New Mexico First

Mathematics and Science Education in New Mexico

Town Hall/Summit

November 17-18, 2005
Glorieta Conference Center

Background Report by the

New Mexico Partnership of Mathematics and Science Education

This report, prepared by Rick Scott and Steve Sanchez on behalf of the New Mexico Partnership for Mathematics and Science Education, is intended to provide Town Hall participants with an overview of issues and information relevant to the Town Hall topic.

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We apologize first for any vital information that was not included, and for any projects that might not have been mentioned. We also apologize for any inconsistencies and peculiarities in the formatting.

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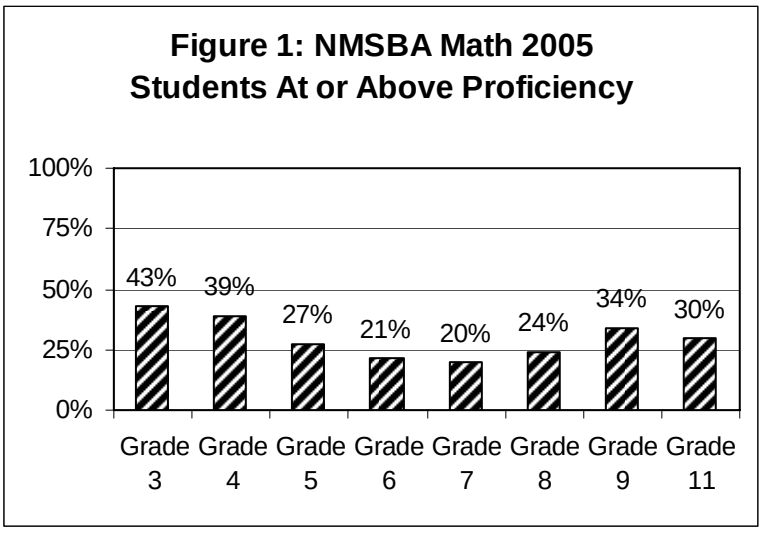
New Mexico Summit/Town Hall on Mathematics and Science Education

BACKGROUND PAPER - Introduction

The principal motivation for designing a New Mexico Summit on Math and Science Education using the collaborative Town Hall process is to build consensus on concrete, short term, research-based recommendations to improve mathematics and science education. These focused recommendations will serve as the basis for understanding (mapping) the "system" so that long range, sustainable strategies can be developed over time.



Although test data alone does not give the complete picture of student achievement, Figure 1 shows the relatively small percentage of students in grades 3 to 9 and 11 who are proficient or advanced in mathematics as measured by the New Mexico Standards-Based Assessments (NMSBA). Although results are somewhat higher in Science (Figure 2), in both subjects there appears to be a dip in performance during the middle school years.

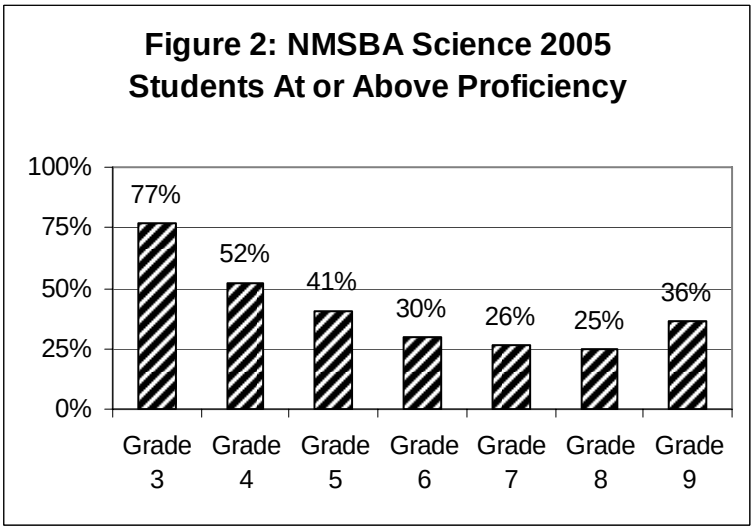


Table 1 gives national data for New Mexico on the National Assessment of Educational Progress (NAEP). NAEP performance levels in math and science are even lower than those on state tests and comparisons to the nation show New Mexico to be far behind.

Table 1: New Mexico Proficient or Advanced on NAEP

	Math 2005		Math 2003		Science 2000	
	New Mexico	Nation	New Mexico	Nation	New Mexico	Nation
Grade 4	19%	36%	17%	31%	18%	27%
Grade 8	14%	29%	15%	27%	21%	30%

The achievement situation is also complicated by achievement gaps related to income levels and ethnicity.

One of the consequences of this low achievement is the math courses that students take in the New Mexico State University system. In the two-year branch campuses in Fall 2004 74% of the enrollments in math courses were in non-credit "developmental" (i.e. remedial) courses. Even on the main campus, the course with highest enrollment (22% of total) was Intermediate Algebra which is essentially a repeat of high school algebra.

These achievement shortcomings have an impact on the workforce. A recent (February 16, 2005) report from the Business-Higher Education Forum (BHEF) indicated that: "Armed with one of the most comprehensive and current reviews of data available, top business and higher education leaders today said that the United States' lackluster performance in science and math has placed the country in grave danger of losing its competitive edge in the global marketplace." In another recent (July 27, 2005) report the Business Roundtable has insisted that "The United States is in a fierce contest with other nations to remain the world's scientific leader. But other countries are demonstrating a greater commitment to building their brainpower."

In taking the lead to sponsor the New Mexico Town Hall/Summit on Math and Science Education the New Mexico Partnership for Math and Science Education decided to focus the event on building "consensus on concrete, short term, research-based recommendations to improve math and science education". To sharpen the focus it was further decided to address the following seven questions:

1. What do the data tell us about the state of mathematics and science education in NM?
2. What are the signs that the public values or does not value mathematics and science literacy? What would be different if our society truly valued mathematics and science literacy?
3. What are specific ways that educators (parents, teachers of all subjects at all levels, administrators, counselors, museum staff, employers) can promote the importance of science and mathematics literacy?
4. What do best practices tell us about successful math and science literacy programs in other states and/or other countries?
5. What model(s)/systems of teacher preparation and professional development can ensure that future teachers have the pedagogical content knowledge they need in order to facilitate high student achievement and positive attitudes?
6. What else? Are there specific strategies in addition to teacher preparation and professional development that are needed in order to achieve mathematics and science literacy?
7. What does our panel believe are the 5 most important things to do, how to do it, and who should do it to achieve math and science literacy in NM?

