a summary of the contributions of all partners to the overall goals and **Key Components** of the AZTEC partnership. All partners have committed to the required matching cost share. Cost-share percentages for each partner meet or exceed the required schedule of 25% Year 1, 35% Year 2, and 50% for subsequent years of the project.

PROJECT PERSONNEL.

Project Administration

Principal Investigator. The Principal Investigator, James A. Middleton, will be released 25% FTE in the academic year by the granted funds, with a matching 25% release provided by the ASU College of Education. During the summer, he will work 100% FTE for two months on granted funds, with the third month cost shared at 100% FTE by the Center for Research on Education in Science, Mathematics, Engineering, and Technology. He will manage the project including the budget, personnel, data collection, and dissemination of research products, coordinating data collection and analysis across sites.

Project Manager. One project manager will be hired to oversee scheduling, budget, hiring, and other logistical necessities of such a large and complex partnership. The entire fiscal year salary for this line ($42,000) will be cost-shared by the Arizona State University Office of the Vice-Provost for Research.

Project Secretary. One full-time secretarial position will be hired to support the Principal Investigator and Project Manager.

The percentage of project funds allocated to administration, thus totals $50,000 (Year 1), or 1.5 percent of the total federal dollars.

Academic Personnel

Co-Principal Investigators. Each University will be represented at the top-level of the partnership by two Co-Principal Investigators representing both education and an academic discipline. At least one at each institution will be released 25% FTE in the academic year. Additionally, 25% of the Co-PI's salaries will be cost-shared by the University. During the summer, each coPI will work one month 100% FTE from granted funds. Their duties will be to oversee local EC/University liaisons, coordinate content and methods course articulation, and oversee data collection for the evaluation of the project. Cost-share commitments for this budget item vary by University. For example, NAU will cost-share 25% of the salary of Dr. Patty Horn, Associate Dean of the Center for Excellence in Education (NAU equivalent of a College of Education) to oversee the development of the Clearinghouse, and to coordinate AZTEC activities with the Arizona K-12 Center. Other universities have elected to cost-share resources for each co-PI's work on AZTEC.

Participating Faculty. Because the needs for each AZTEC partner is different from the rest, faculty time will be purchased on different schedules. Due to the work of the ACEPT project at ASU-Main Campus, faculty have attended summer workshops for each of the past 5

years. Thus, this need is filled through our collaboration. However, deeper work on revising courses, and coordinating programs is necessary to sustain ACEPT innovations. Seven participating faculty at ASU-Main will be released 25% FTE each academic year, and will be paid for 2 months summer salary to reform mathematics and science courses, administer Professional Development Schools, supervise student teachers in EC schools, and oversee the development of video cases. In the other **Regents' Universities**, more summer salary is needed to support faculty to reform courses in the content areas and in education. An additional 40 faculty at NAU and UofA will be provided with one month (100% FTE) summer salary to design new courses and to attend faculty training institutes. At ASU-West, Master Teachers from the schools will be hired as clinical faculty to help coordinate PDS development. In the Community Colleges, because of heavy course loads, and difficulty in buy-out, only 5 faculty lines (20% FTE) will be purchased statewide for course reduction during the academic year. However, summer salary is a greater need, so 15 faculty will be provided with 1month (100% FTE) of support to work on course development.

Mentor Teachers. AZTEC will provide funds for 25% time release and training of 75 Mentor Teachers each year each year of the project. We estimate this cost to be approximately $1.5 million of the $3.5 million average yearly allocation of grant funds.

Partner districts will receive the following real support from granted funds:

1. 25% FTE release of (75 statewide) teachers to be Mentors for AZTEC trained prospective teachers each year of the project;

- The number of Mentor Teachers released per district is negotiable. In general, the larger the district (e.g., Creighton, Phoenix EC) the larger number of Mentor Teachers will be released.

2. Funds for 5 full days each year of substitute teachers for each Mentor teacher released;
3. $1,000 per year for each Mentor Teacher released earmarked for supplies or technology;
4. A small ($48 per teacher) travel allowance for in city travel to-and-from project activities. Additional travel monies are allocated for project meetings, events, and for out-of-town travel.

Partner districts will receive the following in-kind support from University partners.

1. 32 hours of staff development in mathematics, science, and technology related to project goals for district teachers (To include, but not limited to Mentor Teachers);
2. Establishment of a graduate course in mathematics and/or science education directly tailored to the specific goals of the district. Courses will be held on district grounds and may include some distance components depending on the proximity of the district to the local University.

All partner districts have agreed to provide cost-share in the form of real or in-kind contributions to AZTEC activities equal to the required schedule of 25% Year 1, 35% Year 2, and 50% each subsequent year of the project, computed for the portion of granted funds each district receives. This cost-share will take the form of, but is not limited to, the following:

1. Facility rental fee for any staff development, preservice training, or project meetings directly related to AZTEC activities;
2. Equipment purchase that can be directly supportive of AZTEC activities (through use by Mentor Teachers or AZTEC students).
3. Reorganization of the school day for the purpose of providing more preparatory or meeting time for teachers, IF such time is used specifically for mathematics and science-related activities.
4. Release time for Mentor Teachers or district administration in support of the grant. This is generally accomplished by directing the salary savings from purchasing substitute teachers towards grant activities.
5. Hiring of additional aides or reassignment of personnel to mathematics or science specialties; and
6. Cash.

University/School Liaisons. The success of partnerships often hinges on maintaining clear and consistent communications among the various partners. Although there are many approaches to enabling the communications process between schools and universities one effective approach is to use liaisons that position themselves between the two types of institutions. Although liaisons tend to represent one entity above another they can effectively serve as an intermediary for the flow of both procedural as well as educational information. In this project, the role of the University/School Liaison (USL) will be to connect school practice

with University theoretical frameworks so that both parties are well aware of the intents and the effects of the project.

We propose three different types of liaisons. The first type of liaison be based in the EC schools. These individuals will be based at one of the EC schools and will serve the various schools in determining the needs of school faculty for professional development, represent the schools to the partnership, and work with the University project staff to develop appropriate field-based activities for prospective teachers. The second type of liaison will be the based in the College of Arts and Sciences to assist the faculty in the sciences and mathematics in developing courses that are relevant to preservice and inservice teachers. They will play significant roles in curriculum development and in the delivery of basic content courses as well as science and mathematics methods courses. In addition, these faculty members will work with the school-based liaison to observe classrooms of Master Teachers and establish field placements. The third type of liaison will be based in the College of Education. This liaison will be similar to the previous type however they will work with faculty in the College of education and in education courses. They will also work with the school liaison in establishing appropriate fieldwork experiences. The three types of liaisons will meet regularly to provide input to other parts of the project about the implementation of the various aspects of the project. The liaisons in this project will play the critical role of ensuring that University/school relationships are developed as beneficial to all parties.

Eleven liaisons coordinating relationships between the 3 **Regents' Universities** and the local EC schools will be hired by the partnership (approximately 5 in Phoenix EC, 3 each in 4-corners and Border Cities ECs). Liaisons will observe classrooms of Mentor Teachers, develop

field placements for clinical internships, and coordinate staff development at Professional Development Schools. Currently, the salaries of six additional of these liaisons are cost-shared by partner institutions.

Community College Liaisons. Four liaison from partner Community Colleges in the Maricopa Community College District and Dine College will be hired to facilitate articulation of content and pedagogy among reformed mathematics and science courses between the Community Colleges and the **Regents' Universities**. Four additional liaisons (2 mathematics, 2 science) will be hired at 25% FTE to coordinate MCCD staff development with preservice teacher preparation.

Video Cases. Top-of-the-line video production and editing equipment will be provided through our partnership with Technology Based Learning and Research. A modest budget for production software is included. To collect video evidence, edit, digitize, and package the multimedia, TBLR will require a team of 4 graduate students (50% FTE) and one professor of educational technology (25% FTE). NAU has budgeted additional faculty and two webmasters to edit, provide commentary, and assess the content of collected video as well as set up the multimedia platform and statewide distribution network.

Clearinghouse of Best Practices. Full-time staff will be hired to develop the digital library of resources, and archive the video cases produced through the partnership. Four graduate students will be hired to develop and coordinate the activities of the K-12 Clearinghouse related

to AZTEC. The Center Director's salary and local M&O funds will be cost-shared by Northern Arizona University. By the end of the funding period, this clearinghouse will be established as a permanent Statewide Center for K-12 Improvement.

Travel. Funds are requested each year to support travel of project staff to two professional meetings each, and for the Principal Investigators to attend two trips to represent AZTEC at required meetings with the Department of Education. In addition, funds are requested to provide travel expenses for AZTEC Teacher Liaisons to visit EC schools, attend professional meetings, and to attend regular project meetings. Additional travel money is budgeted for recruitment visits and to bring promising high school and Community College students to the **Regents' Universities** as a function of the Future Teachers Club and Pre-Education activities. and in-state travel to collaborating institutions. Lastly, travel money is requested for Mentor Teachers and AZTEC students to attend workshops and institutes at other sites.

Equipment and Supplies

Funds are requested the first year to purchase two PC 500MHz-class computers with 256 MB RAM, 21-inch monitors (for the Co-PI and the administrative assistant), and two laptop PC's for AZTEC Science Teacher Liaisons and AZTEC Math Teacher Liaisons. In subsequent budget years equipment funds are requested to purchase a laser printer, a CD Recorder, video/videoconferencing/audio equipment, and other upgrades to optimize learning/teaching technology functionality as bandwidth and other computer technologies improve. Each

institution is allocated an average of $25,000 in supplies each year to cover mailings, course materials, conference materials and miscellaneous office supplies.

Other Direct Costs

Minimal funds are requested each year for essential software, non-capital equipment, fax, long-distance telephone and printing charges for administering the AZTEC science/math program component. Funds are also requested for printing costs related to dissemination of AZTEC products to the science/math education community. CRESMET will cover distribution costs of AZTEC products.

APPENDIX B.

ARIZONA STATE STANDARDS FOR TEACHER PREPARATION

Professional Development
Certification Rule Language
Title 7. Education
Chapter 2. State Board of Education
Article 6. Certification

After a public hearing on Nov. 24, 1997, the State Board adopted new rule language pertaining to certification and professional development,
including professional standards for teachers and administrators, the
program approval process, certification requirements, assessment of
teachers and administrators, and renewal requirements. The Attorney General's Office approved the rule language on December 3, 1998.

R7-2-601. Definitions

In this Article, the following definitions apply unless the context otherwise requires:

1. "Accredited institution" means one which is listed as accredited in the current American Association of Collegiate Registrars and Admissions Officers Report. An institution based outside the United States shall be considered accredited if an approved foreign document evaluation firm declares it to be comparable to an accredited American institution.

2. "Board" means the State Board of Education.

3. "Department" means the Arizona Department of Education.

4. "Paraeducator" means an individual trained to perform certain specialized tasks in the occupation of education.

5. "Paratherapist" means an individual trained to perform certain specialized tasks in the occupation of habilitation.

6. "Practicum" means a period of structured observation and practice of the skills being learned, supervised by an individual trained in that area. The commonly used terms "student teaching," "internship," "residency," or "observation course" are included in this definition.

7. "Professional Development" means training to increase skills related to the occupation of education.

APPENDIX C

PROJECT EVALUATION

PROJECT EVALUATION

The project evaluation for AZTEC will utilize multiple methods and multiple sources of information. Its key strategy for coordinating data collection to be both comprehensive and generalizable across the state, and sensitive to the conditions unique to local sites, is the development of site-level evaluation teams. Under this model, teams from each University/EC region, led by a co-Principal Investigator, will form to study the case of their own teacher preparation program. Teams will consist of co-PIs, graduate research assistants, faculty in both the Colleges of Liberal Arts and Sciences and Education, Community College faculty, Mentor Teachers, and AZTEC students. Each team will collect data to address the six mandated performance objectives of the HEA section 206(b) from its local site, aggregate this data, and report the case of their site. Four times each year, however, the teams from each University/EC region will meet together to consolidate data, abstract general principals regarding successful strategies for teacher preparation and induction, and revise strategies to shore up areas of the project that need improvement. Both the cases, updated yearly, and the collaborative evaluation of the statewide partnership as a whole, will be combined in the annual report to the US Department of Education. The annual report will contain information on the following sources of data:

- Entrance demographics
- Entrance test scores
- Exit scores
- Course Grades
- Mentor Teacher Evaluations

- Classroom Observations
- Longitudinal video records of practice
- Student self-assessments
- Placement data in ECs
- Results of the Arizona Teacher Proficiency Examination
    - Content Portion (Mathematics and Science)
    - Professional Knowledge Portion (Education)
    - Performance Portion (Practice)

In addition to this annual report, five major reports will be generated. These reports will target the Higher Education audience whose primary interest is in the improvement of teacher preparation programs: 1) Principles and Practices for the Design of Large-scale, Collaborative Partnerships for Teacher Education (coPI Wyckoff lead); 2) The Professional Development School as a Model for Teacher Preparation (coPI Ridley lead); 3) Best Practices in Science and Mathematics Teaching (coPI Horn Lead); 4) Teacher Education in High Need Communities (coPI Luft lead); and 5) The Development of Teachers from Inception through Induction (PI Middleton lead).

Also, each year project activities will be reported as papers and symposia in national and international conferences of professional societies. Through this avenue, the successes of AZTEC can be disseminated widely through professional channels.

Increased student achievement for all students as measured by the partnership:

Student achievement will be measured at all levels of the project.

1. **Entrance Data**

An assessment of the entering knowledge and skills of prospective education students will be collected through State-mandated ACT tests, and high school grade-point average in mathematics and science, weighted by the strength of curriculum taken in high school.

2. Content Understanding

Content understanding will be determined through commonly administered instruments known to discriminate among students who have quality understanding of the nature and content of science and mathematics (e.g., Views About Science (Halloun & Hestenes, 1986), Views about Mathematics (Carlson, 1998)). In addition, grade point average in undergraduate science and mathematics courses (weighted by strength of curriculum) will also be used. Upon exiting the University teacher education programs, all students will be required to take the Arizona Teacher Proficiency Assessment (ATPA content portion).

3. Understanding of Pedagogy

Understanding of Pedagogy will be measured through common instruments administered across mathematics and science methods courses. In addition, mathematics and science methods grades and ATPA scores (professional knowledge portion) will be gathered.

4. Performance in Teaching

At the end of their 2-year induction period, AZTEC teachers will be required to take the performance portion of the ATPA. In this assessment, teachers must submit a portfolio of their work, including a videotape of themselves, teaching a lesson. These

videos will be collected and analyzed for AZTEC-trained teachers. A rubric for determining the level of implementation of reform will be developed to compare AZTEC teachers' performance to the State and National Standards, and to teachers who were not AZTEC trained. In addition, the project will be videotaping a random sample of 25 AZTEC trained teachers each year of the project. These teachers' practice will be videotaped and assessed 5 times each year for the life of the project. In conjunction with the generalizability of the state-level assessment, the ATPA, this fine-grained, longitudinal analysis will determine the quality of performance of AZTEC teachers.

5. **K-12 Student Achievement**

   Each year, students in grades 4, 8, and 12 are required to take the Arizona Instrument to Measure Standards (AIMS). AIMS scores for mathematics and science will be gathered from students of AZTEC-trained teachers. These scores will be compared with scores from classrooms in the same schools, districts, and across districts in the state to ascertain the quality of mathematics and science achievement directly resulting from AZTEC preparation.

Increased teacher retention in the first 3 years of a teacher's career.

A database of the names, addresses, phone numbers, and school placements will be maintained for all AZTEC graduates. Each year, graduates' files will be updated to assess the numbers who have continued in the same school as their initial placement, moved to a new district in the same EC, moved out-of-area but still continue to teach, or who have dropped out of teaching altogether. These data will be compared with EC district data to determine the level of

increase in retention of AZTEC teachers. Mentor teachers assigned to AZTEC teachers will be responsible for keeping up-to-date records on their students for the first two years of induction. Following those first two years, the Office of Student Affairs at each College of Education will be responsible for follow-up.

Increased success in the pass rate for initial State certification or licensure of teachers.

Because the ATPA will only be in its first year of existence in AZTEC's first year, we cannot directly assess this performance objective. The pass rate for the ATPA is now a requirement for continued accreditation of State Colleges of Education, so this data will be available each year to the project. Any trends in the success or failure rate of AZTEC teacher will be reported annually.

Increased percentage of secondary school classes taught in core academic subject areas by teachers--

a. **With academic majors in the areas or in a related field;**

   This data is easily gathered. Transcript data will be used to compare AZTEC students' academic majors with those of students in prior years.

b. **Who can demonstrate a high level of competence through rigorous academic subject area tests or who can demonstrate competence through a high level of performance in relevant content areas.**

Again, the ATPA is a rigorous, state-administered test of all prospective teachers. Results of its content portion will be used to determine the level of competence of secondary teacher candidates in mathematics or science.

Increased percentage of elementary school classes taught by teachers with academic majors through a high level of performance in core academic subject areas.

Transcript data will be used to compare AZTEC students' academic majors with those of students in prior years. Data for the state, at large, will have to be generated for baseline comparison. AZTEC will work with the State Department of Education to abstract the number of elementary teachers with an academic major in mathematics and/or science, and use that baseline to assess the increase in the number of teachers with academic majors in mathematics or science.

Increased number of teachers trained in technology.

Currently, all teachers exiting Colleges of Education in Arizona are trained in technology. The level and content specificity of training, however, is what AZTEC proposes to change. Methods courses will include assessments designed to ascertain the level of proficiency of all teacher education candidates in technology applied to mathematics and science teaching. These instruments will have to be developed. The Principal Investigator of AZTEC, Dr. James A. Middleton, is coPI of a grant from the Center for Innovation in Learning Technologies (sponsored by NSF) designed to develop interactive assessments of understanding of technology and technological standards for teaching.

Rubric for Evaluating the Success of AZTEC Activities

The following Table provides a timeline of the activities proposed by AZTEC (**Key Components)**, along with benchmarks established Year 1, Year 3, and Year 5. This rubric will be used to determine if AZTEC advances are on schedule, and to determine the relative merits of the **13 Key Components** in relation to the overall goal of enhancing teacher preparation.