CHAPTER 1

CURRENT STATE OF MATH AND SCIENCE EDUCATION IN NEW MEXICO

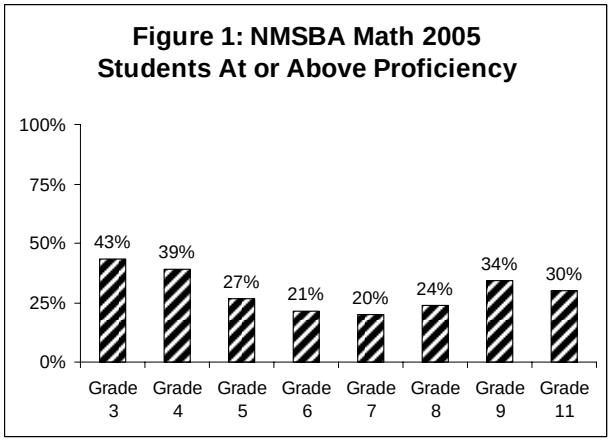
> To maintain its dominance in the new global economy, the United States must have the most skilled, creative, and productive workers in the world. Yet as American businesses require an increasingly educated and agile labor force, the United States is slipping behind other nations in the knowledge and abilities of its citizens, particularly in crucial math and science disciplines that will drive the economy and intellectual innovation in the coming decades. Economists forecast a potentially devastating future gap between the skills American employers require and those workers possess. But in New Mexico, which has among the lowest educational levels in the country, conditions are already dire: The majority of New Mexico workers do not have the skills or experience to succeed in 21st century jobs. (Schubert, 2005)

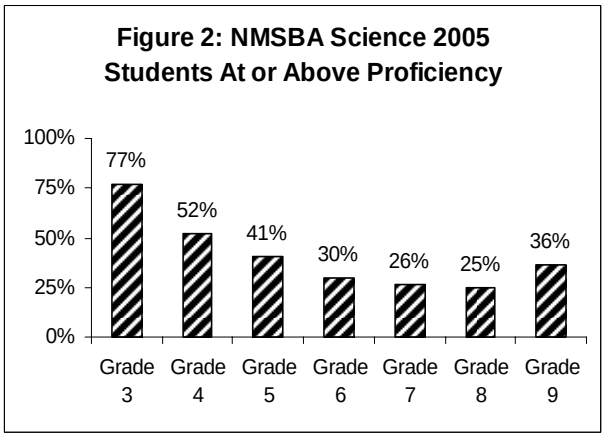
Mathematics and Science Achievement P-20

To provide an overview of achievement in mathematics and science throughout the system in New Mexico data are presented from state and national sources. Some data is presented on course taking patterns in higher education and on achievement gaps by income level and ethnicity. While most of the data might be called discouraging, "one bright spot" is highlighted.

State Assessment Results

For the first time in New Mexico, Standards-Based Assessments (NMSBA) were administered in grades 3, 4, 6, 7 and 9 during the Spring of 2005 (NMPED, 2005) in math, science, and reading. Since standards-based mathematics prototypes were administered in 2004 in grades 4, 8 and 12, the 2005 tests were redesigned based on the process in 2004. Science was tested for the first time in grades 4 and 8 in 2005, but not administered in grade 11. Results for mathematics and science by grade level based on proficiency levels are shown in Figures 1 and 2, <www.ped.state.nm.us/press/2005/august/assesment_samples/Test Results 81805.pdf>.





A student's performance on the NMSBA was reported in one of four performance levels: *Beginning Step*, *Nearing Proficiency*, *Proficient*, and *Advanced*. Figures 1 and 2 combine *Proficient* and *Advanced*. These performance levels are based on the student's scale score. The cut scores for the performance levels were established by New Mexico teachers at "Standard Setting" meeting and reflect the teachers' expectations of what New Mexico students should know and be able to do in each grade/content area. As of this writing, the 2005 technical report that might give the cut scores has apparently not been released to the public.

NAEP

Since the NMSBA is based on New Mexico Standards rather than on a comparison with a normed sample of students, they are referred to as Criterion-Based Tests (CRTs). No other states use the specific CRTs used in New Mexico. One way to approach a comparison of student achievement in New Mexico with the rest of the nation is with the National Assessment of Educational Progress (NAEP). NAEP is given to a sample of students in New Mexico. While participation in NAEP used to be voluntary, it is now required of all states as a part of the *No Child Left Behind (NCLB) Act of 2001*. Extensive information on NAEP, referred to as the "Nation's Report Card", is available at nces.ed.gov/nationsreportcard/. Table 1 indicates NAEP results in Math and Science for Grades 4 and 8. The 2005 results were released on October 19, 2005.

Table 1: New Mexico Proficient or Advanced on NAEP

	Math 2005		Math 2003		Science 2000	
	New Mexico	Nation	New Mexico	Nation	New Mexico	Nation
Grade 4	19%	36%	17%	31%	18%	27%
Grade 8	14%	29%	15%	27%	21%	30%

In comparing New Mexico with the rest of the states the following can be reported.

- Grade 4 Math: Tied with Mississippi for last.
- Grade 8 Math: Mississippi only had 13% Proficient or Advanced.
- Grade 4 Science: Trailed by Mississippi, California and Hawaii.
- Grade 8 Science: Louisiana added to the three states above.

There is considerable discrepancy between the performance levels for the NMSBA and NAEP. For example, 39% of New Mexico students in grade 4 are rated as proficient or advanced on the Mathematics NMSBA, while only 19% are similarly rated on NAEP. In grade 4 Science the discrepancy is even greater (52% on the NMSBA vs. 18% on NAEP). In grade 8 the results on the two different exams are closer (in Mathematics 24% on the NMSBA vs. 14% on NAEP, and in Science 25% on the NMSBA vs. 21% on NAEP).

Every year Morgan Quitno Press publishes its "Smartest State Award". Although for the past three years New Mexico had been dubbed the "Dumbest State", for 2005 New Mexico moved up to 48th, passing Mississippi and Arizona <www.morganquitno.com/edrank05.htm>. This year's ranking was based on 21 factors presumed to measure the quality of education (including percent of grade 4 and 8 students proficient or higher in mathematics). Since 2005 results include the use

of four new factors, this year's results are not directly comparable with past results <www.morganquitno.com/edfact05.htm#FACTORS>.

ACT and SAT

ACT and SAT scores are another proxy measure of overall student achievement. The data in Table 2 come from http://www.act.org/news/data/04/states.html and http://www.collegeboard.com/about/news_info/cbsenior/yr2004/reports.html.

Table 2: ACT and SAT Scores in 2004

	New Mexico		Nation	
	Average	% of Seniors	Average	% of Seniors
ACT MATH	19.4	61%	20.7	40%
ACT SCIENCE	20.2	61%	20.9	40%
SAT MATH	537	14%	518	48%

The ACT and SAT data are perhaps more difficult to translate because of the differences in participation rates and the non-random nature of the samples. One of the most interesting results may be the relatively high ACT score in Science despite the accompanying relatively high participation rate.