Key Components	Benchmarks Year 1	Benchmarks Year 3	Benchmarks Year 5
1. Partners will establish a well-coordinated campaign for recruiting high quality EC High School Seniors into the Teaching Profession.	Identification of 100 promising students in their Junior Year of high school Identification of high school faculty for Future Teachers' Club Advisors First two visits of high school students to Universities and Community Colleges Supervised Teaching Practicum begins in Spring Semester	100 students identified and recruited each year, statewide Future Teachers' Clubs established. 2 visits each year by each FTC Teaching Practicum coordinated with visits to methods courses.	Recruitment activities will be institutionalized into Academic Advising and Student Services in institutions of higher education 2 visits each year by each FTC Recruited students apply for College of Education coursework
2. Partners will establish well-articulated Pre-Education Programs in EC Community Colleges and Clear and Standardized Links and Requirements between Community College and Regents' University Teacher Education Programs	Student services mentoring began focusing on key skills for education majors (writing, speaking, mathematics, science) First cohort of students identified at each EC Community College Establish clinical experiences in EC schools Develop advisement protocols Counselors begin steering education students into reformed courses. Recruitment materials developed	Skills training for education majors becomes institutionalized 1 cohort identified each year Clinical experiences continued Advisement protocols institutionalized Advisement for education students becomes institutionalized Recruitment materials institutionalized	AZTEC education majors enter the Colleges of Education with substantially greater skills First cohort enters induction support system AZTEC students perform substantially better in clinical experiences. Advisement protocols institutionalized Advisement for education students becomes institutionalized Recruitment materials institutionalized
3. Establish new/reformed undergraduate content courses in the Colleges of Liberal Arts and Sciences in the Community Colleges and **Regents' Universities** that are coordinated pedagogically with reformed methods courses in the Colleges of Education.	Formation of committee to examine the current status of these courses. Identification of courses targeted for reform. Plans are developed to ensure the sustainability of the courses.	First set of revised undergraduate courses are implemented and evaluated. Findings of the evaluation are shared during the summer for feedback. Second set of courses targeted for reform are ready for implementation. Support is fostered to ensure that the courses will be sustainable.	Over 20 reformed science and mathematics courses at the universities and Community Colleges have been implemented. Mechanisms formally exist to ensure that the courses will be sustainable. Content area instructional modules in science and mathematics will be developed and presented in web-course and multimedia format by faculty for continued professional development.

4. Establish a set of University/school liaisons between participating higher education institutions and schools in the three EC's served by our partnership.	Liaisons hired Training of Liaisons begun Clear lines of communication between partner schools and higher education established	Liaisons coordinate school needs with needs of Methods faculty Liaisons coordinate necessary staff development (cost-shared) provided to EC schools Liaisons work with Mentor Teachers as reflective practitioners	Liaisons coordinate school needs with needs of Methods faculty Liaisons coordinate necessary staff development (cost-shared) provided to EC schools Liaisons work with Mentor Teachers as reflective practitioners
5. Develop a statewide Mentor Teacher network across each of the 3 ECs in our state.	75 Mentor Teachers Released 25% Mentor Teacher Training Begins Mentors paired with AZTEC students in EC schools Electronic Forum developed Mentor Teachers begin assessment of AZTEC students' clinical experiences and student teaching.	Mentor Teachers continue training Mentor teachers utilize electronic forum to share tips-of-the-trade Mentor Teachers become integral to Methods instruction Mentor Teacher graduate courses established in EC sites	Mentor Teacher network formalized through K-12 Center. Mentor Teachers used as clinical faculty in University Methods courses
6. Establish "Full-Service" Professional Development School Collaboratives in the Enterprise Communities to Maximize the Quality of Clinical Preparation.	Negotiations for collaborative governance of existing PDS sites begun. New PDS sites in ECs identified. Teacher action research projects begun Annual Conference Held	Collaborative governance structures initiated Each EC has a new PDS developed Action research projects compiled into database to be used in Methods Instruction Onsite Masters' courses developed for PDS teachers Teachers present at Annual Conference	PDSs institutionalized Action research projects compiled into database to be used in Methods Instruction and staff development PDS teachers obtain Masters' degrees. Teachers present at Annual Conference

7. Develop a wide-reaching 2-year induction program	New teacher induction models currently in use in the state and nation are reviewed. Extension and revision of BEST and ASIST to be state-wide, and focused on content An integrated statewide website will be developed and served by the K-12 Center Induction workshop materials will be developed and disseminated in the three ECs Induction models utilized will be evaluated at the end of each year.	The Technical Review Committee will review the data from the Induction models utilized in the three state regions. Web-site linkages is on going. Induction workshops materials digitized and presented in web-course format and multimedia by faculty. Mentor Teachers supervise new graduates.	75% of the school districts in the state participating in the statewide induction program through workshops, web based courses, or multimedia presentation. The Induction Program is institutionalized. Web-site linkages is on going.
8. Produce video cases of best practice.	20 AZTEC teachers identified for videotaping Permissions gathered from parents of children in field placement sites. 100 videos shot Rough-edit 5 Year1 cases	Continue 2nd-3rd year videotaping 200 new videos shot Rough edit Year 2-3 cases Final edit Year 1 cases Multimedia platform designed. Begin Beta-testing in Methods courses	Continue 4th-5th year videotaping 200 new videos shot Rough edit Years 3-5 cases Final edit Year 3 cases Multimedia platform finished Beta-testing, released to public
9. Develop a Clearinghouse of Best Practice	Statewide website/teacher forum designed Video cases archived in rough form. Database structure developed	Relational database of materials, videos, training programs in Beta form, begin Beta testing Video Cases archived with searchable index in Beta form Faculty expertise database developed and in Beta form	Database released to public Video cases released to public Faculty expertise database released to public
10. Expand the Statewide Advisory Board for Mathematics and Science Education	Expand members to include businesses, teachers, and school district representatives in AZTEC schools. Begin to design advisory role.	Begin quarterly meetings with Board of Regents' staff. Begin meeting with State Department of Education staff.	Statewide Advisory Board continues to gain influence with Board of Regents/State Department of Education and lawmakers

11. Create a Specialists in Residence Program	Form a committee to direct the Specialists in Residence program. Identify exemplary teachers and professors to participate in the Professors in Residence program. Identify areas needing expertise that are currently not available. Develop first courses that will be taught by exchange Professors	Implement the first Professors in Residence program. Assess the impact of the program. Revise the program to better meet the needs of participating **preservice** and **inservice** teachers.	Implement four Professors in Residence programs during the summer. Mechanisms are in place to ensure the program will be on going.
12. Create an evaluation team to study change within each partner institution, and across the state partnership	Hire graduate assistants Identify representatives from all partners Develop design of local evaluations Meet 4 times per year to coordinate and generalize across state Begin observations/Baseline Data Collection	Continue observational schedule Publish annual reports Begin writing research documents Present findings at state meetings Present findings at national/international conferences	Five major technical reports ready for dissemination. Video cases tagged to insert in technical reports for multimedia production Final report disseminated

APPENDIX D

PARTNERS

PARTNERS

Partner Institutions: Arizona State University, Northern Arizona State University, University of Arizona

All three Colleges of Education in **Regents' Universities** in the state of Arizona meet the Title II HEA definitions of a *Partner Institution* (definition B). All students enrolled in the Colleges of education are required to participate in intensive clinical field experiences each semester of their education coursework, and a mentored student teaching practicum. In addition, supervised service learning is required of undergraduate prospective teachers in their mathematics methods courses (for elementary teachers).

High academic standards are shared by all Colleges of Education in terms of entrance requirements (>2.5 GPA in content coursework, though students with less than 3.0 are rarely admitted), continuing GPA (3.0 required for satisfactory progress), and exit examination (the State Teacher's examination must be passed at a rate of 70% correct on the content portion). In addition, secondary school candidates are required to complete an academic major in the subject area in which they will be certified (2.5 GPA minimum). In the case of elementary teaching candidates, many complete academic majors in the Colleges of Liberal Arts and Sciences. To insure that all candidates demonstrate a high level of competence in core academic subject matter, all must pass the state-level ATPA content knowledge examination. Secondary teacher candidates must complete a subject-matter specific examination. Lastly, all teacher candidates in Arizona, by law, are certified provisionally for their first two years. In the third year of inservice teaching, candidates must pass a practicum examination (ATPA performance portion) that

includes a video of a lesson, with critical commentary, lesson plans, and assessment included as a portfolio.

Schools of Arts and Sciences. Arizona State University, Northern Arizona University, University of Arizona, Maricopa Community Colleges, Pima Community College, Dine College

All Colleges of Arts and Sciences at the three **Regents' Universities** are partners in AZTEC. All offer majors in mathematics and the core disciplines of science including biology, chemistry, physics, astronomy, and geology. In addition the Maricopa Community College District, Pima Community College, and Din❑ College which provides the **Regents' Universities** with the majority of their teacher candidates, and provides the first two years of academic instruction for transfers into mathematics and the sciences and education, are major partners for the reform of content courses and initial education experiences (see attached letters of commitment).

High-Need Local Educational Agencies (LEAs).

Partner school districts in the Phoenix EC include the Phoenix Union High School District and a number of its feeder districts (Creighton, Madison, Osborn, Elementary School Districts). All of these districts contain at least one school in which 40 percent or more of the enrolled students are eligible for free lunch subsidies. In the Creighton district, for example, all of the schools contain a population of more than 40 percent eligible for free lunch subsidies. Partner school districts in the 4 corners area and the Border Cities (Sierra Vista, Nogales, Yuma) also meet the HEA Title II criteria.

Moreover, in each of the target ECs, partner school districts also have a high percentage of secondary mathematics and science teachers (especially physics) who are not teaching in the area of their major specialization (see Table 1, in Project Narrative).

Lastly, all districts served have a high teacher turnover rate. Many have experiences a 1/3 turnover in the past 5 years (See letters of commitment).

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Din❑ College:

Mr. Ben Barney
Dine Teacher Education Program

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Amphitheater Public Schools:

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Associate Superintendent for Secondary School Operations
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Flowing Wells Schools:

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Administrative Services
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Creighton School District:

Ms. Sharon Rosenthal
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(602) 381-6019 (Fax)

Osborn School District:

Dr. Wilma J. Basnett
Superintendent
1226 W. Osborn Road
Phoenix, AZ 85013
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(602) 707-2040 (Fax)

DETAILED INFORMATION ON EACH PARTNER

Arizona State University (Fiscal Agent).

Center for Research on Education in Science, Mathematics, Engineering, and Technology. CRESMET was established as a means of leveraging resources for research and development across the traditional boundaries of University departmental and College structures. The mission of the Center is to bring together individuals, programs and organizations interested in improving K-20 science, mathematics, engineering and technology education to research, develop, and assess educational theories, curricula and administrative policies that impact science, mathematics, engineering and technology education; and to encourage and support wide-scale sharing and implementation of effective approaches to producing a more scientifically and technologically literate populace and more capable science, mathematics, engineering, and technology majors.

The Center is a National Leader in pursuing enhanced educational theories, practices and technologies to improve the teaching and learning of Science, Mathematics, Engineering, and Technology for all students, assessing and sharing information on research and development efforts in Science, Mathematics, Engineering, and Technology education; and expanding the learning community of scholars and organizations interested in the improvement of Science, Mathematics, Engineering, and Technology education throughout the K-20 system.

It houses faculty from biology, physics and astronomy, mathematics, geology, chemistry, engineering, solid state science, curriculum and instruction, and educational technology. The proposed AZTEC partnership will be centrally housed and administered through CRESMET, and much of the cost sharing will come through Center resources. The Principal Investigator of AZTEC, Dr. James A. Middleton, is the Associate Director of CRESMET.

ACEPT. The Arizona Collaborative for Excellence in the Preparation of Teachers is a $5 million grant from the National Science Foundation to reform content area instruction in mathematics and science for prospective teachers. Arizona State University took the lead role in this effort in collaboration with the ten Maricopa County Community Colleges and Dine College (formerly Navajo Community College) to reform the undergraduate science and mathematics courses taken by students studying to become K-12 teachers. ACEPT has created innovative course options, reformed mathematics, biology, physics, and chemistry undergraduate courses, and created a unique post-baccalaureate program to provide Masters' Degrees and secondary certification for candidates with exceptional science and mathematics training. The ACEPT project which initiated reforms such as those proposed by AZTEC ends in 2000. Here we propose to build upon and considerably expand the collaborations and partnerships established with by the ACEPT project over the past five years. These relationships form the basis for AZTEC activities in the Phoenix EC, and in the Four Corners region.

AZSTEP. The Arizona Science and Technology Partnerships is a statewide network of physics faculty and teacher leaders. Its goals are to infuse technology into high school science courses, align curriculum and pedagogy with the National Science Education Standards, and incorporate 20th century science into the curriculum. AZSTEP is creating an infrastructure to support sustained and rapid reform of science teaching with technology by growing and supporting expert teachers as leaders of reform.

Beginning Educator Support Team. BEST is a partnership, between the College of Education at ASU-main, with local school districts in the Phoenix EC that is designed to provide induction services to first- and second-year teachers. Support is offered through extensive orientation before the start of the school year, timely workshops that cover the basics of classroom survival, and an assigned grade-level or subject-matter mentor who provides day-to-day support. In addition to providing support within its buildings and in the school districts, the College of Education at ASU also gives new teachers an opportunity to receive masters-level credit that may be applied to any masters program at ASU. The course features specific activities designed to meet the needs of new teachers and includes monthly support seminars which feature guided reflection of their daily practice.

BEST also provides training for Mentor teachers. The mentor program emphasizes developmental coaching and specific techniques that encourage professional reflection. BEST is also helping second-year teachers develop their professional portfolios, including videotapes of their practice, that provide evidence that the teachers' practice reflects the Standards for Arizona Teachers. This course is co-taught by teachers certified by the National Board for Professional Teaching Standards.

Course content includes assessment of instruction, documentation of practice, video development and portfolio presentation, and the development of exemplary activities.

Under the AZTEC project, the BEST program will be expanded statewide to include NAU, UA, and ASU-West graduates employed in the state's Enterprise Communities. Mentor Teachers will be trained through the BEST model, and graduate courses supporting beginning teachers will be developed and conducted at all universities, supported by a distance network to connect content, assignments, and reflective practice examples across the state. Course content

under AZTEC will expand to include the particularities of teaching mathematics and science content.

TBLR. Technology Based Learning and Research provides a unified structure to coordinate various technology-based research and development projects. As an integral part of the College of Education, TBL&R integration using computers and other information and communication technologies. TBL&R projects have been funded by the National Science Foundation, the U.S Department of Education, and major corporations such as Texas Instruments, Apple and IBM.

Northern Arizona University

Arizona Center for K-12 Improvement. The Arizona K-12 Center supports collaborative efforts in teacher support and development across the state of Arizona. Individual teachers, districts, parent groups, College faculty, and educational support organizations access existing programs, obtain technical information regarding what works, and share the results of their own reflective practice. The K-12 Center also accesses the expertise from all of the state universities through the Colleges of Education, the Colleges of Arts & Sciences, Science & Math Learning Centers, and other teaching/learning units across the higher education institutions' structures.

The Center's **mission** encompasses those areas of preparation and professional practice that influence educators' performance and/or student outcomes. Given the recent revisions to the Arizona teacher and administrator certification processes, special attention must be given to issues of new teacher induction and the preparation of teachers and administrators who exceed

state certification standards. There will be three main concepts developed and implemented in AZTEC through the activities of the K-12 Improvement Center:

Clearinghouse for Best Practice. This database function of the Center would provide educators with a synopsis of new or available materials that represent "best practice" so that adoption decisions are facilitated. Active canvassing of Arizona districts would also result in the development of an Arizona best practice file. Mentor teachers and teacher candidates will be videotaped, and their cases will be developed into a series of multimedia applications for pre- and **inservice** teacher development.

Training and Professional Development. The Center will serve as a source of information regarding training materials and strategies for Mentor Teachers. Additionally, the Center will develop and provide customized training programs at district request. A model for "best practice" would be incorporated throughout all training and professional development activities. These strategies would be on going, on-site, and focused on the content standards that Arizona students and teachers should know and be able to do. Through utilization of computer networking, NAU NET, and various campus facilities, the work of the K-12 Center will incorporate all state supported University campuses and related teaching facilities. The K-12 Center will take advantage of Northern Arizona University's IITV sites, and the numbers teaching sites (61) already offered through web multimedia-based applications.

Action Research and Evaluation. The Center will conduct action research on the statewide ATPA examinations, develop rubrics for evaluating the performance portion of the tests, and assess the continued development of AZTEC teachers.

The Science and Mathematics Learning Center. The SMLC is promoting long range, school wide, systemic reform in the teaching of science and mathematics, customized to the needs and situation in a school or school district. Through such processes, the potential for funding for implementation and the success of the program are both greatly increased.

The SMLC at NAU currently has two such collaboratives, which are in their third year of existence 1) Casa Grande School District and 2) a consortium of BIA contract and grant schools, six in the Chinle area on the Navajo reservation. We also have a project at Leupp School, an elementary school within the Flagstaff School District. This is a school on the Navajo reservation.

The SMLC has a contract with the Navajo Nation Rural Systemic Reform/National Science Foundation project to deliver professional development for ten schools on the Navajo reservation this fall.

The SMLC also has projects with the Mount Elden Middle School in Flagstaff, Kingman Middle School, Madison School District in Phoenix, and Amphitheater District in Tucson. All of these are partnerships, which do need additional funding.

In addition to these school-based programs, the SMLC, in collaboration with the Center for Environmental Education and the Institute for Tribal Environmental Professionals at NAU, have embarked on a program to promote the GLOBE program. This is a national program of environmental education using inquiry-based curricula materials in which K-12 classes throughout the U.S. (and internationally) share results via the Internet. The staff of the SMLC are qualified trainers for this program and currently we are training teams of elementary teachers on the use of GLOBE. The Casa Grande School District, one of our partnership school districts, has also adopted GLOBE materials.

The SMLC is also involved with the coordination of the preservice secondary and middle school science teachers at NAU. In addition, we have worked with the Center for Excellence in Education to assist with instruction in the "methods" course in science for all elementary preservice students. This past year we were actively involved in developing a standards based physical science course for elementary preservice students which will be introduced this fall after some field testing this summer in one of our inservice teacher training institutes. We need assistance in the development of this physical science course and the beginning biology course for preservice teachers.

In the introductory physics course taken by preservice physical science and physics students, Dr. Dan MacIsaac has been developing seat experiments for his lectures. He needs financial assistance for this project to improve the instruction for students in the preservice teacher program.

University of Arizona

Science and Mathematics Education Center. SAMEC is the University of Arizona's coordinating entity for all science and mathematics pre-College programs and teacher education services. Representatives from science, mathematics, and education departments participate in the center and announce their programs through the center. Over 100 different programs are available to **preservice** teachers through this center.

Pima Community College. Pima Community College current has two efforts that support the education of **preservice** mathematics and science teachers. The first is a program that prepares students to enter the College of Education program. The second effort consists of a course that

specifically recruits mathematics and science teachers into the College of Education. Over the years, science faculty at Pima Community College have participated in several professional development programs specifically geared at improving their instruction.

Project: DESERT. This National Science Foundation program targets science education in elementary and secondary settings in the Tucson Unified School District. Student teachers who complete student teaching experiences in these schools have opportunities to participate in student-centered instruction, teacher study groups, and action research projects.

Instructional Technology Facility. The ITF is a technology center that provides services for all education students. Training sessions on the use on instruction technology occurs weekly, with several sessions offered at time conducive for teacher participation.

Arizona Institute for Mathematics and Science Education Research. This Eisenhower funded conference promotes dialogue among k-16 mathematics, science, engineering, and technology educators, while providing a mechanism for Community Colleges, businesses, and universities to share their programs. This conference occurs at different locations in the state in order to encourage a variety of attendees.

Tucson Unified School District, Flowing Wells Unified School District, and Marana Unified School Districts. The College of Education has field-based teacher training programs at each of these districts. **Preservice** elementary and secondary education courses are taught in the schools

by both University and school district personnel. These programs are year-long and offer extensive field experiences.

Clinical Assistant Professors. The University of Arizona has several clinical assistant professor appointments in which public school educators work at the University for one to three years. Clinical Assistant Professors are responsible for the instruction of content and pedagogical courses, and working with local school districts. Currently, the College of Education and the College of Mathematics offer Clinical Assistant Professor appointments.

Department of Hydrology. This year, College of Education faculty will collaborate with the educators from the Department of Hydrology to develop a course for pre- and **inservice** teachers. Currently, the collaboration is funded through the state with additional funds requested through the National Science Foundation.

Din❑ College

DTEP. The Din❑ College Teacher Prep Program is a new teacher certification program currently under review for accreditation. It was founded as a collaboration between ASU College of Education and Din❑ College in Tsaile. Its mission is to recruit and train fluently bilingual individuals from the Navajo nation to become elementary teachers. DTEP has collaborated extensively with the ACEPT, the Arizona Collaborative for Excellence in the Preparation of Teachers. The new Diné College Teacher Education Program (DTEP) graduated its first cohort of 17 teachers last June in the project's fourth year. The Diné science faculty developed a new biology component to the DTEP *Patterns in Nature* course. The number of students accepted

into the DTEP has increased each year, and the program has achieved sufficient maturity that accreditation by North Central has been scheduled for 2001. Once accredited Din□ College will offer a bachelor's degree in education (a four-year program within a two-year College), with elementary certification.

American Indian Programs.

The office of American Indian Programs The Office of American Indian Programs at Arizona State University East (Williams Campus) is involved, collaboratively with tribal communities and other partners, in a wide range of activities dedicated to improving educational opportunities for all American Indians by providing educational opportunities for teachers and administrators in schools serving tribal communities. The office of American Indian Programs collaborates directly with the Arizona Tribal Coalition, a collaborative sponsored by the Utah, Colorado, Arizona, and New Mexico (UCAN) Rural Systemic Initiative, a multiyear National Science Foundation sponsored project (see letter of support).

Maricopa Community College District (See letter of support).

Office of Public School Programs. The Office of Public School Programs at the MCCD offers support for mathematics and science education to classroom teachers in Maricopa county, and targets services for urban schools in the Phoenix EC. Currently, the Office is involved in four major multimillion dollar, federally-funded projects (National Science Foundation, Eisenhower): The Phoenix Urban Systemic Initiative (USI); the Cognitively Guided Instruction Project; the Arizona Interactive Mathematics Program; and the Coalition of Latinos for the Advancement of Systemic Equity. The Office also provides technologies for interactive, hands-

on mathematics and science, including computers, graphing calculators, data probes, and software. Identified master teachers in urban districts (many of which will form our Mentor Teacher corps) are trained in the use of these technologies and are in charge of their distribution and use in public schools.

Phoenix USI. The Phoenix Urban Systemic Initiative is a 5-year $15 million effort funded by the National Science Foundation to improve teaching in the Phoenix urban core districts through staff development. The USI has developed an infrastructure for identifying and training teacher leaders at the local building level, and has created common curriculum across the elementary districts. It is currently focusing its attention on elementary/high school articulation of curriculum. AZTEC partner districts in the Phoenix EC are all members of this consortium. Master Teachers from these districts have already been trained extensively by the Phoenix USI and have supported inservice teachers through conducting academies, workshops, graduate courses, and through observation and modeling. As the AZTEC project coincides with the end of the USI's funding cycle, these Master Teachers will be recruited to serve in the AZTEC grant.

Cognitively Guided Instruction. The Cognitively Guided Instruction project is a 3-year $1 million dollar project sponsored by the National Science Foundation. Its activities include providing in-depth training in diagnosing the ways in which children think about mathematics problems in arithmetic, rational number, geometry and algebra, and using this diagnosis as a springboard for future instruction. CGI has trained over 1,000 teachers in the Phoenix EC, and is spreading to surrounding districts. In addition, Phoenix USI Master Teachers were trained to support classroom teachers in their implementation of CGI principals. Dr. Middleton, AZTEC PI is coPI of the CGI project.

Arizona Interactive Mathematics Project. Implementing the Interactive Mathematics Program (IMP) in Arizona is a collaboration of schools and/or districts throughout the state of Arizona, the Maricopa Community College District, and Arizona State University. Major goals of the project are to increase the number of schools and teachers implementing IMP and to enhance the ability of IMP teachers to effectively teach using IMP's standards based curriculum. AZ IMP2 collaborates with the Phoenix Urban Systemic Initiative (USI) in providing professional development activities for high school teachers. IMP, a four-year, problem-based mathematics curriculum program, is designed to meet the needs of both College and non-College-bound students, and replace the traditional Algebra I-Geometry-Algebra II/Trigonometry-Precalculus sequence.

Coalition of Latinos for the Advancement of Systemic Equity. The Coalition of Latinos for the Advancement of Systemic Equity (CLASE) is a group of Latino education professionals representative of the Latino community in the United States of America, i.e., Mexican, Cuban, Puerto Rican, and Central and South American. Collectively, CLASE brings extensive years of direct experience with the United States of America's educational system, both as former students and as current leaders representing the various levels of our nation's public school organizations. In addition to shared racial and cultural backgrounds, CLASE participants have a shared involvement in a mathematics education equity and leadership development project, funded by the National Science Foundation, called the Equity in Mathematics Education Leadership Institute EMELI has brought together educators from diverse backgrounds to increase the ability of mathematics education reform leaders to effectively and productively address equity, in order that teachers and schools will change practices that impede the learning of students from groups underrepresented in mathematics.

Arizona Board of Regents

The ABOR is the governing body of the state's universities, and is in charge of mathematics and science staff development through administering the Eisenhower Higher Education grants. ABOR has been instrumental in bringing the various partners together to develop this proposal, and it is committed to statewide reform of science and mathematics education.

QUALIFICATIONS OF PROJECT PERSONNEL

Principal Investigator :

James A. Middleton:

Dr. James A. Middleton is an Associate Professor of Mathematics Education in the Division of Curriculum and Instruction at Arizona State University. He earned his Ph.D. in Educational Psychology from the University of Wisconsin. Prior to coming to ASU, he held a postdoctoral position in the National Center for Research in Mathematical Sciences Education, where he coordinated the development and field testing of innovative mathematics curricula. He is currently Associate Director of the Center for Research on Education in Science, Mathematics, Engineering and Technology.

Dr. Middleton's research interests focus on the development of mathematical models, cognitive approaches to the study of intrinsic motivation in mathematics, and technological innovation in mathematics instruction. Dr. Middleton has publshed numerous chapters, technical reports, and journal articles on the reform of mathematics teacher education. In particular, he has studied teacher collaboration in urban settings. He is principal investigator of a $1 million grant (Cognitively Guided Instruction) from the National Science Foundation to reform inner-city teachers' understandings of children's mathematical thinking, and is examining the sociolinguistic factors of teaching arithmetic in the primary grades. He recently authored a book on changing the practice of mathematics teaching published by the American Psychological Association. In addition he has authored or co-authored more than 50 other publications stemming from his research. He is a reviewer for the *Journal for Research in Mathematics Education,* and *Mathematics Teaching in the Middle School, Educational Researcher, and School Science and Mathematics.* He is a member of the American Association of Colleges of Teacher Education, the National Council of Teachers of Mathematics, and the American Educational Research

Association.

Dr. Middleton currently teaches mathematics methods for elementary and middle school teachers and graduate courses in children's mathematical thinking. In each of these courses, he strives to coalesce the latest knowledge of how children learn mathematics, the technological tools that facilitate student learning, and ways in which teachers can design meaningful activity in their classes.

Dr. Middleton's role as Principal Investigator will be to maintain the central focus of AZTEC **Key Components**, coordinate the activity of all **Points-of-Presence**, and administer the grant.

Co-Principal Investigators :

Thomas Brush:

Dr. Brush is an assistant professor of educational technology whose research interests focus on integrating technology into teaching, and designing technology-supported environments to promote higher-order thinking in students. He has authored or coauthored more than 20 publications related to his research interests, and serves as a reviewer for *Educational Technology Research and Development*, a publication of the Association for Educational Communications and Technology. Dr. Brush has also served on state-level educational technology advisory boards in both Michigan and Alabama.

Dr. Brush has been the recipient of several awards related to his research. In 1992, he received an award from the Society for Technology and Teacher Education for his efforts to integrate technology into field-based teacher training. In 1998, Dr. Brush received the Young Scholar Award from the Association for Educational Communication and Technology for his

work integrating computer-based instruction with social learning strategies.

Prior to coming to ASU, Dr. Brush was assistant professor of educational technology at Auburn University in Auburn, Alabama from 1995-1998. In that position, he was responsible for providing technology training to all undergraduate teacher education students. Dr. Brush has also served as director of instructional technology for Mt. Clemens School District in Mt. Clemens, Michigan.

Dr. Brush currently teaches educational technology courses for undergraduate and graduate education majors. He also teaches graduate courses in computer-based instruction and open-ended learning environments. His role in AZTEC will be to coordinate the production of videocases. He will oversee the taping, editing, digitizing, and multimedia platform development.

Patty J. Horn:

Dr. Patty J. Horn is the Associate Dean for Professional Development in the Center for Excellence in Education at Northern Arizona University. Dr. Horn has been involved in elementary education since her certification in 1966. She has been a classroom teacher, University Professor, Dean of a College of Education, and Executive Director of the Arizona K-12 Center. She is currently on the Board of Directors of the American Association of Colleges for Teacher Education. Dr. Horn's role in AZTEC will be to administer the Four-Corners **Point-of-Presence**, and to direct the development of the clearinghouse of best practices. Moreover, she will coordinate the work of NAU in the Phoenix EC.

Julie A. Luft:

Dr. Julie A. Luft is an Assistant Professor of Secondary Science Education in the department of Teaching and Teacher Education at the University of Arizona. She obtained her Ph.D. from the University of Iowa in Science Education with supporting foci in Ecology and Statistics. Her research has focused on the development of teachers, both pre- and inservice. Her work has a distinctive classroom focus, and she is expert in the development of clinical faculty in collaboration with public school teachers. Dr. Luft is intimately familiar with the state of teacher education in Arizona, having evaluated the state Eisenhower Mathematics and Science Program, and the state's initial certification programs.

Dr. Luft's role in AZTEC will be to coordinate the development of clinical faculty, and administer the Border Cities **Point-of-Presence.**

D. Scott Ridley:

Dr. D. Scott Ridley is an Associate Professor of Educational Psychology in the ASU West College of Education. Before coming to Phoenix, he was at the University of Texas at Austin. In addition to teaching classes in learning & motivation theory and classroom assessment, Dr. Ridley has served as the Coordinator of the Professional Core and worked extensively with valley schools. The last five years have been devoted to working exclusively with urban schools. During this time, Dr. Ridley led the creation of multiple-district professional development program called ExCEL (Exchange for Effective Learning). This collaborative offered classroom teachers in urban schools opportunities to share expertise and study their practice through action research.

Reflective practice, motivation, and school change are research interests for Dr. Ridley who was awarded the Outstanding Researcher Award at ASU West in 1994. More recently, Dr. Ridley has published articles on the effectiveness of Professional Development Schools as a vehicle for preservice teacher education.

Dr. Ridley is currently housed at Longview Elementary School, an urban K-6 school which serves as a Professional Development School. This program, one of the few in the state of Arizona, is an intensive year-round apprenticeship program for new urban teachers. Dr. Ridley considers himself as a pragmatic scholar/activist from the Dewey tradition who balances intellectualism with grass-root action in the urban school community. He continues to seek collaborative ventures that more effectively prepare new teachers, support existing teachers, and challenges schools to higher levels of excellence.

In the AZTEC project, Dr. Ridley will be in charge of developing the PDS model and establishing structures and systems for working closely with the community colleges.

Susan Wyckoff

Dr. Susan Wyckoff was PI/Project Director of the ACEPT project for five years. Under her direction, more than 200 science/math and science/math faculty from ASU and the community colleges in the Phoenix area have become actively involved in the ACEPT project to reform the undergraduate science and mathematics pedagogy and content. The Co-PI's role in the AZTEC program will be to lead, oversee and coordinate the collaboration among science and mathematics faculty in the partnership institutions (universities and community colleges) to continue the reforms the undergraduate courses and curriculum. The undergraduate course reforms will consist of changes in the content to align with state and national science and

mathematics standards, and in the pedagogy to align with effective pedagogical methods. Faculty who are recognized nationally for their science/math education scholarship from biology, chemistry, geology, mathematics and physics who have been collaborating in the ACEPT program, will continue their collaboration in the AZTEC program. In addition to her leadership in science and mathematics education reform, Dr. Wyckoff is an internationally renowned astronomer and physicist. Her work on the makeup of comets and other astronomical work has earned her numerous awards.

C URRICULUM VITAE

James A. Middleton

Mathematics Education
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ARIZONA STATE UNIVERSITY

PERSONAL DATA

Date of Birth:	11th February, 1964
Place of Birth:	Susanville, CA
Married:	27th June, 1987, to Tracy A. Austin

ACADEMIC PREPARATION AND EXPERIENCE

Preparation

Ph.D. University of Wisconsin, Madison 1990-1992

Major: Educational Psychology (Human Learning, Statistics)

Minor: Curriculum and Instruction (Mathematics Education)

Dissertation: An Analysis of the Congruence of Teachers' and Students' Personal Constructs Regarding Intrinsic Motivation in the Mathematics Classroom

M.S. University of Wisconsin, Madison 1988-1990

Major: Educational Psychology

Thesis: Analysis of Gifted Students' Representations of Academic Fun: A Model of Academic Intrinsic Motivation

Other Graduate Work

California State University, Chico (1987-88)

B.A. California State University, Chico, 1984-1987
Honors in Psychology
Psi Chi (Psychology Honorary)

Experience

1998 – present Associate Professor of Mathematics Education, Department of Curriculum and Instruction, Arizona State University

Associate Director. Southwest Center for Research in Science, Mathematics and Engineering Education.

1994 - 1998 Assistant Professor of Mathematics Education, Department of Curriculum and Instruction, Arizona State University

1991-1994 Assistant Researcher, National Center for Research in Mathematical Sciences Education, University of Wisconsin Madison. Postdoctoral position. Coordinator of field testing of *Mathematics in Context: A Connected Curriculum for Grades 5 through 8*, a National Science Foundation funded middle school mathematics curriculum development/research project.

1991 Associate Lecturer, University of Wisconsin Madison. Teacher education seminar and practicum: Meeting the cognitive and affective needs of gifted students.

1988-1991 Wisconsin Center for Education Research. Project Assistant to Thomas A. Romberg. Responsibilities include survey development, statistics and data analysis, research and report writing for the Ford Foundation.

1987-88 California State University, Chico. Teaching Assistant to Joseph A. Scott with lecturing and course development responsibilities in research methods in personality and social psychology.

1987-88 California State University, Chico. Peer Counselor. Developing individualized study plans for minority persons with learning difficulties. Conducting workshops on essay test-taking and mnemonic strategies. Teaching a beginning summer course in library usage.

PROFESSIONAL ACTIVITIES

Membership in professional organizations

American Educational Research Association
- Special Interest Groups:
  - Research in Mathematics Education
  - Motivation in Education
- Reviewer: *Educational Researcher*
  American Educational Research Journal

American Psychological Association
- Division 15: Educational Psychology

National Council of Teachers of Mathematics
- Reviewer *Journal for Research in Mathematics Education*
  Mathematics Teaching in the Middle School

Psychology of Mathematics Education
Reviewer *School Science and Mathematics*

National Science Foundation Review Panel: Networking Infrastructure for Education initiative, July, 1996
Presidential Awards, July, 1998
National Academy of Sciences Action Conference on Research in Middle Grades Mathematics Education, September, 1998

Journal Articles

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Books

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Middleton, J. A., Smith, Stephanie Z., Romberg, T. A., & Smith, Marvin E. (in press). What to teach next year in seventh grade mathematics. In *What's a Teacher to Do? New Curricula for New Standards*. National Alliance for Restructuring Education.