Advanced Placement (AP)

Since success on Advanced Placement (AP) Examinations, taken while in high school, can give students college credit at many institutions of higher education, AP is often considered an indication of superior achievement in high school. AP grades are reported on a 5-point scale as follows:

5 Extremely well qualified*
4 Well qualified*
3 Qualified*
2 Possibly qualified*
1 No recommendation**
* Qualified to receive college credit or advanced placement
** No recommendation to receive college credit or advanced placement

Traditionally, the measure used to determine AP success at the state level was the percentage of students taking the exams that scored 3 or higher. Using that measure, although the number of AP exams on which New Mexicans scored 3 or higher increased from 755 to 844, the percentage scoring that high remained just slightly above 40%. Recently, however, AP state-level results are being reported as the percentage of students in the state who had at least one AP experience resulting in an exam score of 3 or higher. On that measure, in New Mexico, 8.1% of graduating seniors in 2004 scored 3 or higher on at least one AP exam. That is up from 6.1% in 2000. Nationally the percentage increased 10.2% in 2000 to 13.2% in 2004. New Mexico tied with Idaho for 33rd <www.collegeboard.com/prod_downloads/about/news_info/ap/2005/ap-report-nation.pdf>.

College Course Taking Patterns

Another way to look at high school achievement is in course taking patterns in introductory university courses. Here the results, though far from conclusive, are not encouraging. (The enrollment data was taken from the publicly available websites provided by the institutions in question.) The tables show total enrollments, not just enrollments for recent high school graduates and not enrollments at the end of the semester. The "Developmental Math" courses do not receive college credit. However, Intermediate Algebra, which does receive college credit, is essentially a repeat of high school algebra. Even the content of College Algebra and Trigonometry are generally taught in high school and it should be expected that a student who has done well in four years of high school Math (Algebra I, Geometry, Algebra II and one advanced high school course) should be ready to enter Calculus I.

Table 3: Fall 2004

MATH Enrollments at NMSU Branches

Course	Enrollment	% of total
"Developmental" Math	2896	74%
Intermediate Algebra	508	13%
College Algebra & Trig	171	4%
Math Appreciation	103	3%
Math for ElEd Tchrs	123	3%
Calculus for Biol&Bus	42	1%
Other Calculus	12	0.31%

Table 4: Fall 2004

MATH Enrollments at NMHU

Course	Enrollment	% of total
"Developmental Math"	185	37%
Intermediate Algebra	97	19%
College Algebra & Trig	125	25%
Math for ElEd Tchrs	23	5%
Calculus for Biol&Bus	25	5%
Other Calculus	27	5%
Total Lower Division	297	59%
Upper Division	20	4%
Graduate	2	<1%

Table 5: Fall 2004

MATH Enrollments at NMSU Main Campus

Course	Enrollment	% of total
Intermediate Algebra	782	22%
College Algebra & Trig	602	16%
Math Appreciation	474	13%
Math for ElEd Tchrs	202	6%
Calculus for Biol&Bus	311	9%
Other Calculus	629	17%
Total Lower Division	3198	88%
Upper Division	340	9%
Graduate	117	3%

Table 6: Fall 2004

MATH Enrollments at NMT

Course	Enrollment	% of total
Intermediate Algebra	16	2%
College Algebra & Trig	218	20%
Calculus	375	36%
Total Lower Division	730	70%
Upper Division	285	27%
Graduate	30	3%

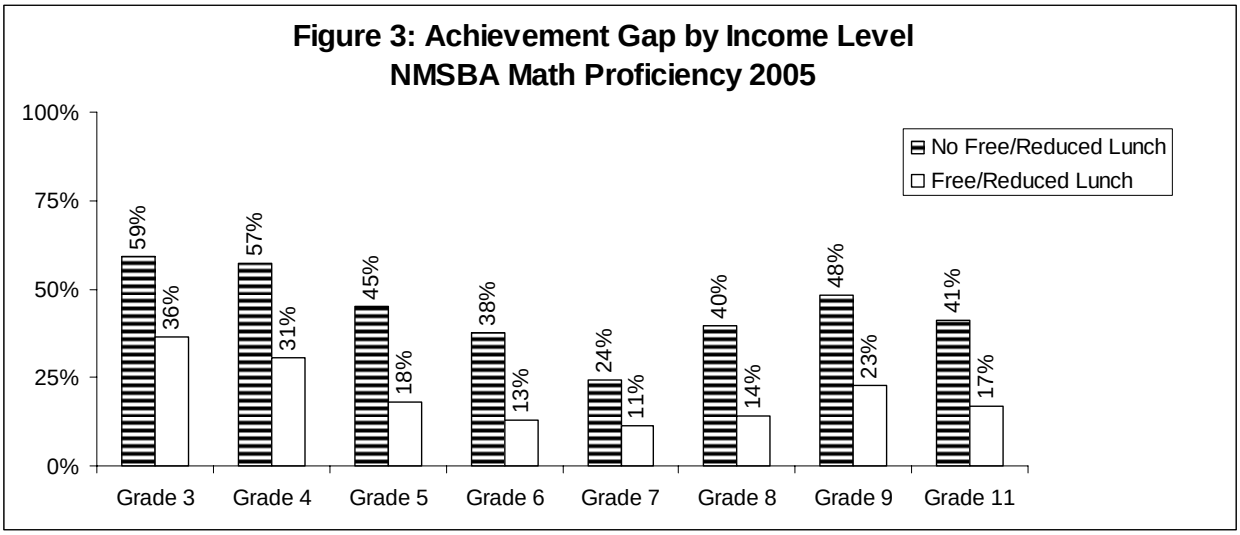
Part of the rest of the story is two fold:

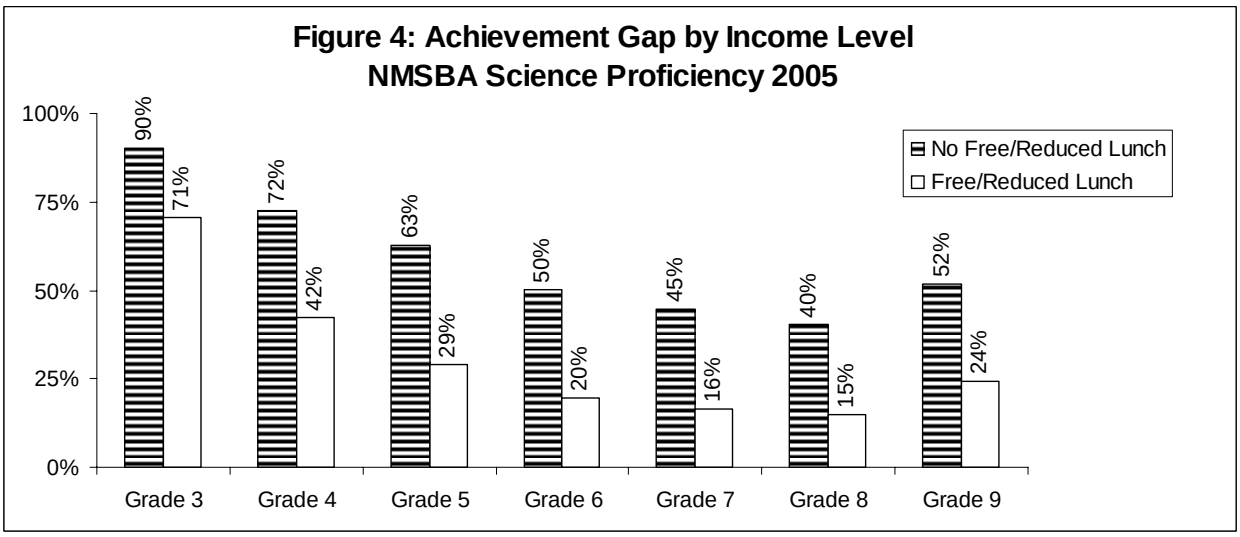
1. Of the approximately 1000 students initially enrolled in Intermediate Algebra on the main campus at NMSU only 781 finished the course and only 377 (48%) of those received an A, B or C.
2. However, those that pass Intermediate Algebra do have a 75% pass rate in Calculus for Biological and Management Sciences.

Achievement Gaps

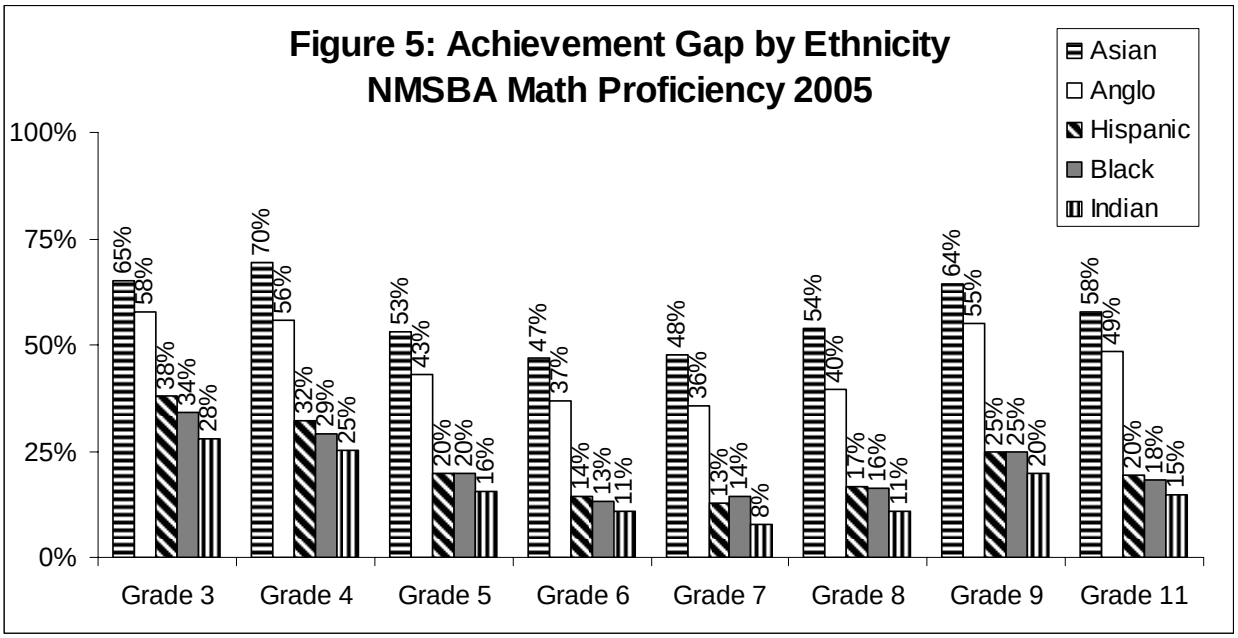
"The gaps in school achievement among racial and ethnic groups and between students from poor and non-poor families are well documented. They are large and have been persistent; this is well known and widely accepted" (Barton, 2003, p. 4).

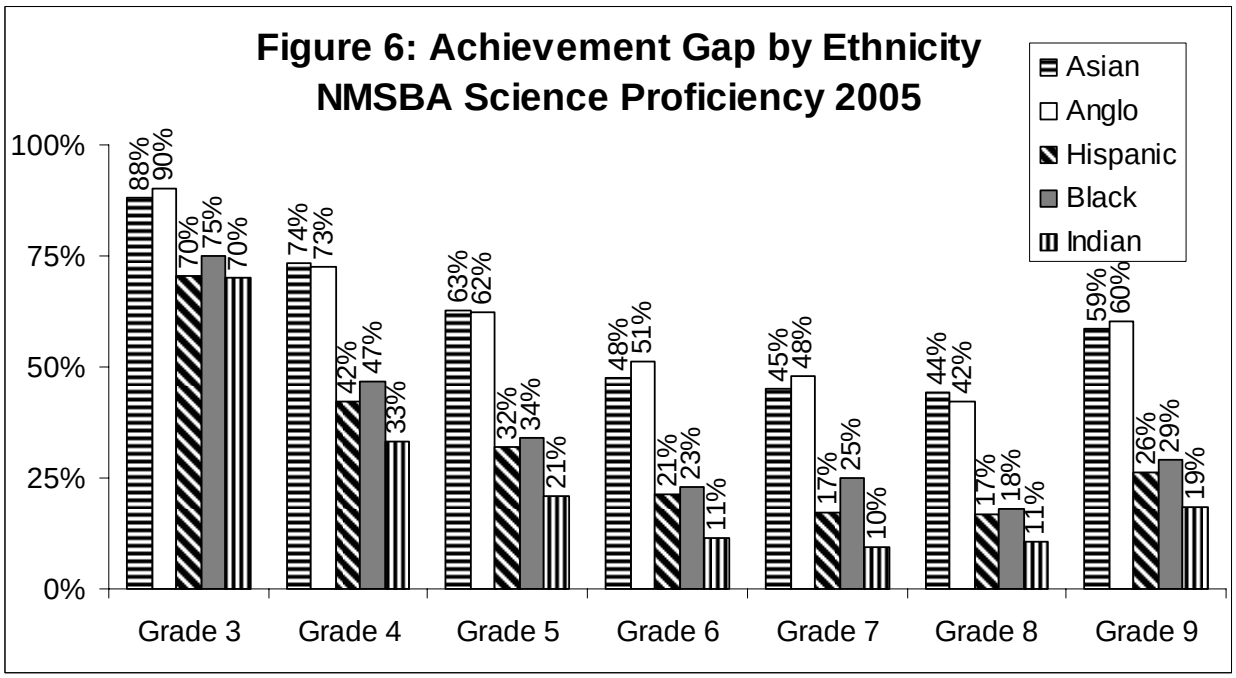
Figures 3 and 4 show the achievement gaps by grade level based on "family income level". The measure used for family income level is whether or not a child qualified for free or reduced lunch. (During the 2004-5 school year, NMPED data indicate that 49% of students received free lunches and 10% received reduced lunches <www.ped.state.nm.us/div/ais/data/fs/11/04.05.free.lunch.pdf>.) The gaps are significant, often with less than half as many low income kids reaching proficiency. Also, the gaps tend to get wider as the children progress through school.