Middleton, J. A., & Webb, N. L. (1994). Collaboration and Urban School Systems. In N. L. Webb and T. A., Romberg (Eds.), *Reforming Mathematics Education in America's Cities*, (pp. 105-128). New York: Teachers' College Press.

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Clasen, D. R., & **Middleton, J. A**. (1991). Identifying gifted minority students: An analysis of the Project STREAM talent assessment model. In N. Colangelo, S. G. Assouline, & D. L. Ambroson (Eds.), *Talent Development: Proceedings from the 1991 Henry B. and Jocelyn Wallace National Research Symposium on Talent Development*. Unionville, NY: Trillium Press.

Technical Reports

Flores, A., **Middleton, J. A.**, Knaupp, J. E., & Staley, F. (1997). Authentic Integration of Technology in Science and Mathematics Teacher Education. Arizona State University. Technical Report Submitted to the National Science Foundation

Jaslow, L., Middleton, J. A., Vital, J., Koellner, K., & Bote, Lisa A. (1997). *Accomplishments, Learnings, and Anticipated Changes for the Phoenix Urban Systemic Initiative (USI) Cognitively*

Guided Instruction Project: Report to the National Science Foundation for the 1996-97 funding year. Technical Report submitted to the National Science Foundation.

Koellner, K., & **Middleton, J. A.** (1997). USI Teachers' Conceptions of Mathematics and Science. Arizona State University: Technical Report submitted to the National Science Foundation.

Middleton, J. A. (1996). Report on Math Achievement Test Results: Scales Professional Development School 1995-1996 School Year. Arizona State University. Technical Report to the Scales Professional Development School.

Middleton, J. A. (1994). Student Attitudes and Motivations Towards Mathematics in the *Mathematics in Context Project*: a First Look. Arizona State University.

Middleton, J. A. (1991). Designing fun activities for gifted students: A taxonomy of motivational objectives. In R. E. Clasen (Ed.), *Educating Able Learners: A Study Guide*. Madison, WI: University of Wisconsin Extension.

Middleton, J. A. (1994). Technological Platform for the Maths in Context Project. In T. A. Romberg (Ed.), *A Blueprint for Maths in Context: A Connected Curriculum for Grades 5-8.* Chicago, IL: Encyclopaedia Britannica Educational Corporation.

Middleton, J. A. (1994). Field Testing for Maths in Context. In T. A. Romberg (Ed.), *A Blueprint for Maths in Context: A Connected Curriculum for Grades 5-8.* Chicago, IL: Encyclopaedia Britannica Educational Corporation.

Middleton, J. A., Cho, S., & Popkewitz, T. (1991). ***Preservice*** *Teachers' Backgrounds, Beliefs and Dispositions: Results of the 1990 Summer Institute Corps Member Questionnaire*. University of Wisconsin--Madison: Wisconsin Center for Education Research.

Middleton, J. A., Knaupp, J. E., Staley, F., Benson, K., & Aljibari, S. (1996). Report of the Technoteach module. Arizona State University, Technical Report Submitted to the National Science Foundation.

Middleton, J. A., Pitman, A. J., Webb, N. L., & Romberg, T. A. (1991). *Mathematics Teachers' Views about Teaching as a Profession: A Final Assessment*. Madison Wisconsin: University of Wisconsin--Madison, Wisconsin Center for Education Research.

Middleton, J. A., Webb, N. W., Romberg, T. A., & Pittelman, S. D. (1990). *Teachers' Conceptions of Mathematics and Mathematics Education.* Madison Wisconsin: University of Wisconsin--Madison, Wisconsin Center for Education Research.

Middleton, J. A., Webb, N. W., Romberg, T. A., Pittelman, S. D., Pitman, A. J., Richgels, G. M. & Fadell, E. M. (1989). *Characteristics and Attitudes of Frequent Participants in the Urban Mathematics Collaboratives: Results of the Secondary Mathematics Teacher Questionnaire.* Madison Wisconsin: University of Wisconsin--Madison, Wisconsin Center for Education Research.

Romberg, T. A., Pitman, A., Pittelman, S. D., Webb, N. W., Fadell, E. M., & **Middleton, J. A.** (1988). *Mathematics Teachers' Views about Teaching as a Profession: An Initial Assessment.* Madison Wisconsin: University of Wisconsin--Madison, Wisconsin Center for Education Research.

Webb, N. L., Pittelman, S. D., Romberg, T. A., Pitman, A. J., Fadell, E. M., & **Middleton, J. A.** (1989). *The Urban Mathematics Collaborative Project: Report to the Ford Foundation on the 1987-88 school year (Program Report 89-1).* Madison Wisconsin: University of Wisconsin--Madison, Wisconsin Center for Education Research.

Webb, N. L., Pittelman, S. D., Romberg, T. A., Pitman, A. J., **Middleton, J. A.**, Fadell, E. M., & Sapienza, M. (1990). *The Urban Mathematics Collaborative Project: Report to the Ford Foundation on the 1988-89 school year (Program Report 90-1).* Madison Wisconsin: University of Wisconsin--Madison, Wisconsin Center for Education Research.

Webb, N. L., Pittelman, S. D., Romberg, T. A., Pitman, A. J., Sapienza, M., & **Middleton, J. A.** (1991). *The Urban Mathematics Collaborative Project: Report to the Ford Foundation on the 1989-90 school year (Program Report 91-1).* Madison Wisconsin: University of Wisconsin--Madison, Wisconsin Center for Education Research.

Mathematics Curriculum Booklets

de Jong, J. A., **Middleton, J. A**., Simon, A., & Burrill, G. (1997). Dealing with Data. In T. A. Romberg (Ed.), *Mathematics in Context: A Connected Curriculum for Grades 5 - 8.* Chicago, IL: Encyclopaedia Britannica Educational Corporation.

de Lange, J., van Reeuwijk, M., Feijs, E., & **Middleton, J. A.** (1997). Figuring all the Angles. In T. A. Romberg (Ed.), *Mathematics in Context: A Connected Curriculum for Grades 5 - 8.* Chicago, IL: Encyclopaedia Britannica Educational Corporation.

de Lange, J., Roodhardt, A., **Middleton, J. A**., Fix, M. A., & Burrill, G. (1997). Digging Numbers. In T. A. Romberg (Ed.), *Mathematics in Context: A Connected Curriculum for Grades 5 - 8.* Chicago, IL: Encyclopaedia Britannica Educational Corporation.

de Lange, J., Wijers, M., Burrill, G., Shafer, M., & **Middleton, J. A.** (1997). Check it Out. In T. A. Romberg (Ed.), *Mathematics in Context: A Connected Curriculum for Grades 5 - 8.* Chicago, IL: Encyclopaedia Britannica Educational Corporation.

Jonker, V., van Galen, F., Ruesink, N., Simon, A., Burrill, G., & **Middleton, J. A.** (1997). Take a Chance. In T. A. Romberg (Ed.), *Mathematics in Context: A Connected Curriculum for Grades 5 - 8.* Chicago, IL: Encyclopaedia Britannica Educational Corporation.

Roodhardt, A., de Jong, J. A., Brinker, L. J., & **Middleton, J. A.** (1997). Triangles and Beyond. In T. A. Romberg (Ed.), *Mathematics in Context: A Connected Curriculum for Grades 5 - 8.* Chicago, IL: Encyclopaedia Britannica Educational Corporation.

Roodhardt, A., **Middleton, J. A.**, & Burrill, G. (1997). Decision Making. In T. A. Romberg (Ed.), *Mathematics in Context: A Connected Curriculum for Grades 5 - 8.* Chicago, IL: Encyclopaedia Britannica Educational Corporation.

Ruesink, N., Niehaus, J., Gravemeijer, K., **Middleton, J. A.**, & Spence, M. K. (1997). Picturing Numbers. In T. A. Romberg (Ed.), *Mathematics in Context: A Connected Curriculum for Grades 5 - 8.* Chicago, IL: Encyclopaedia Britannica Educational Corporation.

van den Heuvel-Panhuizen, M., Meyer, M., **Middleton, J. A.**, & Browne, J. (1997). Per Sense. In T. A. Romberg (Ed.), *Mathematics in Context: A Connected Curriculum for Grades 5 - 8.* Chicago, IL: Encyclopaedia Britannica Educational Corporation.

Paper Presentations

Koellner, K. A., & **Middleton, J. A.** (1999). Children's Multiplicative Schemes in the Operator Subconstruct of Rational Number. Paper to be presented at the Annual Meeting of the American Educational Research Association, Montreal CA.

Leader, L., **Middleton, J. A.**, & Leavy, A. (1999). From Ability to Action: Designing Instruction for Critical Thinking Dispositions. Paper to be presented at the Annual Meeting of the American Educational Research Association, Montreal CA.

Leader, L., & **Middleton, J. A.** (1999). From Ability to Action: Designing Instruction for Critical Thinking Dispositions. Paper to be presented at the Annual Meeting of the Association for Educational Communications and Technology, Houston, TX.

Middleton, J. A., Poynor, L., Wolfe, P., Toluk, Z., & Bote, L. A. (1999). A Sociolinguistic Perspective on Teacher Questioning in a Cognitively Guided Instruction Classroom. Paper to be presented at the Annual Meeting of the American Educational Research Association, Montreal Canada.

Smith, G. G., Olkun, S., & **Middleton, J. A.** (1999). Interactive Versus Observational Learning of Spatial Visualization of Geometric Transformations. Paper to be presented at the Annual Meeting of the American Educational Research Association, Montreal Canada.

Koellner, K. A., Bote, L. A., & **Middleton, J. A.** (1998). Cycles of transformation in assessment practices in a Cognitively Guided Instruction Classroom. Paper presented at the Annual Meeting of the American Educational Research Association, San Diego, CA.

Middleton, J. A. (1998), The Self-in-the-Task: Modeling as Adaptive Thought. Invited paper presented at the International Conference on Symbolizing and Modeling in Mathematics Education. Utrecht, the Netherlands.

Middleton, J. A., & Toluk, Z. (1998). First steps in the development of an adaptive, decision-making theory of motivation. Paper presented at the Annual Meeting of the American Educational Research Association, San Diego, CA.

Smith, G. G., & **Middleton, J. A.** (1998). The development of spatial visualization and mental representation of geometric transformations in a computer-mediated environment. Paper to be presented at the Annual Meeting of the American Educational Research Association, San Diego, CA.

Middleton, J. A. (1997). Musings on Model Eliciting Tasks: Why Would Anyone Want to Do Such a Thing? Paper presented at the National Center for Improving Student Learning and Achievement in Mathematics and Science-sponsored conference on Mathematical and Scientific Modeling, Park City, UT.

Middleton, J. A. (1997). Expresseness, motivation, and mathematics learning: Using technology to enhance human potential. Paper presented at the Research Presession of the Annual Meeting of the National Council of Teachers of Mathematics, Minneapolis, MN.

Middleton, J. A. (1994). Engineering and structural stability as a contextually rich domain for teaching 6th grade geometry. Paper presented at the Annual Meeting of the American Educational Research Association, New Orleans, LA.

Middleton, J. A. (1993). The Effects of an Innovative Curriculum Project on the Motivational Beliefs and Practice of Middle School Teachers. Paper presented at the Annual Meeting of the American Educational Research Association, Atlanta, GA.

Middleton, J. A., & Romberg, T. A. (1993). Teachers' Conceptions of Mathematics and Mathematics Education: Effects of Collaboration on Teacher Beliefs. Paper presented at the Annual Meeting of the American Educational Research Association, Atlanta, GA.

Middleton, J. A., Webb, N. L., & Pitman, A. J. (1993). Collaboration and Change in Mathematics Teachers' Professional Beliefs: A Report of a Four-Year Longitudinal Study. Paper presented at the Annual Meeting of the American Educational Research Association, Atlanta, GA.

Middleton, J. A. (1992, April). Teachers' versus Students' Beliefs Regarding Intrinsic Motivation in the Mathematics Classroom: A Personal Constructs Approach. Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco, CA.

Piburn, M. D., & **Middleton, J. A.** (1997, January). Listserve as journal: Computer-based reflection in a program for preservice mathematics and science teachers. Paper presented at the International Conference on Science, Mathematics, and Technology Education, Hanoi, Vietnam.

Van den Heuvel-Panhuizen, M., Streefland, L., & **Middleton, J. A.** (1995). Students' Own Productions as a Source for Assessment Development. University of Twente, The Netherlands: Manuscript to be presented at the European Conference on Curriculum.

Clasen, D. R., & **Middleton, J. A.** (1991, May). Identifying gifted minority students: An analysis of the Project STREAM talent assessment model. Paper presented at the Henry B. and Jocelyn Wallace National Symposium on Talent Development, Iowa City, IA.

Bonk, C. J., **Middleton, J. A.**, & Reynolds, T. H. (1991, April). The Index of Writing Awareness: One tool for measuring early adolescent metacognition in writing. Paper presented at the Annual

Meeting of the American Educational Research Association, Chicago, Il.

Middleton, J. A. (1988, April). Generalizability, reliability and validity of a test of adolescent social competence. Paper presented at the Western Psychological Association Annual Convention, San Francisco CA.

Middleton, J. A., & Philpot, K. (1987, April). Social Competence in Adolescence: Internal consistency, criterion-group validity and construct validity of a scale of assessment. Paper presented at the Western Psychology Conference for Undergraduate Research, Santa Clara, CA.

Works in Progress

Middleton, J. A. (in preparation). *Designing Mathematicsl Experiences for Elementary and Middle School Learners.* Book contracted for publication by Houghton Mifflin & Co.

Middleton, J. A.. (in preparation). Student attitudes and motivation towards mathematics: What happens when you change the rules? Arizona State University: Manuscript in preparation for publication in a refereed journal.

Middleton, J. A., Kaput, J., Shafer, D. W., Inkpen, S., Wilensky, U., & Wolfe, D. (in preparation). Expressivity, motivation, and mathematics learning: Using technology to enhance human potential. Manuscript in preparation for publication in a refereed journal.

Poynor, L., Wolfe, P., & **Middleton, J. A.** (in preparation). Cultural Appropriation and Situated Practice of Four First Grade Teachers: Cases of Cognitively Guided Instruction. Manuscript in preparation for publication in a refereed journal.

SPONSORED PROJECTS

WISE Investments. Three-year (Spring 1999-Spring 20020. $300,000 National Science Foundation project to improve the status of engineering as a viable career opportunity for young women. Co-Principal Investigator.

Cognitively Guided Instruction in the Phoenix Urban Systemic Initiative. Three-year (Fall, 1996-Fall, 1999), $1 million National Science Foundation project to provide staff development to 2300 teachers in the Phoenix USI, and to do research in children's' mathematical thinking and teacher change. Principal Investigator, Director of Research Component.

$8,000 *Proposal to Develop Integrated Mathematics, Science Modules for Undergraduate Teacher Preparation* Funds were awarded by the Provost 's Office through the Initiative to Improve Undergraduate Education. $4,500 was awarded to Middleton, Staley, and Knaupp to develop a curriculum module for the integration of data probe hardware and software into the undergraduate mathematics and science methods courses. $3,500 in matching funds were provided by the Phoenix Urban Systemic Initiative. Principle Investigator.

Technology Coordinator for the *Teacher Education for Arizona Mathematics and Science* project, the College of Education component of the Arizona Collaborative for the Educational

Preparation of Teachers, a 5 million dollar project sponsored by the National Science Foundation. Applied for and received $70,000 to develop a model mathematics and science technology-based classroom.

PRESENTATIONS

Conference Presentations

National Council of Teachers of Mathematics. (1998). "Authentic Integration of Technology in Science and Mathematics Teacher Education."

Arizona Congress of Parents and Teachers (PTA) Convention, 1997, Phoenix, AZ. "Children's Mathematical Thinking."

ASU Investigates Modelling, Visualization, and Imaging, 1997, Tempe, AZ. "Visual tools for eliciting mathematical knowledge in young children."

Western Regional Meeting of the National Science Teachers Association, 1996, Phoenix, AZ. "Integrating Mathematics Science and Technology in an Innovative Teacher Education Program."

Fourth Annual National Conference on Curriculum Integration, 1996, Scottsdale, AZ. "Use of Computer Based Laboratory (CBL) Data Probes as a Vehicle for Integrated Science, Mathematics and Technology Investigations."

Western Regional Meeting of the National Council of Teachers of Mathematics, 1994, Phoenix, AZ. "Mathematics in Context."

Canadian Regional Meeting of the National Council of Teachers of Mathematics, 1994, Edmonton, Alberta. "Mathematics in Context."

Annual Meeting of the National Council of Teachers of Mathematics, 1994, Indianapolis, IN. "Assessment in Mathematics in Context."

Annual Meeting of the National Council of Supervisors of Mathematics, 1994, Indianapolis, IN. "Involving Parents in Mathematics Education Reform."

The Geometry Center: The National Science and Technology Research Center for Computation and Visualization of Geometric Structures, 1993, Minneapolis, MN. Invited presentation "Geometry in Mathematics in Context."

Annual Meeting of the National Council of Teachers of Mathematics, 1993, Seattle, WA. "Developing Middle School Mathematics Power Through Realistic Contexts."

Partnerships for Systemic Change in Mathematics and Science Education. The Association of State Supervisors of Mathematics Fall Conference, 1992, "Maths in Context: A Connected Curriculum for Grades 5 through 8."

Seventh International Congress on Mathematics Education, 1992, "The National Center for Research in Mathematical Sciences Education."

Wisconsin Mathematics Council Annual Meeting, 1992, "Maths in Context: A Mathematics Project that Helps Students to Make Connections in the Middle School."

"Rethinking the role of the mathematics meet in the face of school reform." Presented to mathematics teachers of southern Wisconsin, April, 1992.

Assessing Learning and Educational Achievement, sponsored by the American Psychological Association, Mid-Continent Regional Educational Laboratory (McREL), and The Johnson Foundation, November, 1991. Participant in Wingspread conference to explore the relationship of performance-based assessment to current efforts in systemic education reform.

Fifth Annual Wisconsin Association for Educators of the Gifted and Talented Conference, 1990, Madison, Wisconsin. Reactant to session on programs, models and strategies to facilitate the teaching of thinking skills to gifted students.

Consulting

Arizona Early Childhood Initiative. "Children's Mathematical Thinking." June, 1998.

Scottsdale School District. "Children's Mathematical Thinking I." February, 1998.

Scottsdale School District. "Children's Mathematical Thinking II." February, 1998.

Scottsdale School District. "Mathematics Your Professor Didn't Want You to Know About." February, 1998.

Kyrene School District. Reviewed the developmental appropriateness and mathematical significance of the Kyrene School District draft curriculum document, 1997.

Arizona State University. "Using Data Probe Technologies for Teaching Science and Mathematics." May, 1997.

Arizona State University. "Cognitively Guided Instruction Leadership Academy." March 1997.

Glendale Elementary School District. "Cognitively Guided Instruction Project." March 1997.

Glendale Elementary School District. "Algebra in Mathematics in Context" December, 1996.

Goals 2000 Conference, Cochise Consortium, Wilcox, AZ. "Children's Mathematical Thinking." August, 1996

Goals 2000 Conference, Cochise Consortium, Wilcox, AZ. "Higher Order Thinking Skills." August, 1996.

Goals 2000 Conference, Cochise Consortium, Wilcox, AZ. "Introduction to Technology--Data Probes." August, 1996.

Goals 2000 Conference, Cochise Consortium, Wilcox, AZ. "Introduction to Technology--Macintosh."

August, 1996.

Tempe School Board Meeting. “Report on Math Achievement Test Results: Scales Professional Development School 1995-1996 School Year.” June 5, 1996.

Project PRIME, University of Arizona, Tucson AZ. “Mathematics in Context.”

Madison Elementary School District, Phoenix AZ. "The NCTM Standards and mathematics teaching." September, 1995.

Annual Cooperating Peer Teacher Retreat for the Phoenix Urban Systemic Initiative. Lead in Planning and Conduct of Retreat. September, 1995.

Pleasant Valley School District, Scottsdale, AZ. "Mathematics your professor didn't want you to know about." August, 1995

Madison Elementary School District, Phoenix AZ. "Reform in elementary mathematics education." August, 1995.

Madison Elementary School District, Phoenix AZ. "Curriculum development in mathematics education." April, 1995.

Madison Elementary School District, Phoenix AZ. "Reform and mathematics education." April, 1995.

Phoenix Urban Systemic Initiative. Phoenix, AZ. "Countries (Probability and Statistics)." April 1995.

Phoenix Urban Systemic Initiative. Phoenix, AZ. "To Catch a Fish." March, 1995.

Phoenix Urban Systemic Initiative. Phoenix, AZ. "Countries (Probability and Statistics)." March, 1995.

Phoenix Urban Systemic Initiative. Phoenix, AZ. "Countries (Probability and Statistics)." February, 1995.

Phoenix Urban Systemic Initiative. Phoenix, AZ. "Flying Through Math." February, 1995.

Phoenix Urban Systemic Initiative. Phoenix, AZ. "Mathematics, Measurement, and Me." February, 1995.

Research Consultant, Project STREAM (Javits Grant # R 206A00188; Dr. Donna Rae Clasen, Director). Development of a culture fair talent identification model, research on gifted minority students' sense of competence and efficacy 1990-1994.

Scottsdale School District, Scottsdale, AZ. "The NCTM Standards and mathematics teaching." September, 1994

Ames Community Schools, 1993, Ames, IA. "Using SPSS for Windows in District Action Research."

Statistical consultant to Norman L. Webb, evaluation of the Woodrow Wilson Summer Institutes. 1989-1991.

"Students as Mathematicians." Six week enrichment course/research project designed to uncover students' metacognitive awareness of mathematics, Spring 1991. University of Wisconsin Extension.

Teach For America. Grant writing for Thomas S. Popkewitz. Prepared an $800,000 dollar grant proposal for the evaluation of the Teach For America project. Research planning and design, survey development, statistical consultation, and report writing. 1990-1992.

Teaching enriched mathematics to gifted minority students. Project STREAM. 1990.

Research and Creative Consultant to the Learning Cocoon, Inc., Chicago, Illinois. Development and testing of educational software and video applications for English as a Second Language. 1989-1990.

"Using Heuristics in Mathematics Teaching." Presented to the Satellite Educational Resources Consortium (STAR School Network), University of Wisconsin--Madison, November, 1990.

"Counter-intuitive Problems as Math Motivators." Presented to the Satellite Educational Resources Consortium (STAR School Network), University of Wisconsin--Madison, November, 1990.

"Using Heuristics to Engage Students in Learning Mathematics." Presented to mathematics teachers in the Staff Development Conference: Project STREAM, University of Wisconsin--Whitewater, April, 1990.

"The Magic of Math." Presented to minority gifted students, on Saturday enrichment day, project STREAM, University of Wisconsin--Whitewater, April, 1990.

Statistical consultant to the Middleton/Cross Plains Public School District, Middleton, Wisconsin. Evaluation of a public opinion survey regarding district performance, goals and policy. 1989.

DISSERTATIONS DIRECTED

Ferrell, M. J. (1995). How Three Instructors' Conceptions about Mathematics and Mathematics Teaching Relate to Their Instructional Practices. Arizona State University. Unpublished Doctoral Dissertation.

Smith, G. G. (1998). The Relationship Between Active Control and Spatial Unpublished Doctoral Dissertation

Koellner, K. A., (1998). Children's Multiplicative Schemes in the Operator Subconstruct of Rational Number. Arizona State University. Unpublished Doctoral Dissertation.

AWARDS AND HONORS

College of Education Award for Outstanding Achievement in Research, Arizona State University 1997.

TEACHING INTERESTS

Students' mathematical thinking. Research on Teaching Mathematics. Integrating research on teaching and learning. Motivation in mathematics education. Curriculum design and implementation.

RESEARCH INTERESTS

Development of an integrated model of cognition and motivation. Student's mathematical thinking. Teachers' conceptions of mathematics and mathematics education. Curriculum implementation and teacher support. Development of interactive technologies for enhancing mathematics education.

PERSONAL DATA

NAME -	Melvin E. Hall	
ADDRESS -	1663 N. Continental Drive Flagstaff, AZ 86004	
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EDUCATIONAL HISTORY

B.S.	Psychology - University of Illinois at Urbana/Champaign
M.S.	Guidance and Counseling - Northern Illinois University
Ph.D.	Educational Psychology (Measurement & Evaluation) University of Illinois at Urbana/Champaign

EMPLOYMENT HISTORY

1998 - Current	Northern Arizona University. Flagstaff Dean/Executive Director, Center for Excellence in Education
1994 - 1998	University of Maryland at College Park Dean, Continuing Education, Summer and Special Programs
1989 - 1994	University of California, Irvine Dean, University Extension
1984 - 1989	Florida Atlantic University Dean, Division of Continuing Education
1976 - 1984	Sangamon State University Associate Professor with tenure (1982) Director of Continuing Education and Off Campus Programs and Faculty Associate to the Vice President for Academic Affairs (1982 - 1984) Assistant Professor (1976) Assistant Dean for Academic Programs (1976 – 1979)
1973 - 1976	University of Illinois Staff Assistant, Office of the Vice Chancellor for Academic Affairs (1974 - 1976); Teaching Assistant/Field Placement Supervisor, Alternative Teacher Education Program (1973 - 1974)
1971 - 1973	Northern Illinois University - Counselor, C.H.A.N.C.E. Program
1970 - 1971	U.S. Department of Labor - Counselor, Neighborhood Youth Corps

PROFESSIONAL APPOINTMENTS AND CIVIC INVOLVEMENT

1991 - Current	Western Association of Schools and Colleges(WASC) Substantive Change Committee (1991 - 1994) Accreditation Team Member (one institution each year since 1991)
1991 - 1994	Member, Board of Directors - Irvine Temporary Housing
1991 - 1992	Member, Multi-Cultural Task Force

Cultural Affair Commission, City of Irvine

1987 - 1989	Chair, Committee on Minority Leadership Development CHEL Project - Kellogg Foundation funded project of NUCEA
1987 - 1989	Member, Prevention Resource Center Advisory Board Florida Department of Education
1985 - 1988	Member, Illinois State Board of Education Technical Review Committee on Student Outcomes Assessment
1984 - Current	University Continuing Education Association (UCEA) formerly know as National University Continuing Education Association (NUCEA) Chair, 1994 National Conference Program Committee Institutional Representative (since 1984) Vice Chair Task Force on Black Issues (1985 - 1989) Vice Chair Finance Committee (1986 - 1989) Treasurer, Region III (1987 - 1989) Vision & Values Task Force (1989) Secretary Region III (1989) Chair, Environmental Scanning Task Force (1990) Member, Board of Directors (1989 - 1992, 1993)
1984 - 1987	Palm Beach County (FL) Regional Coordinating Council
1980	Panel Member, Blue Ribbon Panel on Achievement Related Motivation, Illinois State Board of Education
1977 - 1983	Member, Research and Evaluation Advisory Council Illinois State Board of Education

TECHNICAL PAPERS

"An External Assessment of Project COMPAS"
FIPSE Grant supported evaluation project
"An External Assessment of the Disadvantaged and Minority Youth Prevention Program" - Illinois Department of Mental Health supported evaluation project
"Student Evaluation Practices in Selected Illinois School Districts"
Prepared under contract to the Illinois State Board of Education
"An External Assessment of the Nutrition Education Program"
Illinois State Board of Education funded evaluation project
Evaluation Report - Project City Science,
Submitted to the National Science Foundation by the Center for Instructional Research and Curriculum Evaluation (CIRCE)

DISSERTATION TOPIC

Issues in the Development of Formal Evaluation Systems for Higher Education

MEMBERSHIPS

American Educational Research Association
University Continuing Education Association

Patty J. Horn, Ed.D.
Associate Dean, Professional Development Programs
Center for Excellence in Education
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PART I: PROFESSIONAL BACKGROUND

Academic Preparation

1980	Arizona State University, Tempe, Arizona Elementary Education: Math and Science	Ed.D.
1971	Northern Arizona University, Flagstaff, Arizona Elementary Education: Science	M.A.
1966	University of Oklahoma, Norman, Oklahoma Elementary Education; Music	B.S.

Academic Experience

1998 to Present	Associate Dean, Professional Development Programs, Center for Excellence in Education, Northern Arizona University; Professor of Education
1986-1998	Dean, College of Education, Grand Canyon University; Professor of Education
1979-1986	Chairman, Department of Education and Psychology; Director of Teacher Education; Director of Education Placement (1983); Director for Field Services (1984); Professor of Education, Grand Canyon College
1977-1979	Director of Placement, Grand Canyon College
1975-1977	Classroom Teacher, Grades 4 and 5 at Bicentennial School, Glendale Elementary School District
1974-1976	Consultant, Science Curriculum Improvement Study, Arizona State University
1974-1976	Adjunct Instructor, Elementary Education (The Methods of Teaching the Curriculum of Math, Science and Social Studies), Grand Canyon College
Spring 1975	Acting math Coordinator, Interdistrict Continuous Uniform Evaluation System, Glendale Elementary School District

1974-1975	Classroom Teacher, 4th Grade at Glendale Unit #1, Glendale Elementary School District
Fall 1974	Science Portal Leader, Madison School District
1973-1974	Classroom Teacher, Open Structured Classroom (Grades 1-4), Avondale School #1, Avondale Elementary School District
1973-1974	Science Textbook Selection Chairman, Avondale School #1, Avondale Elementary School District
1972-1973	Classroom Teacher, 1st Grade, Avondale School #1, Avondale Elementary School District
Summer 1969/1972	Classroom Teacher, Lower Primary Summer School, Tolleson Elementary School District

PART II: HONORS AND AWARDS

1998	Distinguished Higher Education Administrator, Arizona Schools Administrators Association
1995	Plank Holder of the Arizona Alliance for Math, Science, and Technology Education, Arizona Alliance Tenth Anniversary Celebration
1993	Outstanding Contributor to Teacher Education in Arizona, The Arizona Association for Supervision and Curriculum Development
1990	Environmental Educator of the Year, Arizona Association for Learning In and About the Environment
1985	Distinguished Professor of the Year, Alumni Association of Grand Canyon College

PART III: SCHOLARLY PRODUCTIVITY

Publications:

Horn, P.J. (1992). Are you game? Science games in the classroom. Phoenix, AZ: Antelope Press.

Horn, P.J. (1990, June). Learning about energy. Phoenix, AZ: Arizona Public Service.

Horn, P.J. (1990). Sustainable development for a new world agenda. Proceedings of the world environment energy and economic conference. Winnipeg, Manitoba, Canada: A STAM/CASE/ICASE Publication.

Horn, P.J. (1989). Teacher empowerment begins with the College of education. Proceedings of the 3rd Annual Forum of the Association of Independent Liberal Arts Colleges for Teacher Education. Chicago: University of Chicago Press.

Additional Areas of Experience:

1998 to Present	Board of Directors, American Association of Colleges for Teacher Education (AACTE)

July 1996	Team Member, in collaboration with Cooperative Services International Education Consortium and the University of Tibet, Hong Kong, Guilin, Chengdu, China.
1996-1997	President, Arizona School Administrators, Phoenix, Arizona
March 1995	Team Member, in collaboration with Business and Educational Institutions and Cooperative Services International Education Consortium, Tunisia, Africa.
1994-1998	Representative to AACTE Combined Committee on Governmental Relations, Association of Independent Liberal Arts Colleges for Teacher Education.
July 1990	Team Member, in collaboration with Cooperative Services International Education Consortium and the University of Kazakhstan, Alma Alta, Kazakhstan, Soviet Union.
1986	President, Arizona Science Teachers Association.
1984	Created the first Master's Degree Programs at Grand Canyon College (M.A. and M.Ed.).
Since 1990	Sixteen National and International presentations on topics related to Professional Development Teacher Certification, Assessment, Environmental Education, and Science for the K-8 child.
Since 1982	Sixteen State Advisory Committees to the Arizona Board of Education on topics related to Special Education, Teacher Certification and Assessment, Science and Math Student Standards.

Julie A. Luft, Ph.D. (Wilson)
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Secondary Science Education
Teaching and Teacher Education
University of Arizona
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Vitae

Education

1991-1994	The University of Iowa, Iowa City, IA Ph.D. Science Education; supporting areas of Ecology and Statistics
1987-1990	New Mexico Institute of Mining and Technology, Socorro, NM M.S. Science Education, Ecology
1981-1985	University of New Mexico, Albuquerque, NM B.S.Ed., Life Sciences

Professional Experience

1994-present	Assistant Professor, Science Education The University of Arizona, Tucson, AZ Teaching: Secondary Science Methods, Environmental Education, Supervision of Science Student Teachers, Coordinator of Science Student Teaching, Advanced Science Methods, Student Teaching Seminar, Science Education Research, Biological Curriculum for Science Teachers, History and Philosophy of Science, Cognition and Science Education, Staff Development Research: Teacher education, multicultural science education, alternative assessment
1991-1994	Research Assistant, Teaching Assistant The University of Iowa, Iowa City, IA Teaching: Elementary Science Methods, Secondary Science Methods, Environmental Education, Student Teaching Supervisor and Coordinator Research: Inservice programs
1986-1991	Middle School and High School Science Teacher Jordan School District, Sandy, UT Department Head, Science Olympiad Coordinator, and Science Fair Coordinator. Recognized in '90 for outstanding science instruction.

Scholarship

Journal Articles

Luft, J.A. (in press). The Border Crossings of a multicultural science education enthusiast. *School Science and Mathematics*

Edwards, M., Luft, J., Potter, T., & Roehrig, G. (in press). Student-centered chemistry. *The Science Teacher*

Luft, J.A., Bragg, J., & Peters, C. (in press). Learning to teach in a diverse setting: A case study of a multicultural science education enthusiast. *Science Education*

Luft, J.A. (in press). Rubrics: Design and use in science teacher education. *Journal of Science Teacher Education*

Luft, J.A. (in press). Alternative follow-up experiences for science education **inservice** programs. *Staff and Educational Development International*

Luft, J.A. (1999). Challenging myths. *The Science Teacher, 66*(4), 40-43.

Luft, J.A., & Ebert-May, D. (1999). One state's self study of initial certification programs in science and mathematics. *School Science and Mathematics, 99*(3), 124-132.

Luft, J.A. (1999). Assessing science teachers as they implement inquiry lessons: The Extended Inquiry Observational Rubric. *Science Educator, 8*(1), 9-18.

Luft, J.A. (1999). Teachers' salient beliefs about a problem solving demonstration classroom **inservice** program. *Journal of Research in Science Teaching, 36*(2), 141-158.

Luft, J.A. (1998). Multicultural science education: An overview. *Journal of Science Teacher Education, 9*(2), 103-122.

Luft, J.A., & Pizzini, E.L. (1998). The demonstration classroom **inservice**: Changes in the classroom. *Science Education, 82*(2), 147-162.

Luft, J.A., Narro, M., & Slaughter, J. (1998). Science teachers and the Master's programs they select: A preliminary study [35 paragraphs]. *Electronic Journal of Science Education* [Online serial], 2(3). Available: http://unr.edu/homepage/jcannon/ejse/luftetal.html [March 20, 1998].

Luft, J.A. (1998). Alternatively assessing an **inservice** program. *School Science and Mathematics, 98*(1), 26-34.

Luft, J.A. (1997). Design your own rubric. *Science Scope*, 20(5), 25-27.

Luft, J.A., Bancroft, J., & Burketta, V. (1997). An illuminating view of math and science integration. *Science Scope,* 20(7), 18-21.

Pizzini E.L., Wilson, J.L., & Veronesi, C. (1995-1996). A study of the perceptions of demonstration teachers in Iowa relating to the development and implementation of problem solving demonstration classrooms. *Iowa Educational Leadership, 7*(1), 35-43.

Wilson, J.L., & Pizzini, E.L. (1995-1996). Considerations for the development of demonstration classrooms in Iowa. *Iowa Educational Leadership, 7*(1), 29-34.

Wilson, J.L., & Pizzini, E.L. (1994). A new perspective for science inservice: Problem solving demonstration classrooms. *Iowa Science Teachers Journal, 30*(3), 3-11.