Data on achievement gaps by ethnicity are presented in Figures 5 and 6. Here again we see a tendency for the gaps to increase as the children get older and they appear to be more pronounced in mathematics than in science.





One Bright Spot

Since 2001 the Gadsden Independent School District (GISD) has received funding from the National Science Foundation (NSF) for a Gadsden Math Initiative (GMI). GISD is a 95% Hispanic and 80% low income district. In comparison, New Mexico schools overall are 53% Hispanic and 58% low income <www.ped.state.nm.us/div/ais/data/dcrfactsheets.html>. While

some details on practices implemented by the GMI are presented in Math and Science Projects, three significant components of the initiative include: district-wide adoption and gradual implementation of NSF-developed textbooks, teacher professional development, and higher achievement in schools with teacher study groups. Figures 7 and 8 give an indication of the progress that has been made in closing the achievement gap.

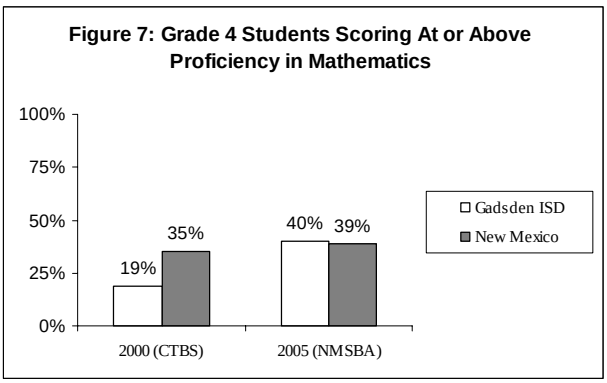


Figure 7: Grade 4 Students Scoring At or Above Proficiency in Mathematics

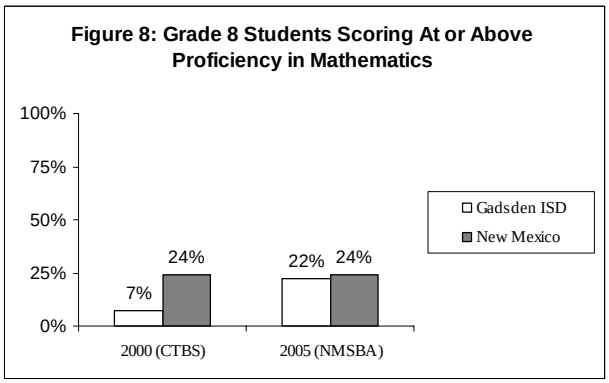


Figure 8: Grade 8 Students Scoring At or Above Proficiency in Mathematics

Mathematics and Science Requirements K-12

Information on the Mathematics and Science requirements for K-12 students is given below. This information is useful to assess the state of Mathematics and Science education in New Mexico.

Subject Area Requirements

Statute 22-13-1 (see Appendix 1) requires that Math be taught daily in grades 1-3, but does not specify for how long. Although New Mexico Statutes apparently do not require that science be taught at all in grades 1-3, they are required Science Content, Benchmarks, and Performance Standards for those grades and, as indicated above, there is testing in Science in grade 3. In grades 4-8 "instruction that meets academic content and performance standards shall be provided in" Math and Science. House Bill 212 from the 2003 Legislative Session specified Algebra I as one of the three unit requirements for high school graduation and raised the Science requirement for graduation from two to three units. Those graduation requirements are now in Statute 22-13-1.1 (see Appendix 1). Although including additional course requirements for graduation is often praised as "raising the bar", there is some concern that it could lead to "watered-down" courses.

State Standards and Benchmarks

The *Standards* for New Mexico are officially known as the *Content Standards, Benchmarks and Performance Standards*. They can be downloaded from www.ped.state.nm.us/standards/index.html. The PED also maintains a website with support for implementing the *Standards* called *my*Standards at www.mystandards.org.

The current *Standards* for Mathematics, adopted in June of 2002, are based on the *Principles and Standards for School Mathematics* from the National Council of Teachers of Mathematics (NCTM, 2000). The *Standards* contain both content performance standards and the process standards of Problem Solving, Reasoning and Proof, Communication, Connections, and

Representations. The process standards are general and not specified by grade levels. For grades K to 8 there are performance standards specified by grade level. A group of educators was convened during the Summer of 2005 to consider ways to integrate the process standards into the mathematics standards. The results of that process are still under review.

A potential mismatch exists between the *Standards* and the courses that are taught in most high schools. Although Algebra I, Algebra II and Geometry are the typical courses, the three content "Strands" for grades 9-12 are "Algebra, Functions and Graphs", "Geometry and Trigonometry", and "Data Analysis and Probability". Students who take no course higher than Algebra I will not have seen many of the required Standards. Proposals to phase in the requiring of Algebra II and Geometry, and to come up with a state framework for matching the Standards to the three course sequence have apparently not been implemented. (Note: There are some Math programs that take a more integrated approach than the traditional Algebra I, II and Geometry, such as the *Integrated Math Program (IMP)* and the *SIMMS Integrated Mathematics.* Information on the programs that were developed with funding from NSF is available at www.ithaca.edu/compass/.)

The Science *Standards* were adopted in August of 2003. They are based on the *National Science Education Standards* from the National Research Council (NRC, 1997). They are organized into three Strands: Scientific Thinking and Practice, Content of Science, and Science and Society. As is the case with the Math Standards they are organized by grade level for Grades K to 8, but there is a single band for Grades 9 to 12. The Content of Science Standards are organized into Physical Science, Life Science, and Earth and Space Science. They therefore have the same situation as Math of not fitting seamlessly into the traditional sequence of courses (Biology, Chemistry and Physics).

New Mexico currently does not have student-level Technology Standards. However, a new set of Standards referred to as "21st Century Skills" is being developed.