Pizzini, E.L., & Wilson, J.L. (1992). Assessment in Iowa. *Science Scope*.

Chapters in Monographs

Luft, J.A. (in press). I do not understand. In T.R. Koballa & D.J. Tippins (Eds.), *The promises and dilemmas of teaching elementary science: A classroom case handbook*. Upper Saddle Ridge, NJ: Merrill/Prentice-Hall.

Quintenz, J.A., & Luft, J.A. (in press). While the animals sleep. In T.R. Koballa & D.J. Tippins (Eds.), *The promises and dilemmas of teaching middle and secondary science: A classroom case handbook*. Upper Saddle Ridge, NJ: Merrill/Prentice-Hall.

Wilson, J.L., & Pizzini, E.L. (1996). A paradigm for developing demonstration classrooms. In J. Rhoton & P. Bowers (Eds.), *Issues in Science Education* (pp. 214-220). Washington, DC: National Science Teachers Association.

Wilson, J.L., & Livingston, S. (1996). Process skill enhancement in the S/T/S classroom. In R.E. Yager (Ed.), *Science/Technology/Society as reform in science education* (pp. 59-69). New York, NY: SUNY Press.

Other Published Works

Luft, J.A. (1998). Surviving the first years: An exploration of support that **inservice** programs offer induction science teachers. In J.B. Robinson & R.E. Yager (Eds.), *Translating and using research for improving teacher education in science and mathematics: The final report of the Chautauqua ISTEP research project* (pp. 73-82). Washington, DC: Office of Educational Research and Improvement, U.S. Department of Education.

Luft, J.A., & Cox, W. (1998). *Final report: A report on preservice and mentoring programs in Arizona for mathematics and science teachers*. Phoenix, AZ: Arizona Board of Regents: Eisenhower Mathematics and Science Program.

Luft, J.A., & Cox, W. (1998). *Executive summary : A report on preservice and mentoring programs in Arizona for mathematics and science teachers.* Phoenix, AZ: Arizona Board of Regents: Eisenhower Mathematics and Science Program.

Luft, J.A., da Cunha, T., & Allison, A. (1998). Multicultural science education enthusiasts: Lessons from the field. In *Proceedings of the 1997-98 Dean's Forum* (pp. 55-57). Tucson, AZ: The University of Arizona.

Luft, J.A., Ebert-May, D., Eslamieh, C., & Buss, R. (1997). *A report of initial certification in science and mathematics at Arizona **Regents' Universities***. Phoenix, AZ: Arizona Board of Regents. (ERIC Document Reproduction Service No. ED 411 224)

Luft, J.A., Ebert-May, D., Eslamieh, C., & Buss, R. (1997). *Analysis to Action: A report of initial certification in science and mathematics at Arizona **Regents' Universities***. Phoenix, AZ: Arizona Board of Regents.

Wilson, J.L. (1996). Combining demonstration classrooms and inservice for teachers. In P. Rubba, P. Keig, & J. Rye (Eds.), *Proceedings of the 1996 Annual International Conference of the Association of Educators in the Teaching of Science* (pp. 130-144). Pensacola, FL: Association for the Education of Teachers in Science. (ERIC Document Reproduction Service No. ED 398 060).

In-review

Narro, M., Slaughter, J., & Luft, J.A. Beliefs of teachers involved in a content-based Master's program. *Science Education*

Luft, J.A. Changing inquiry practice and beliefs? The impact of a one-year inquiry-based professional development program on the beliefs and practices of secondary science teachers. (revised and resubmited) *International Journal of Science Education*

Luft, J.A., & Patterson, N. The case for a secondary science induction program. *Journal of Science Teacher Education*

In-progress

Luft, J.A., & da Cunha, T. Teaching in a diverse setting: An examination of two science teachers who impact the persistence and participation of minority students in science

Luft, J.A. The importance of investing in the future: An comparison of two groups of induction science teachers who received different forms of support

Ebert-May, D., & Luft, J.A. Rethinking undergraduate faculty development

Scholarly Presentations

International/National Presentations

Luft, J. (in review). Bridging the gap: Supporting secondary science teachers during their induction years. Association for the Education of Teachers in Science.

Luft, J. (in review). Utilizing a participant-centered evaluation plan in an extended-inquiry **inservice** program. Association for the Education of Teachers in Science.

Cox, W., & Luft, J.A. (March, 1999). An examination of preservice and mentoring programs in Arizona for mathematics and science teachers. National Association for Research in Science Teaching, Boston, MA.

Ebert-May, D., & Luft, J.A. (March, 1999). How faculty change their teaching: Community College biology instructors engage in long-term professional development. National Association for Research in Science Teaching, Boston, MA.

Beller, C., DiBiase, W., Hueni, J., James., R., Luft, J., & Nason, P. (January, 1999). Using rubrics and performance assessment in science teacher education. Association for the Education of Teachers in Science, Austin, TX.

Potter, T., Amaro, W., Edwards, M., Roehrig, G., & Luft, J. (December, 1998). A model of inquiry instruction for the chemistry classroom. National Science Teachers Association, Albuquerque, NM.

da Cunha, T., Allison, A., & Luft, J.A. (April, 1998). Multicultural science education enthusiasts: A cross case comparison. National Association for Research in Science Teaching, San Diego, CA.

Luft, J.A., & Ebert-May, D. (April, 1998). **Preservice** mathematics and science education in Arizona. National Association for Research in Science Teaching. San Diego, CA.

Luft, J.A. (April, 1998). Extended inquiry for science teachers: An inservice program. American Educational Research Association, San Diego, CA. (ERIC Document Reproduction Service No. ED 421 336).

Luft, J.A. (January, 1998). Rubrics: Design and use in science education. Association for the Education of Teachers in Science, Minneapolis, MN. (ERIC Document Reproduction Service No. ED 417 145)

Luft, J.A. (March, 1997). Learning to teach in a diverse setting: The case of the multicultural science education enthusiast. National Association of Research in Science Teaching, Chicago, IL. (ERIC Document Reproduction Service No. ED 417 143)

Narro, M., Luft, J.A., & Slaughter, J. (March, 1997). Science teachers and the Master's programs they select: A preliminary study. National Association of Research in Science Teaching, Chicago, IL.

Wilson, J.L. (April, 1996). The effects of a problem solving demonstration classroom on elementary teachers behaviors. National Association of Research in Science Teaching, St. Louis, MO.

Wilson, J.L. (January, 1996). The problem solving demonstration classroom: Preliminary findings. Association for the Education of Teachers in Science, Seattle, WA.

Wilson, J.L. (October, 1995). The use of case in science teaching. National Association of Biology Teachers, Phoenix, AZ.

Wilson, J.L. (October, 1995). Multicultural science education. National Association of Biology Teachers, Phoenix, AZ.

Wilson, J.L. (March, 1995). Salient beliefs about a problem solving demonstration classroom. National Association of Research in Science Teaching, San Francisco, CA.

Wilson, J.L. (March, 1994). The role of the demonstration classroom in a problem solving inservice. National Association for Research in Science Teaching, Anaheim, CA.

Wilson, J.L. (July, 1993). Problem solving demonstration classrooms in Iowa. International Science Teachers Conference, Oaxtepec, Mexico.

Wilson, J.L. (July, 1993). Problem solving in the classroom. International Science Teachers Conference, Oaxtepec, Mexico.

Wilson, J.L., & Huber, R. (December, 1992). Problem solving in the classroom. National Science Teachers Association, Charlotte, NC.

Local Presentations

Luft, J.A, & Potter, T. (accepted). Rethinking science education. Dean's Forum for the Advancement of Knowledge and Practice in Education. University of Arizona, Tucson, AZ.

Luft, J.A., & Cox. W. (October, 1998). Directions for change: Meeting the needs of new mathematics and science teachers. Arizona Institute for Mathematics and Science Education Research Conference, Tucson, AZ.

Luft, J.A., da Cunha, T. & Allison, A. (January, 1998). Multicultural Science Education. Dean's Forum for the Advancement of Knowledge and Practice in Education. University of Arizona, Tucson, AZ.

Luft, J.A.(October, 1997). Border crossings: Learning to teach in diverse settings. Arizona K-16 Science/Mathematics Teacher Reforms Conference, Phoenix, AZ. (ERIC Document Reproduction Service No. ED 417 144)

Luft, J.A., & Carlson, M. (October, 1997). Action research for the science or mathematics teacher: A teacher workshop. Arizona K-16 Science/Mathematics Teacher Reforms Conference, Phoenix, AZ.

Luft, J.A., Lebowitz, S., & Edwards, M. (February, 1997). Using vee-maps in the science classroom. Math and Science Conference, Tucson, AZ.

Wilson, J.L. (February, 1996). Using concept maps and rubrics in the science classroom: A teacher workshop. Tucson Unified School District; Problem Solving Inservice Program, Tucson, AZ.

Wilson, J.L. (February, 1996). Issues in science education. Math and Science Conference, Tucson, AZ.

Wilson, J.L. (October, 1995). Alternative assessment in the science classroom. Arizona Science Teachers Association, Phoenix, AZ.

Kornmuller, D., Voyles, T., Roehrig, G., & Wilson, J.L. (October, 1995). Problem solving and technology. Arizona Science Teachers Association, Phoenix, AZ.

Wilson, J.L., & Berkey, S.D. (February, 1995). Problem solving in the environment: A teacher workshop. Science and Mathematics Conference, Tucson, AZ.

Wilson, J.L. (October, 1994). Problem solving in the classroom. Arizona Science Teachers Convention, Phoenix, AZ.

Grants and Contracts

National

Sustainability of Water Resources in Semi-Arid Regions: A Science and Technology Center proposal. co-P.I. (in review, site visit by NSF February, 1999). Funding requested by National Science Foundation, $14.5 million.

State

Project: Alternatives for Supporting Induction Science Teachers (ASIST) II. P.I. funded by the Arizona Board of Regents: Eisenhower Mathematics and Science Program for $49,900 (January, 1999 - May, 2000).

Project: Alternatives for Supporting Induction Science Teachers (ASIST) I. co-P.I. with Horak, funded by the Arizona Board of Regents: Eisenhower Mathematics and Science Program for $49,500 (January, 1998 - May, 1999).

Status of Mathematics and Science Induction Teachers in Arizona. P.I. funded by the Arizona Board of Regents: Eisenhower Mathematics and Science Program for $28,000 (January, 1998 - May, 1999).

Arizona K-16 Science and Mathematics Teaching Reforms Conference. co-P.I. with Wyckoff (ASU), Buss (ASU West), and Ebert-May (NAU). Funded by the Arizona Board of Regents: Eisenhower Mathematics and Science Program for three years at $66,000 (October, 1997 - October, 2000).

Project: Problem Solving Demonstration Classrooms in Biology. P.I. funded by the Arizona Board of Regents: Eisenhower Mathematics and Science Program for $45,000 (January, 1997-December, 1997).

Status of Initial Certification of Mathematics and Science Education at Arizona **Regents' Universities**. P.I. funded by the Arizona Board of Regents: Eisenhower Mathematics and Science Program for $15,000 (May, 1996-August, 1996).

Project: Science/Technology and the Reforms in Teaching (START) - Part 1. P.I. funded by the Arizona Board of Regents: Eisenhower Mathematics and Science Program for $49,000 (February, 1995- May, 1996).

University

Supporting induction science teachers. Funded by the University of Arizona, at $5,000.

Inquiry-based demonstration classroom research project. Funded by the College of Education at $5,000.

Exemplary science education instruction: Teachers who increase the participation and persistence of students who are not represented in science. Funded by the College of Education at $2,200.

Project: Science Education and Technology (SET). Funded by the Center for Computing and Instructional Technology, $7,400 (April, 1996- May, 1997)

Case study of a multicultural science education enthusiast & science education cases. Funded by the College of Education at $2,200.

Service

Department / College

Academic Programs Committee representative (9/97-5/98).
Advisor for Science Education / Environmental Education Programs (9/94-current)
Course development: Advanced Science Methods (‘94) & Topics in Teacher Education (‘97)
Development of Master’s of Arts exit options (‘95)
Director of the Science Education Masters and Certification Program (9/98-current)
Graduate Committee member (9/94-5/96)
Initial Teacher Preparation (ITP) Committee member (5/96-current)
Master’s Committees (30)
Ph.D. Committees (8)
Post-doctoral Students (1) (10/99-10/01)
Program development: Master’s of Arts in Science Education (‘95) &
Master’s in Education: Science Education and Certification (‘98)
Reviewer of ITP folders, MA exams, and MA admission folders (9/94-current)
Technology Committee (9/94-5/95)

University

Advisor to the University of Arizona Bicycling Team (9/95-current)
Advisor to the University Triathlon Team (9/96-5/98)
Arizona Women’s Faculty treasurer (5/99-current)
Flandrau Science Center and Planetarium - Science Education Contact (9/94-5/96)
Flynn Mentor (9/96-5/97)
Master’s of Biology for Teachers’ Advisory Committee (9/94-5/97)
Preservice Awards Committee for Science and Mathematics, Chair (9/96-current)
SAMEC (Science and Mathematics Education Center)
Active member and contributor (9/94-current)
Admissions Requests Committee (9/94-5/96)
Preservice Math and Science Initiative Committee (9/94-5/96)
Advisory Committee to the Teacher Preparation Grant (9/94-5/96)

Local

University contact for the Tucson Resource Center for Environmental Education
(TREE Center) and local environmental educators (9/94-9/97)
Science education out-reach to local districts - seminars, site-based science education, and
classroom visitations: Tucson Unified SD, Amphitheater SD, Sunnyside SD,
Marana SD, and Catalina Foothills SD (9/94-current)
State Science Olympiad judge (5/95, 5/96)

State and Regional

Arizona Board of **Regents’**Eisenhower Advisory Committee (9/94-current)
Arizona Board of **Regents’**- Eisenhower Math and Science Competition -
assessment guidelines development (9/95-5/96)

Arizona Science/Mathematics Teaching Reforms conference, co-coordinator (9/97-current)
Arizona Teaching and Certification Committee (9/94-5/95)
Arizona Teacher Proficiency Assessment Committee, Biology Review Team (9/98-5/99)
Arizona Science, Curriculum, Instruction, and Assessment Committee (9/94-5/95)
Arizona Science Standards Development Committee (9/94-5/95)
Department of Education: Science Standards Development (9/97-5/98)
Environmental Education sub-committee and state contact (9/94-5/95)
Project: Arizona Collaborative for Excellence in the Preparation of Teachers (ACCEPT) - University of Arizona representative (9/96-current)
Science and Technology Consultant to Cooperative Education Services (9/94-current)

National/International

Department of Education project: Chautauqua for Science Teacher Educators - University of Arizona Team Leader (5/97-9/98)
Chapter consultant for the book Models for science teacher preparation: Bridging the gap between research and practice (1/99-7/99)
Judge for the International Science and Engineering Fair (5/96)
Long Term Ecological Research (LTER) education committee workshop facilitator (10/98)
Middle East Environmental Education Forum Host (7/96)
National Association for Research in Science Teaching: New NARST Committee (94-95)
National Science, Mathematics, Engineering, and Technology Center Conference, co-facilitator (12/98)
National Science Foundation, Linkages Project -- Geosciences and Education (5/98- 12/98)
Reviewer for The American Biology Teacher (9/94-current)
Guest reviewer for The Journal of Teacher Education (9/94-5/96)
Guest reviewer for Elementary School Journal (9/94-5/95)
Reviewer for Electronic Journal of Science Education (9/97 -current)
Editorial board member for the Journal of Science Teacher Education (1/98-current)
Editorial board member for the Journal of Research in Science Teaching (11/98-current)
NARST Publications Advisory Committee (4/99-present)
Reviewer of NARST conference proposals (9/97)
Reviewer of AETS proposals (9/98)

Awards

Nominated for Outstanding Teaching and Service in the College of Education, 1999
Nominated for the Millman Promising Scholar Award, 1999
Nominated for Outstanding Research and Mentoring in the College of Education, 1998
Nominated for Outstanding Service in the College of Education, 1997
ACT Travel Award, The University of Iowa, 1992
Mc Bride Scholarship for Natural Study, Biology Department, The University of Iowa, 1992
“Outstanding teacher” recognition, Utah Middle Level Association, 1990
School Science Award, National Semiconductor, 1989, 1990
New Mexico Scholarship for Graduate Study, 1987, 1989, 1990

Professional Memberships

American Educational Research Association
Arizona Science Teachers Association
Association for the Education of Teachers in Science
Association for Supervision and Curriculum Development
National Association for Research in Science Teaching
National Association of Biology Teachers
National Science Teachers Association
Phi Delta Kappa

Dale Scott Ridley

July 4th, 1999

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Arizona State University:
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Phoenix, AZ 85069-7100
602-543-6346 FAX 543-6350

EMPLOYMENT

Jan. 1999-present	Associate Professor & Coordinator of the Longview Professional Development School	College of Education Arizona State University West
Jan. 1995- Aug. 1998	Assistant Professor & Coordinator of the Professional Core	College of Education Arizona State University West
Aug. 1991-Jan. 1995	Assistant Professor	College of Education Arizona State University West
Aug. 1990-May 1991	Instructor	College of Education Arizona State University West
Jan. 1990-May 1990	Instructor	Dept. of Psychology The University of Texas at San Antonio
Sept. 1987-May 1990	Program Evaluation Consultant	School of Nursing The University of Texas at Austin
Sept. 1985-May 1989 & Instructor	Assistant Coordinator	Dept. of Educational Psychology The University of Texas at Austin

EDUCATION

1990	The University of Texas at Austin	Ph.D. Educational Psychology
1988	The University of Texas at Austin	Masters Educational Psychology Emphasis: Program Evaluation
1978	New Mexico State University	Bachelors Economics

PUBLICATIONS

Books

Ridley, D.S. & Walther, B. (1995). Creating responsible learners: The role of a positive classroom environment. Psychology in the classroom: A mini-series on applied educational psychology. (B.L. McCombs & S. McNelly, Series Eds.), Washington, DC: American Psychological Association. (Walther and I conceptualized and outlined the text. I wrote the manuscript while Walther critiqued the drafts. I revised the manuscript to final form.)