Assessment K-12

New Mexico Statute 22-2C-4 (see Appendix 1) requires statewide "standards-based academic performance tests in mathematics" in grades 3 to 9 and 11. Similar testing in science is required "for one of grades three through five and six through nine and for grade eleven" beginning in the 2007-2008. However, tests have been developed for Science in grade 3 to 9. These tests are often referred to as the New Mexico Standards-Based Assessments (NMSBA). (Another term used to refer to tests based on standards is Criterion-Referenced Test (CRT)).

In 2003 and 2004 standards-based assessments in Math and Language Arts were developed and administered by CTB McGraw-Hill (and now Harcourt Assessment, Inc.) with input from New Mexico educators. In its report to the NMPED, CTB McGraw-Hill stated that

> In part, the rationale for the claim that the NMSBA scores are credible individual ability scores is based on the fact that the NMSBA were constructed using items very much like the questions and activities teachers use to teach their students. These items were selected from CTB item pools, including *Balanced Assessments in Mathematics, TerraNova,* and the *CTB Assessment Bank.* The items were aligned to the *New Mexico K-12 Content Standards, Benchmarks, and Performance Standards* by CTB and New Mexico State

> Department of Education (NMSDE) content experts. This alignment was reviewed by New Mexico teachers. New Mexico teachers reviewed all items in the NMSBA in order to foster a close relationship between these items and the content standards from which the test was developed <www.ped.state.nm.us/div/acc.assess/assess/dl/nmsba.tech.report.2004.pdf>.

The rest of the grades 3 to 9 tests and the science tests were administered for the first time in March of 2005. As mentioned above, as of this writing the technical report for the 2005 assessments has apparently not been released to the public.

In order to receive a high school diploma, students must pass all six subtests (including Math and Science) of the New Mexico High School Competency Examination (NMHSCE). Although classified as a CRT, the NMHSCE was developed before the current Math and Science Performance Standards, and no apparent attempt to have the test measure knowledge much beyond the grade 8 level. Students take the test in grade 10. If they fail they can take it in grade 11, twice in grade 12, and after completion of high school courses. Versions of the NMHSCE are available in both English and Spanish.

At grade 11 New Mexico has been administering CRTs in Reading and Mathematics designed to measure student performance against state standards. This test is called the New Mexico High School Standards-based Assessment (NMHSSA). The use of such a test for 95% of the whole group and identified subgroups is required under NCLB. The development was under contract first to Pearson Educational Measurement (PEM) with input from New Mexico educators. It is available in English only. Legislation from the 2005 Session (SB 647 – Senate Floor Substitute and HB 136 – Senate Floor Amended) would have replaced the NMHSCE with the NMHSSA but did not reach the Governor for signature. The NMHSSA attempts to measure achievement on the Performance Standards that are expected to be in Algebra I, Geometry and the first half of Algebra II.

College Placement Tests

HB 212, The School Reform Act of 2003, requires that

> High school curricula and end-of-course tests shall be aligned with the placement tests administered by two- and four-year public post-secondary educational institutions in New Mexico. The department shall collaborate with the commission on higher education in aligning high school curricula and end-of-course tests with the placement tests.

This requirement is in Statute 22-13-1.2 (see Appendix 1), but attempts to operationalize this requirement have been largely unsuccessful. The Legislative Education Study Committee (LESC) has attempted to coordinate efforts with respect to alignment. The Minutes of the August 2004 LESC meeting indicate that Frank Renz of the New Mexico Association of Community Colleges (NMACC) had completed “an inventory of placement exams used by two-year institutions of higher education (IHEs)” and “the inventory shows little consistency either in the kind of exam or the cut score used at the various two-year IHEs” <legis.state.nm.us/lcs/lesc/lescdocs/Aug2004LESCMinutes.pdf>. One LESC response to the situation (in collaboration with a team from the two-year and four-year IHEs) was proposed in the 2005 Legislative Session as HB 136. Its original intent was that “the commission on higher

education shall adopt and promulgate standardized placement tests for general education requirements for use by all public post-secondary educational institutions". The original bill was substituted in the House Education Committee with version that would have required most grade 11 students to take the "standardized placement test" and plan their senior year based on the results of the test. A Senate Floor Amendment required that the NMHSSA would be the test used for both college placement and high school graduation. The House refused to accept the Senate amendments (at least in part because some Representatives apparently realized that the NMHSSA did not reach far enough in the college-prep curriculum to serve as a college placement test) and a Conference Committee did not reach a consensus in time to send the bill to the Governor.

The Mathematics and Science Teaching Force

Current Teacher Education Programs in New Mexico

There are thirteen institutions of higher education in New Mexico that offer teacher licensure programs <www.teachnm.org/becoming_a_teacher/becoming_a_teacher.htm>. Table 7 indicates undergraduate, regular post-bachelors and alternative licensure programs that are available in elementary and secondary by institution (Math and Science).

Table 7: Teacher Licensure Programs in New Mexico

	Elementary			Secondary		
Institution	Undergrad	PostBA	Alternative	Undergrad	PostBA	Alternative
Clovis Community College	No	No	Yes	No	No	Yes
College of Santa Fe [1]	Yes	Yes	Yes	Yes	Yes	Yes
College of the Southwest	Yes	Yes	No	Yes	Yes	No
Eastern New Mexico U	Yes	Yes	Yes	Yes	Yes	Yes
New Mexico Highlands U	Yes	Yes	No	Yes	Yes	No
New Mexico Tech	No	No	No	No	No	Yes
New Mexico State U [2]	Yes	Yes	Yes	Yes	Yes	Yes
Northern New Mexico College	Yes	No	Yes	No	No	Yes
San Juan College	No	No	Yes	No	No	Yes
University of New Mexico [3]	Yes	Yes	No	Yes	Yes	Yes
University of Phoenix	No	Yes	No	No	Yes	No
Wayland Baptist U	Yes	Yes	No	No	Yes	No
Western New Mexico U	Yes	Yes	Yes	Yes	Yes	Yes

[1] College of Santa Fe has licensure programs in Santa Fe and Albuquerque.
[2] NMSU has elementary licensure programs in Alamogordo, Carlsbad and Grants.
[3] UNM has elementary and secondary licensure programs in Farmington and Gallup.

Teacher Education General Licensure Requirements

Note: One good source of information on teacher requirements and opportunities in New Mexico is www.teachnm.org.

The legislation that structured current teacher licensure requirements was Senate Bill 106 in 1986. In fact, it was through that legislation that the term officially changed from "certification"

to licensure. Under Senate Bill 106 four different kinds of teaching licenses were established (the web references are to the specific New Mexico Administrative Code for each license):

Elementary Level – K to grade 8
<http://www.nmcpr.state.nm.us/nmac/parts/title06/06.061.0002.htm>
Secondary Level – Grades 7 to 12
<www.nmcpr.state.nm.us/nmac/parts/title06/06.061.0004.htm>
K – 12 <www.nmcpr.state.nm.us/nmac/parts/title06/06.061.0005.htm>
Special Education – Grades K-12
<www.nmcpr.state.nm.us/nmac/parts/title06/06.061.0006.htm>

(Note: the Administrative Code for the Elementary and Secondary Level licenses are in Appendix 2 for your convenience.)