Refereed Journal Articles

Ridley, D.S., McCombs, B.L., & Taylor, K.D. (1994). Walking the talk: Fostering self-regulated learning in the classroom. The Middle School Journal, 26(2), 50-55. (I conceptualized the paper and wrote the original draft. A draft was given to McCombs and Taylor who made additions. Taylor and I revised the manuscript to final form.)

Ridley, D.S., Schutz, P.A., Glanz, R.S., & Weinstein, C.E. (1992). Self-regulated learning: The interactive influence of metacognitive awareness and goal-setting. Journal of Experimental Education, 60(4), 293-306. (I conceptualized the study. Schutz and Glanz helped me to collect the data. I analyzed the data with the input of Schutz. I wrote the manuscript and my colleagues critiqued the drafts. I revised the manuscript with their suggestions to create the final version.)

Ridley, D.S. (1991). Reflective self awareness: A basic motivational process. Journal of Experimental Education, 60(1), 31-48.

Weinstein, C.E., Ridley, D.S., Dahl, T., & Weber, E.S. (1989). Helping students develop strategies for effective learning. Educational Leadership, 46(4), 17-19. (Weinstein, Dahl, and I

conceptualized the paper. I wrote the manuscript with the help of Dahl. Weinstein and Weber critiqued the draft of the manuscript. Weinstein and I created the final version.)

Schutz, P.A., Ridley, D.S., Glanz, R.S., & Weinstein, C.E. (1989). Goal-setting and goal-using: Developing personal meaning to enhance the use of learning strategies. Innovation Abstracts, 11(11). (Schutz, Glanz, and I conceptualized and wrote the draft. Weinstein critiqued the draft. Schutz and I created the final version.)

Weinstein, C.E., Johnson, K., Malloch, B., Ridley, D.S., & Schutz, P.A. (1988). The high school to College transition. Innovation Abstracts, 10(21). (This was a collaborative paper written as part of the creation of a summer course for new College students. My role was to contribute to the conceptualization and outlining of the paper. I edited the manuscript written by Johnson and Malloch.)

Manuscripts in Progress

Ridley, D.S., Knutson Miller, K., & Carlile, B.J. Examining the Effectiveness of Reflective Inquiry Oriented Educational Psychology Courses Delivered in Urban Professional Development Schools: Are They Really Better Than a Campus-Based Course?

In the first of a longitudinal series, this study compared the early achievement of preservice teachers at two urban PDS sites versus at a traditional campus program.

Ridley, D.S., Cardelle-Elawar, M. A motivationally-based explanation for parent involvement in their children's education.

The path analysis in this large study (N=454) suggests that student motivation and parents' perspective of whether the school is learning-oriented (instead of performance-oriented) and parents' rating of teachers' effectiveness impact their involvement in their children's education. Using an analysis of variance, strong grade level differences in these variables were also found with declining student motivation, parent perception of learning-oriented school culture, parent ratings of teacher effectiveness, and parent involvement as grade level increased. The manuscript will suggest key implications for schools in terms of their goal orientation and their method of communicating with parents. The findings are particularly important for middle and secondary schools.

ACADEMIC AWARDS

1993-1994 ASU West Award of Achievement in Research, Scholarship, and Creative Activity

PRESENTATIONS

Referred Presentations

Ridley, D.S., Knutson-Miller, K., & Carlile, B.J. (April, 1999). Examining the effectiveness of reflective inquiry oriented educational psychology courses delivered in urban

professional development schools: Are they really better than a campus-based course? Paper presented at the annual meeting of the American Educational Research Association, Montreal, Canada.

Ridley, D.S. (July, 1997). Exchange for effective learning (ExCEL): A collaborative change facilitation venture for urban teachers, service providers, and parents. Paper to be presented at the China-U.S. Conference on Education, Beijing, Peoples' Republic of China.

Cardelle-Elawar, M., & Ridley, D.S., (July, 1997). Parents as partners with teachers to improve students' motivation to learn. Paper to be presented at the China-U.S. Conference on Education, Beijing, Peoples' Republic of China.

Ridley, D.S., Cardelle-Elawar, M., & Buss, R., & Robbins, S. (March, 1997). A motivationally-based explanation for parent involvement in their children's education. Paper to be presented at the annual meeting of the American Educational Research Association, Chicago, Ill.

Ridley, D.S., Cardelle-Elawar, M., & Buss, R., & Robbins, S. (October, 1996). Parents as partners in their children's' motivation to learn. Paper presented at the annual meeting of the Arizona Educational Research Organization, Phoenix, AZ.

Ridley, D.S. (1995, April). Teachers' beliefs about learners and learning Paper presented at the annual meeting of the American Educational Research Association, San Francisco, CA.

Ridley, D.S. (1994, August). Teachers' self-reported beliefs about learners and learning: walking their talk? Paper presented at the annual meeting of the American Psychological Association, Los Angeles, CA.

Ridley, D.S. (1994, February). Learner-centered principles as standards for the design of teacher education. Paper presented at the annual meeting of the American Association of Colleges of Teacher Education, Chicago, Ill.

Referred Presentations Continued

Ridley, D.S., & Taylor, K.D. (1993, April). The reciprocal nature of teacher and student self-regulation and motivational orientation in the classroom. Paper presented at the annual meeting of the American Educational Research Association, Atlanta, GA.

Ridley, D.S. (1992, November). The development of the Teacher's Psychological Assumptions Scale (TPAS) Paper presented at the annual meeting of the Arizona Educational Research Organization, Phoenix, AZ.

Ridley, D.S. (1992, April). What do theories of self-regulated learning have to offer teachers? Paper presented at the annual meeting of the American Educational Research Association, San Francisco, CA.

Ridley, D.S. (1991, October). Self-regulated learning: toward an integration of theory and practice. Paper presented at the annual meeting of the Arizona Educational Research Association, Flagstaff, AZ.

Ridley, D.S. (1991, April). Reflective self awareness: a basic motivational process. Paper presented at the annual meeting of the American Educational Research Association, Chicago, Illinois.

Ridley, D.S. (1990, January). The development of a model of purposeful self-regulation. Paper presented at the annual meeting of the Southwest Educational Research Association, Austin, Texas.

Ridley, D.S., Schutz, P.A., Glanz, R.S., Weinstein, C.E. (1989, June). Self-regulated learning: The interactive influence of metacognitive awareness and goal-setting. Paper presented at the annual meeting of the American Psychological Society, Washington, D.C.

Schutz, P.A., Ridley, D.S., Glanz, R.S., Weinstein, C.E. (1989, March). The development of a self-regulation scale: The conceptualization and measurement of a process model of academic self-regulation. Paper presented at the annual meeting of the American Psychological Society, Washington, D.C.

Ridley, D.S., Glanz, R.S., & Schutz, P.A. (1989, January). The interactive influence of metacognitive awareness and goal-setting. Paper presented at the annual meeting of the Southwest Educational Research Association, Houston, Texas.

Schutz, P.A., Ridley, D.S., Glanz, R.S., & Weinstein, C.E. (1989, January). The construction of a self-regulation scale for learning. Paper presented at the annual meeting of the Southwest Educational Research Association, Houston, Texas.

Schutz, P.A., Ridley, D.S., & Weinstein, C.E. (1988, October). Components of autonomous learning: A conceptual framework for learning skills courses. Paper presented at the annual meeting of the Texas Association of Developmental Education, El Paso, Texas.

Ridley, D.S., Mason, E., Boverie, P., & Grubb, P. (1988, March). An examination of the relationship between cognitive development and ego identity development. Paper presented at the annual meeting of the Southwest Psychological Association, Tulsa, Oklahoma.

Ridley, D.S. & Schutz, P.A. (1988, January). Does metacognitive awareness imply the existence of explicit goals for learning? Paper presented at the annual meeting of the Southwest Educational Research Association, San Antonio, Texas.

Invited Presentations

Ridley, D.S. (1995, October). How can parents and teachers help make students more responsible learners? Presented at Arrowhead Elementary School, Phoenix, AZ.

Ridley, D.S. (1995, August). Motivating College students Presented at the Paradise Valley Community College Fall Faculty Retreat, Phoenix, AZ.

Ridley, D.S. (1994, September). Fostering self-regulation in the homeless: theory and practice from the field of education Paper presented at the "Homelessness: Current Issues, Practices, and Research" Conference, Phoenix, AZ.

Ridley, D.S. (1992, June). The role of teacher self-regulation and motivational orientation in effective teaching and student learning. Paper presented at the annual meeting of the Impact Conference on Assessment and the Teaching of Thinking, Tucson, AZ.

UNPUBLISHED MANUSCRIPTS

Ridley, D.S. (1990). Reflective intentionality: The development of a model of purposeful self-regulation. Unpublished doctoral dissertation, The University of Texas at Austin.

Ridley, D.S., Mason, E., & Boverie, P. (1989). An examination of the relationship between cognitive development and ego identity development.

RESEARCH & INSTRUCTIONAL SUPPORT GRANTS

1991	ASU West Summer Research Grant "Self-regulated learning: Towards an integration of theory and practice." Scott Ridley - Principal Investigator	$ 3,850
1992	ASU West Summer Research Grant ASU FGIA Grant "A study of the interactive nature of of self-regulated learning." Scott Ridley - Principal Investigator	$ 18,613 $ 5,168
1995	ASU West Instructional Support Grant "The development of an institute for teacher renewal and growth in the	$ 8,000

ASU West College of Education."
Scott Ridley - Principal Investigator

COURSES TAUGHT

-Professional Development, Learning and Motivation in Education
-Essentials of Classroom Learning
-Classroom Assessment in Education
-Psychology of Thought
-Individual Learning Strategies
SERVICE

Schools/Educational Community

Coordinator of the Longview Professional Development School since January, 1999

• Helped to created and implement an urban, fully site-based teacher preparation program. Served as a professional development and assessment resource for Longview Elementary School.

Member of the Osborn School District Executive Council 1996-1999

• Higher education representative on the district's executive council which is responsible for making strategic policy recommendations to the governing board.

Chair of the ExCEL Urban Collaborative Staff Development Initiative 1995-1998

• Lead a large team in the development and beginning implementation of the ExCEL initiative (Exchange for Effective Learning). ExCEL is a multi-institutional professional development collaborative that combines and reciprocally shares staff development resources. ExCEL is supported by a $78,000 multi-year grant from the Ford Foundation. Achieved the following while Chair of ExCEL:

- Conducted numerous teacher professional development dialogue forums and best practices symposia.
- Created and implemented several competitive grant programs for urban schools and teachers.
- Created and implemented a best practices demonstration site program in the urban school community.
- Created and implemented teacher action research training and support programs.
- Formed three urban Professional Development Schools.
- Created an ExCEL Website.

Member of the Phoenix Think Tank 1994 -1998

• Participated in subcommittees developing the framework leading up to the three Think Tank initiatives: Connectivity, Family Resource Centers, and ExCEL.

Resource Specialist for the Agua Fria Union High School District 1991-1996

• Helped to guide and focus AFHS's School Improvement Plan. Gathered, analyzed, and reported data for purposes of assessing progress toward their NCA accreditation goals.

Volunteer Mentor for Carl Hayden High School Students 1995-1996

• As part of the Phoenix Drop-Out Coalition, met one day every other week with freshman minority students at Carl Hayden High School to discuss strategies for surviving high school. Planned and implemented field trips for high school students to Glendale Community College and ASU West.

School Evaluator for the Arizona North Central Association (NCA) 1992-1995

• Worked with the Arizona NCA, as a team member in the assessment of Arizona schools.

Resource Specialist for Amphitheater District Career Ladder Program 1991-1993

• Helped to develop evaluation criteria to measure the degree to which teachers foster students' self-regulated (i.e., independent) learning.

• Worked with site-based staff developers to help teachers at a newly opened middle school (i.e., La Cima) to create curriculum and school policy that fostered the development of independent learners.

College of Education

Member of the Dean Search Committee 1999-2000

• Participant in the search for a new Dean for the College of Education

Coordinator for the "Block Buddy" Student Mentoring Program 1993-1999

• Helped to create and implement a mentoring program for ASU West Education students. Mentored students, conducted a number of student information/support events, collected, and analyzed program evaluation information on the Block Buddy program.

Coordinator of the Professional Core 1995-1998

• Found, schedules, and oversaw (on average) 23 Faculty Associates in Professional Core courses per semester.

• Wrote a FIPSE grant in 1995-1996 for the development of an Institute for Teacher Renewal and Growth. Co-developed a summer course with a public school teacher, oversaw the development of two other co-developed summer courses.

• Helped to revise the Common Ground Agreements, approved in December of 1993, to allow programs to cope with ABOR program hour restrictions and changes in state certification standards.

• Worked with other program coordinators to propose and/or make curriculum changes.

• Ongoing coordination of common & specialized core courses:
-changed the human development course from a life-span to an age-appropriate instructional methods focus.
-increased the assessment and technology courses from 1 to 2hr experiences.
-increased within semester articulation and consistency of content across multi-section courses.
-created and delivered team-taught courses.

Chair of the Search Committee for the Classroom Organization & Management Position 1996-1997

• Hired an Assistant Professor in the Classroom Organization & Management area of the Professional Core.

Chair of the Search Committee for the Schools in Society Position 1995-1996

• Hired an Assistant Professor in the Philosophy/Sociology of Education area of the Professional Core.

Member of the Dean Search Committee 1993-1994

• Participated in a successful search for a new Dean for the College of Education.

Member of the Core Course Writing Team 1993-1994

• Helped to develop and present to College of Education Faculty an in-depth syllabus for a proposed integrated common core course.

Member of Student Affairs Committee 1991-1993

• Helped to make decisions on student admission policy as well as retention issues.

Member of the Common Ground Curriculum Development Committee Fall 1993

• Worked with the committee to develop a set of guiding principles and procedures for the development of curriculum in the College of Education.

Chair of the Professional Studies Curriculum Development Committee 1992-1993

• Developed white papers for each discipline in the Professional Core and proposed a new curriculum in the common and specialized core areas.

Member of the Curriculum Planning Committee 1991-1992
• Helped prepare white paper suggesting a process for the College of Education to follow for curriculum development and helped to create a set of ASU West Education Program Goals.

Campus

Member of the Task Force on Student Advising: Fall 1996

Faculty Senator for College of Education 1993-1995

Member of the Teaching Excellence Committee 1991-1993

Professional

Reviewer for Urban Education 1995-1996
• Reviewed selected articles relating to ethnicity and motivation to learn issues.

Member of the American Psychological Association (Division 15) Learner-Centered Principles Committee 1991-1995.
• Contributed to the creation of the Learner-Centered Principles document published by APA in 1993. Participated in several conference presentations to disseminate learner-centered concepts and methods into educational research and teacher education circles.

PROFESSIONAL ORGANIZATIONS

-American Psychological Association - joined 1986
-American Educational Research Association - joined 1987
-Arizona Educational Research Association - joined 1990

CURRICULUM VITAE: SUSAN WYCKOFF

EDUCATION

Ph. D. 1967 Case Western Reserve University, Astronomy
B.A. 1962 Mount Holyoke College, Physics/Astronomy

PROFESSIONAL EXPERIENCE

1991-94 -Chair, Department of Physics and Astronomy, Arizona State University
1982- -Professor, Arizona State University
1979-82 -Associate Professor, Arizona State University
1978-79 -Visiting Professor, Ohio State University
1975-78 -Principal Research Fellow, Royal Greenwich Observatory, Sussex, U.K.
1972-75 -Senior Lecturer, Department of Physics and Astronomy, Tel-Aviv University, Tel-Aviv, Israel
1970-72 -Research Associate, Department of Physics and Astronomy, University of Kansas
1968-70 -Assistant Professor, Department of Physics, Albion College
1967-68 -Post-Doctoral Fellow, University of Michigan

VISITING POSITIONS

- Visiting Scientist, Mount Stromlo and Siding Spring Observatories, Australian Natl University.
- Visiting Scientist, Royal Greenwich Observatory, Sussex, U.K.
- Visiting Professor, Institute of Theoretical Astrophysics, Univ of Heidelberg, Germany.
- Visiting Professor, University of Sussex, U.K.
- Visiting Professor, Department of Physics and Astronomy, Tel-Aviv Univ, Tel-Aviv

MAJOR PROJECTS DIRECTED

1994- - Project Director/Principal Investigator, Arizona Collaborative for Excellence in the Preparation of Teachers (ACEPT)
1982-90 -Co-Director/Principal Investigator, International Halley Watch, Center for Spectroscopy

PUBLICATIONS AND THESIS SUPERVISION

Author or Co-Author of over 115 refereed journal articles

Author or Co-Author of 6 Chapters in Edited Volumes
Author or Co-Author of two books
Ph.D., M.S. Thesis Chair--10 students

CURRICULUM VITAE: SUSAN WYCKOFF *(continued)*

HONORS & AWARDS

- *ASU Graduate College Outstanding Faculty Research Award*
- *Phoenix Woman of Achievement Award,* Phoenix Junior League, Mujer and Soroptomists International,
- *ASU Faculty Distinguished Achievement Award* , College of Liberal Arts & Sciences
- *ASU Alumni Association Faculty Achievement Award*

CURRENT GRANT SUPPORT

- *Chemical Constraints On the Early Solar Nebula: Molecular Isotopic Abundances in Clouds* 1997-, NASA
- *Search for Extra-Solar Planets*, 1997-, NASA
- *Arizona Collaborative for Excellence in the Preparation of Teachers*, 1994-, NSF

REPRESENTATIVE BIBLIOGRAPHY LAST TEN YEARS

Carbon Isotope Abundances in Comet Halley, 1989 S. Wyckoff, E. Lindholm, P. Wehinger, B. Peterson, J. Zucconi and M. Festou, Astrophys. J., 339**,** 488.

Nitrogen Abundance in Comet Halley, 1990, S. Wyckoff, S. Tegler and L. Engel, Astrophys. J., 367, 641.

Comets: Clues to the Early History of the Solar System, 1991, S. Wyckoff, Earth Science Reviews, 30, 125.