Over the years a few of the details of the above licenses have been changed. Also, Early Childhood and Middle Level licenses have been added:

Early Childhood – birth to grade 3
<www.nmcpr.state.nm.us/nmac/parts/title06/06.061.0008.htm>
Middle Level – Grades 5 to 9 (apparently no NM college currently offers this program)
<www.nmcpr.state.nm.us/nmac/parts/title06/06.061.0003.htm>

There is also a license for Secondary Vocational-Technical Education
<www.nmcpr.state.nm.us/nmac/parts/title06/06.061.0007.htm>

The New Mexico Legislature in 1999 passed Alternative Licensure programs that require many fewer credits: 12-21 credits for elementary and 12-18 for secondary (see Appendix 2). <www.nmcpr.state.nm.us/nmac/parts/title06/06.060.0003.htm>

Teacher Education Licensure Requirements Specific to Mathematics and Science

Outlined below are specific licensure requirements for Mathematics and Science

- K-8 – 6 credits in Mathematics and 12 credits in Science unless you are going to teach Middle School in which case you have to have 24 credits in the subjects you will teach (the 24 credits can all be lower division).
- 5-9 – 24 credits in Mathematics and/or Science (12 credits must be upper division or graduate).
- 7-12 – same as 5-9
- Special Education – same as regular education

Certification requirements prior to Senate Bill 106 for middle-grades allowed teachers with Elementary certification to teach any academic subject even if they had taken no college course in a given subject. A State Board of Education decision was to take effect in the early 1980s that would have required all middle teachers to have at least 15 college credit hours in any basic subject area they were teaching. Apparently, concerned that it would cause staffing difficulties, some rural Superintendents put pressure on the Board and the decision was rescinded before it went into effect.

The reforms under Senate Bill 106 did not change the situation, and for almost 20 years K-8 licensed teachers with little formal Mathematics preparation could teach middle school

Mathematics, while 7-12 licensed teachers needed 24 credit of Mathematics to teach the same courses. The passage of the *No Child Left Behind Act of 2001 radically changed this situation.* Now, to be able to teach Mathematics and Science in middle school (i.e. to be "highly qualified"), students graduating and receiving a K-8 license must have 24 credits in the subjects they will teach and must pass the associated middle level content knowledge test from the New Mexico Teacher Assessment (NMTA). (There is an exception for 45 rural districts where newly hired teachers have up to three years in which to become "highly qualified".) It looked like the same requirements might apply to middle school Mathematics and Science teachers already in the field. However, one change was that instead of having 24 credits of Mathematics or Sciences they could pass the Middle Level Content Knowledge tests of the NMTA. For those with at least five years of experience there are other options, referred to as Subject Area Competency HOUSSE (High Objective Uniform Statewide Standard of Evaluation):

- Have successful annual evaluations for the prior two school years
- Have two complete school years of teaching experience and either A or B below:
  - (A) Complete at least 18 lower or upper division credit hours in each core academic subject the teacher teaches; or
  - (B) Complete lower or upper division credit hours as follows:
    (1) 12 semester hours in a single core subject area; or
    (2) 15 semester hours in two core subject areas, with at least 6 hours in each one; or
    (3) 18 semester hours in three core subject areas, with at least 6 hours in each one; or
    (4) 24 semester hours in four core subject areas, with at least 6 hours in each one; and
    - Demonstrate competence in the instructional strand of the statewide teacher competencies and indicators for the level of licensure the candidate holds to a local panel. The local panel shall consist of two teachers:
      i.) One teacher will be appointed by the principal in the school where the teacher seeking to demonstrate that he/she is highly qualified is teaching. The second teacher will be appointed by the candidate.
      ii.) Panelists must be highly qualified in the content area being evaluated, as defined in Public Education Department rules, and hold a current Level II or III-A license, and, if applicable, hold an endorsement in the subject area to be evaluated.
      iii.) Panelists may be from the candidate's same school, or same district, or from another school or district in New Mexico
      - The candidate must gather and submit to the panel evidence demonstrating how he/she meets the competencies in the instructional strand of the state's teacher competencies and indicators. Evidence must include:
        i.) Documentation from student data, assessment techniques, instructional plans, information about student work, and implementation of state curriculum standards, as provided in 6.69.4.11. E (1) NMAC, and

ii.) Observation summaries, by each panel member, of the candidate teaching in the area for which he or she is applying. Observations by the panel members may be done in person or by video, and

iii.) At least two observation summaries, completed by the candidate, of a teacher(s) teaching in the subject area for which the candidate is seeking to be highly qualified.

- Both teachers on the panel must agree that the candidate has met, or exceeds, the competencies and indicators for the level of licensure the teacher being evaluated holds.

<www.teachnm.org/highly_qualified/highly_qualified.htm>

New Mexico Teacher Assessment (NMTA) Requirements

The New Mexico Teacher Assessments (NMTA) <www.nmta.nesinc.com> were developed by the National Evaluation Systems, Inc. (NES) with input from New Mexico educators. Teachers at all levels must pass an NMTA Basic Skills test that includes mathematics. For those teaching at the middle level either with a K-8 or 5-9 license there are Middle Level Mathematics and Science tests. For grades 7-12 there are secondary content Mathematics and Science tests.

Since its implementation in 1999 through 2004, the NMTA Basic Skills test had been taken by 14,617 individuals and the pass rate was 94%. The Secondary Content Knowledge Tests were not implemented until 2002. The results for the Mathematics and Science tests are given below for the total, those in regular licensure programs in New Mexico, and those in alternative licensure programs. For both tests there were students taking the test that apparently were not associated with a licensure program. Even for those associated with programs in New Mexico there was no guarantee that they had taken all the mathematics and science courses required by the institution before taking the tests. The Middle Level tests were recently developed and no results were available.