Cometary Constraints on the Planet Forming Environment, 1991, S. Wyckoff, Advances in Space Research, 12,13.

A Survey of N_2H^+ in Dense Molecular Clouds: Implications for Interstellar Nitrogen and Ion- Molecule Chemistry , 1992, M. Womack, L. Ziurys, S. Wyckoff, Astrophys. J., 387, 417.

Observational Constraints on Solar Nebula Nitrogen Chemistry: N_2/NH_2, 1992, M. Womack, S. Wyckoff, L. Ziurys, Astrophys J., 395, 204.

Carbon Isotope Abundances in Comets: Model, 1994, M. Kleine, S. Wyckoff, P. Wehinger, B. Peterson, Astrophys. J., 436, 885.

The Carbon Isotope Abundance Ratio in Comet Halley, 1995, M. Kleine, S. Wyckoff, P. Wehinger, B. Peterson, Astrophys. J., 439, 1021.

Unidentified Molecular Bands in Plasma Tail Spectra of Comets, 1999, S. Wyckoff, R. Heyd, R. Fox, Ap.J. Letters, 512, L73.

Carbon Isotope Ratios in Comets, 1999, S. Wyckoff, M. Kleine, P. Wehinger, B. Peterson, Astrophys. J., in press.

Cyanide Chemistry in Comet Hale-Bopp (C/1995 O1), 1999, Ziurys, L.M., Brewster, M.A., Savage, C., Apponi, A.J., Pesch, T.C., Wyckoff, S. ApJ, in press.

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Arizona State University
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Email: tbrush@asu.edu
WWW: http://www.public.asu.edu/~tbrush

EDUCATION

Ph.D. in Curriculum and Instruction, 1995
Indiana University, Bloomington, IN
Emphasis Area: Instructional Systems Technology
Research Interests: Alternative delivery strategies for CBI;
Training educational technology leaders.

Master of Science in Education, 1988
Potsdam College of SUNY, Potsdam, NY
Major: Instructional Technology
Honors & Awards: Kappa Delta Pi, Education Honor Society

Bachelor of Arts in Mathematics, 1986
Potsdam College of SUNY, Potsdam, NY
Minor: Secondary Education
Teaching Certification: Math 7-12
Honors: Pi Mu Epsilon, Mathematics Honor Society

EXPERIENCE

Assistant Professor
EMC Department, Arizona State University, Tempe, AZ
Junior faculty in Educational Media and Computers. (8/98 – present)

Assistant Professor
EFLT Department, Auburn University, Auburn, AL
Graduate faculty in Educational Technology. (9/95 – 8/98)

Director of Instructional Technology
Mt. Clemens Community School District, Mt. Clemens, MI
Oversaw all aspects of technology and instruction for the district. Developed and presented in-service opportunities for faculty. Managed technology budget. (1/93 - 9/95)

Associate Director for Technology
Indiana University, Center for Media and Teaching Resources
Consulted with faculty and public school clients on technology-based instructional development projects. Oversaw administration, design,

and evaluation of technology-based instructional projects. (1991 - 1992)

Project Director, Instructional Services
Indiana University, School of Education
Developed instructional materials.
Consulted with faculty on teaching.
Supervised audio/visual center. (1990 - 1991)

Research and Development Assistant
Indiana University, Department of Special Education
Developed and field-tested instructional materials.
Taught field-based classes using distance learning techniques.
Assisted with communication technology. (1989 - 1992)

TEACHING EXPERIENCE

Assistant Professor, Arizona State University, Tempe, AZ

Graduate Courses Taught
EMC531 – Hypermedia
EMC530 – Development of Computer-Based Instruction
EMC528 – Media Production
EMC505 – Presentation Technology

Assistant Professor, Auburn University, Auburn, AL

Graduate Courses Taught
EM630 - Community Information and Reference Sources
EM651 - Research in Educational Media
EM670 - Advanced Computer-Based Instructional Design
EM671 - Computer-Based Instructional Strategies
EM672 - Emerging Technologies in Education
EM685 - Computer Graphics in Educational Applications
EDL750 - Doctoral Seminar in Educational Leadership

Undergraduate Courses Taught
EM200 - Teaching with Technology
EM370 - Microcomputer Concepts and Applications

REFEREED PUBLICATIONS
Educational

Brush, T. (1998). Embedding cooperative learning into the design of Integrated Learning Systems: Rationale and guidelines.

Technology Research and Development, 46(3), 5-18.

Brush, T. (in press). Teaching pre-service teachers to use technology in the classroom. *Journal of Technology and Teacher Education.*

Brush, T. & Bannon, S. (in press). Characteristics of technology leaders: A survey of school administrators. *International Studies in Educational Administration*.

Scott, B. & Brush, T. (accepted for publication). Teaching

instructional

technology: A problem-based learning approach. *Canadian Journal of Educational Communications*.

Brush, T. (1997). The effects on student achievement and attitudes when using integrated learning systems in cooperative pairs. *Educational Technology Research and Development*, *45*(1), 51-64.

Brush, T. (1997). The effects of group composition on achievement and time-on-task for students completing ILS activities in cooperative pairs. *Journal of Research on Computing in Education*, *30*(1), 2-17.

Knapczyk, D., Rodes, P., & Brush, T. (1994). Improving staff development in rural communities using distance education and communication technology. *Rural Special Education Quarterly, 13*(2), 19-24.

Brush, T., Knapczyk, D., & Hubbard, L. (1994). Incorporating technology in the field-based preparation of teachers. *Journal of Technology and Teacher Education, 2*(1), 91-102.

Knuth, R.A. & Brush, T. (1990). Results of the Hypertext '89 design survey. *Hypermedia, 2*, 91-107.

OTHER PUBLICATIONS

Brush, T. (1998). Using CMC to bring real-world experiences into the classroom: The electronic "pen-pal" project. In Berge, Z.L. and Collins, M.P. (Eds.), *Wired Together: The Online Classroom in K-12. (Volume 4*: *Writing, Reading, and Language Acquisition)*. Cresskill NJ: Hampton Press.

Brush, T. (1997). Curriculum integration of technology: Teaching pre-service teachers to use technology in the classroom. *Technology and Teacher Education Annual - 1997*. Charlottesville, VA: AACE.

Brush, T., Knapczyk, D., & Hubbard, L. (1993). Developing a collaborative performance-support system for practicing teachers. *Educational Technology, 33*(11), 39-45.

Knapczyk, D., Brush, T., Rodes, P., & Marche, T. (1993). Continuing teacher education through distance learning and audiographics. *T.H.E. Journal, 20*(11), 74-77.

Knapczyk, D., Brush, T., Champion, M., Hubbard, L., & Rodes, P. (1993). Staff development in rural schools through distance education. *Educational Media International, 30*(2), 78-82.

Brush, T., Knapczyk, D., & Hubbard, L. (1992). Using technology to facilitate field-based training of practicing teachers. *Technology and Teacher Education Annual - 1992*. Charlottesville, VA: AACE.

Knapczyk, D., Brush, T., Champion, M., Hubbard, L., & Rodes, P. (1992). Staff development in rural schools through

distance education. *Educational Horizons, 70,* 88-91.

Brush, T., Carr, A., & Honebein, P. (1992). Using hypermedia to facilitate art education: The *Artstrands* project. *HyperNexus, 2*(4), 6-11.

CONFERENCE PAPERS

Brush, T. (1998, April). *Technology planning and implementation in public schools: A five state comparison*. Paper presented at the annual meeting of the American Educational Research Association, San Diego, CA.

Brush, T. (1998, February). *Integrating Cooperative Learning with Advanced CMI: Research and Future Directions.* Paper presented at the 1998 Meeting of the Eastern Educational Research Association, Tampa, FL.

Brush, T. (1998, February). *The Effects of Combining Adult Tutoring with ILS-Based Instruction on the Behaviors of Students At-Risk of School Failure* Paper presented at the 1998 Meeting of the Eastern Educational Research Association, Tampa, FL.

Brush, T. (1997, April). *Teaching pre-service teachers to use technology in the classroom*. Paper presented at the 1997 Society for Information Technology in Education Conference, Orlando, FL.

Brush, T. (1997, February). *Technology leaders: What do schools need?* Paper presented at the 1997 Eastern Educational Research Association, Hilton Head, SC.

Brush, T. (1996, February). *The effectiveness of cooperative learning for low- and high-achieving students using an integrated learning system.* Paper presented at the 1996 Association for Educational Communications and Technology Conference, Indianapolis, IN.

Brush, T. (1996, February). *The effects on student achievement and attitudes when utilizing cooperative learning with ILS-delivered instruction.* Paper presented at the 1996 Eastern Educational Research Association, Boston, MA.

Brush, T., Knapczyk, D., & Hubbard, L. (1992, March). *Using technology to facilitate field-based training of practicing teachers*. Paper presented at the 1992 STATE Conference, Houston ,TX.

Brush, T.A. & Knuth, R.A. (1990, October). *The use of Intermedia to promote a new epistemology of learning.* Paper presented at the 1990 Mid-Western Education Research Association, Chicago, IL.

CONFERENCE PRESENTATIONS

Brush, T. & Scott, B. (1998, February). *Teaching Instructional Technology: A Problem-Based Learning Approach.* Presentation at the 1998 Association for Educational Communications and Technology Conference, Saint Louis, MO.

Brush, T. & Bannon, S. (1998, February). *What do Schools Need from Technology Leaders? A Comparison of Rural Schools in Five Southeastern States*. Presentation at the 1997 Association for Educational Communications and Technology Conference, Saint Louis, MO.

Brush, T. (1997, June). *Reviewing and selecting software.* Presentation at the 1997 Alabama Educational Technology Conference, Birmingham, AL.

Brush, T. (1997, February). *Planning for technology: Guidelines for school districts*. Presentation at the 1997 Association for Educational Communications and Technology Conference, Albuquerque, NM.

Brush, T. & Bannon, S. (1997, February). *Characteristics of technology leaders: A survey of school administrators.* Presentation at the 1997 Association for Educational Communications and Technology Conference, Albuquerque, NM.

Brush, T. & Prigge, W. (1995, October). *Bringing multimedia into the classroom*. Presentation at the Hypermedia '95 Conference, Bloomington, IN.

Brush, T. & Armstrong, J. (1995, February). *Using technology to facilitate extended learning opportunities for students at-risk of school failure.* Presentation at the 1995 AASA Conference, New Orleans, LA.

Brush, T. & Refalo, M. (1994, October). *Integrating technology into the curriculum.* Presentation at the 1994 NSBA Technology and Learning Conference, Dallas, TX.

Knapczyk, D. & Brush, T. (1992, August). *Using audiographics in field-based teacher training.* Presentation at the 1992 Audiographics Conference, State College, PA.

Brush, T. (1992, February). *Audiographic applications in field-based teacher training*. Presentation at the 1992 Association for Educational Communications and Technology Conference, Washington, DC.

Knapczyk, D., & Brush, T. (1991, November). *Staff development in rural schools through distance education*. Presentation at the 1991 Council for Exceptional Children Conference, "Children on the edge.", New Orleans, LA.

Brush, T. & Honebein, P. (1991, October). *Using hypermedia to facilitate art education: The Artstrands project*. Presentation at the 1991 Hypermedia conference, Ball State University, Muncie, IN.

Knapczyk, D., Brush, T., Garfinkle, R., Glendening, J., & Rodes, P. (1991, March). *Collaborative teacher training via distance education.* Presentation at the 1991 Indiana Council for Exceptional Children Conference, Indianapolis, IN.

Brush, T. (1991, February). *Teaching students with learning disabilities math problem-solving processes.* Presentation at the 1991 Association for Educational Communications and Technology Conference, Orlando, FL.

Brush, T., Prigge, W. & Welsh, T. (1991, February). *The use of hypermedia to promote a new epistemology of learning.* Presentation at the 1991 Association for Educational Communications and Technology Conference, Orlando, FL.

GRANT PROPOSALS

Brush, T. (1996). Daniel F. Breeden endowment for faculty enhancement and competitive teaching grant-in-aid. Proposal funded by Auburn University.

Brush, T. & Messenger, M. (1995). *Developing a tutoring program for students at-risk using senior citizens and technology.* Proposal funded by the United Way.

Brush, T. (1994). *Increasing achievement levels of students at-risk through center-based learning and a focus on technology.* Proposal funded by the Michigan Department of Education.

Brush, T. (1994). *The learning village project: Providing school districts access to the internet.* Proposal funded by Ameritech Corporation.

Brush, T. (1993). *Using telecommunications to increase collaboration between the school and community*. Proposal funded by Ameritech Corporation.

Brush, T. (1992). *A prototype electronic collaborative network to improve teaching effectiveness in rural schools.* Proposal funded by Tandy Corporation.

SERVICE ACTIVITIES

Association for Educational Communications and Technology
Board Member, Research and Theory Division. (1997 - present)

Eastern Educational Research Association
Alabama, Kentucky, Louisiana, Mississippi, and Tennessee Regional Representative. (1997 - 1998)

Allyn and Bacon Publishers
Book reviewer for educational technology publications.

State of Alabama
Member, Technology Planning Advisory Committee.
Member, Technology for Alabama Teachers Standards Committee.

Army Research Institute, Fort Benning, GA.
Design/Evaluation Consultant.

US Army
Trainer/Developer for the Army Infantry School at Ft. Benning, GA and the Chemical School at Ft. McLellan, AL.

Technology consultant for the following schools:
Mount Clemens Schools, Mount Clemens, MI.
L'Anse Creuse Schools, Harrison Township, MI.
South Lyons Schools, South Lyons, MI.
Auburn City Schools, Auburn, AL.
Opelika City Schools, Opelika, AL.

WORK IN PROGRESS

Presentations Accepted

Brush, T. & Saye, J. *Instructional tools for student problem-solving: The Decision Point project.* Paper to be presented at the 1999 Association of Educational Communications and Technology conference, Houston, TX.

Manuscripts Submitted

Brush, T. A. Combining adult tutoring and ILS-based instruction to help students at-risk of school failure. Manuscript submitted to *The Journal of Research in Education.*

Brush, T. A. Technology planning and implementation in public schools: A five-state comparison. Manuscript submitted to *Computers in the Schools*.

Other Work

Currently working on manuscripts for *The Journal of Educational Computing Research,* and *Educational Technology Research and Development.*

AWARDS

1998 Young Scholar Award by the *Association for Educational Communications and Technology*.

1998 Nominee for best paper, *Eastern Educational Research Association*.

Best field-based application of technology. 1992 STATE Conference, Houston, TX.

REFERENCES

Provided by request.

APPENDIX E.

NEEDS ASSESSMENT

History of the Development of the AZTEC Proposal

This AZTEC proposal developed out of a central focus group meeting, held March 10, 1999 in the Dean's conference room at ASU-Main College of Liberal Arts and Sciences. The meeting brought together representatives from each of the following partners: Colleges of Education in all Regents' Universities; Colleges of Arts and Sciences in all Regents' Universities; Community Colleges, School Districts in the Phoenix EC; the Phoenix Urban Systemic Initiative; and the Arizona Board of Regents. At that meeting, the possibility of collaborating on a statewide partnership was discussed. During the discussion, the structure of the **Vision** and **Key Components** of AZTEC were developed as a mechanism for meeting the needs of all partners *and* providing a workable collaborative arrangement. The Principal Investigator, James A. Middleton agreed to follow up on this initial needs assessment with the development of a draft preliminary proposal for funding.

Following the meeting, co-PIs Middleton, Ridley, Wyckoff, Horn, and Board of Regents representative Thomas Wickenden prepared the draft preliminary proposal. The proposal was distributed to the representatives present at the focus group meeting of March 10 for feedback and the submission of a draft budget. Using the critical feedback from participants, the Principal Investigator developed the final draft of the preliminary proposal.

Upon receiving word that the AZTEC partners were invited to submit a full proposal, the preliminary proposal was again distributed to the original set of partners and additional partners such as Din□ College, other school districts, other community colleges and Center Directors. Each partner was required to submit text for the grant that embodied the specific needs that they had, and to submit a budget they felt would meet those needs. The Principal Investigator, along

with the CoPrincipal Investigators then took the partners' proposals and incorporated them into the preliminary document to produce a first draft of the final proposal. Through successive iterations and negotiations of the budget, the final form of AZTEC was developed.

Assessment of the State of Collaboration between Colleges of Arts and Sciences and Colleges of Education in the Regents' Universities.

Throughout this document, we have relied upon data from formal evaluations of state certification programs, the pre- and inservice experiences of prospective teachers, and the collaborative programs supporting mathematics and science education in the state. At the University of Arizona, Dr. Julie Luft, AZTEC CoPI has authored or co-authored 4 of these reports:

Luft, J. A., & Ebert-May, D. (1999). One state's self study of initial certification programs in science and mathematics. *School Science and Mathematics, 99*(3), 124-132.

Luft, J. A. & Cox, W. (1998). *Final Report: A report on preservice and mentoring programs in Arizona for mathematics and science teachers.* Phoenix, AZ: Arizona Board of Regents: Eisenhoweer Mathematics and Science Program.

Luft, J. A., Ebert-May, D., Eslamieh, C., & Buss, R. (1997). *A report of initial certification in science and mathematics of Arizona Regents' Universities.* Phoenix AZ: Arizona Board of Regents. (ERIC Document Reproduction Service No. ED 411 224).

Luft, J. A., Ebert-May, D., Eslamieh, C., & Buss, R. (1997). *Analysis to Action: A report of initial certification in science and mathematics of Arizona Regents' Universities.*

Phoenix AZ: Arizona Board of Regents. (ERIC Document Reproduction Service No. ED 411 224).

Moreover, at ASU-Main, the ACEPT project has hired a permanent evaluator, Dr. Daiyo Sawada to evaluate the ways in which the ACEPT project has impacted the collaboration among the College of Education and the College of Liberal Arts and Sciences. Dr. Susan Wyckoff, AZTEC CoPI, has freely provided this information from ACEPT annual reports to assist in the development of this proposal. Lastly, at Northern Arizona University, AZTEC CoPI Dr. Patty Horn has provided the proposal with information used in developing the Arizona K-12 Center.

APPENDIX F

LETTERS OF COMMITMENT