Table 8: NMTA Results in Secondary Math and Science

Test	Total	Pass Rate	Regular Program	Pass Rate	Alternative Lic	Pass Rate
Math	n=279	74%	n=149	77%	n=60	80%
Science	n=286	83%	n=164	84%	n=67	87%

<teachnm.org/documents/NMTAPASSAGERATES99-04.pdf>

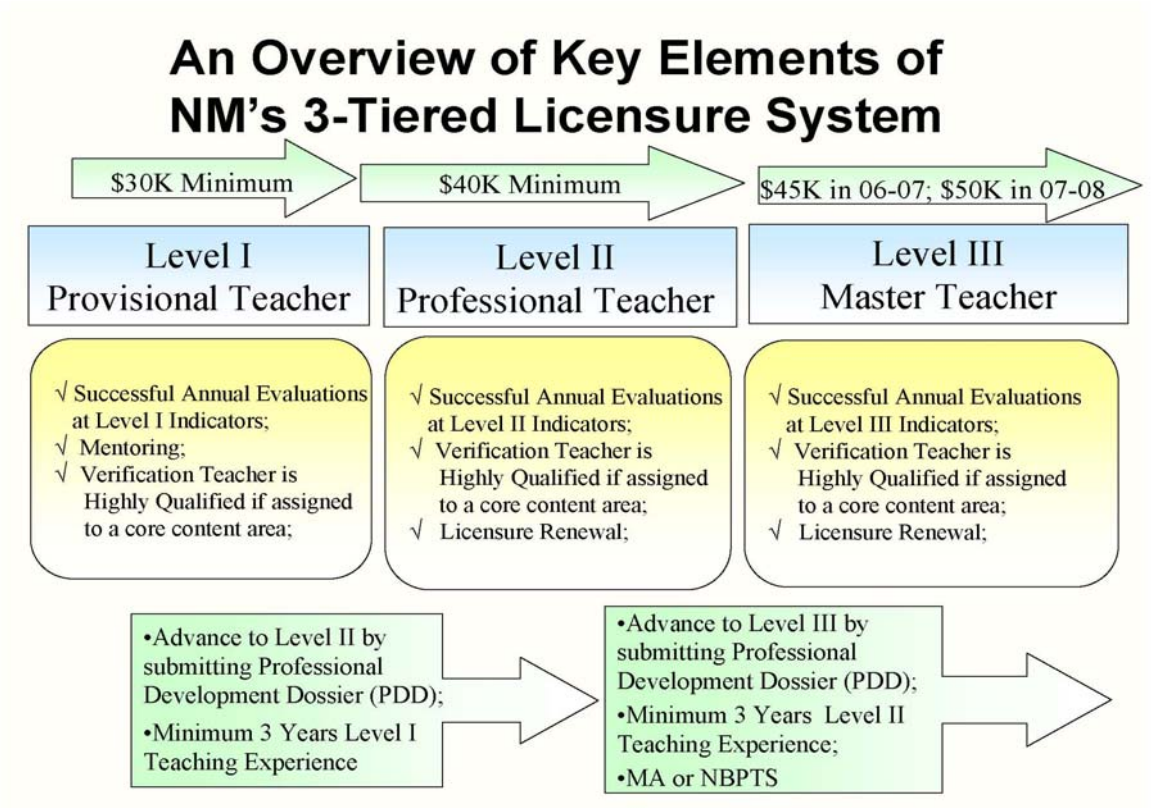
The Three-Tiered Licensure System

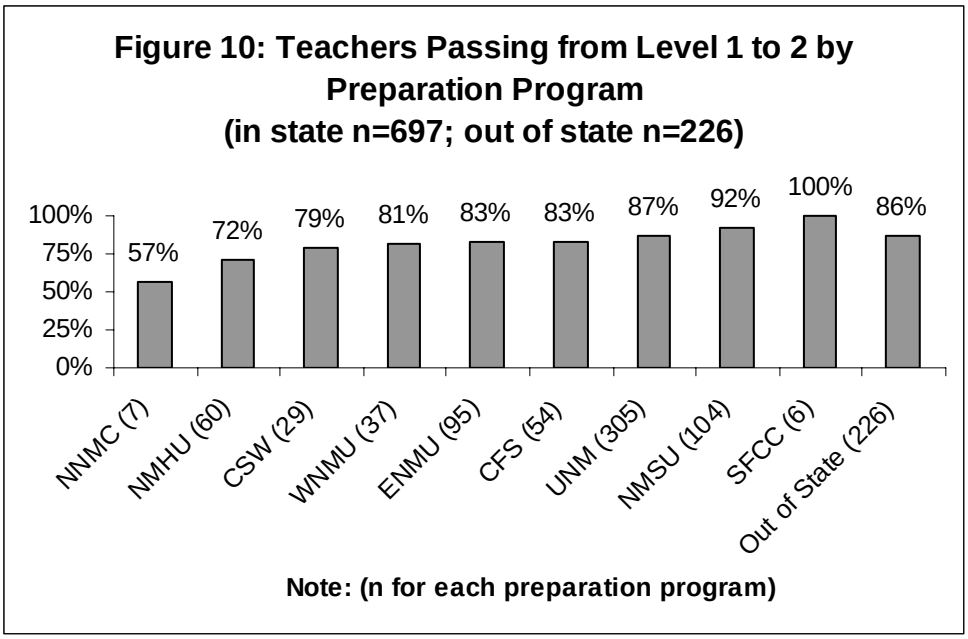
Although New Mexico has had a three-tiered licensure system since the 1980s, it was with the passage of the Educational Reform Act (HB 212) in 2003 with significantly enhanced salary levels that it gained particular attention. The following diagram (Figure 9) from Mitchell et al. (2005, p. 7) indicates many of the pertinent details of the current system.

In summarizing the results of an assessment of New Mexico's three-tiered licensure system Mitchell et al. (2005, p. 34) suggested that "Teacher preparation programs should prove their effectiveness by gathering data about the performance of their graduates. … Gathering almost

any data is a start because data will show what needs to be done." One measure of teacher program effectiveness that they present is the percent of teachers passing from Level 1 to Level 2. Figure 10 presents that data. Overall of the 697 teachers 85% passed from Level 1 to Level 2. Only 22 of the teachers had received their licenses in alternative programs and their pass rate was 82%. (Teachers have from three to five year after receiving their Level 1 license to prepare the Profession Development Dossier (PDD) that is evaluated externally.) Mitchell et al. (2005) are quick to point out that since new teachers are mentored by the district, that the district, in addition to the higher education institution, has a role in whether or not they pass. At this time there is not sufficient data to see if Mathematics and Science teachers exhibit any special situations with respect to passing from Level 1 to Level 2. One organization that has been involved in assisting teachers with this is the Regional Technology Educational Assistance (RETA) program <reta.nmsu.edu/profdev/onsite/3tiered.html> .

Figure 9





Mathematics and Science Workforce Needs in New Mexico

If indeed, one of the goals of Mathematics and Science education is to prepare students to have options for their own future and to be able to contribute to the economic well being and security needs of the nations, then it makes sense to look at the related workforce needs.

SCANS: A National Perspective

Nearly 20 ago, the U.S. Department of Labor Secretary's Commission on Achieving Necessary Skills (SCANS) (1991 & 1992) identified the kinds of skills high school graduates need to enter high-skill, high-pay employment <wdr.doleta.gov/SCANS/whatwork> and <wdr.doleta.gov/SCANS/lal>. The SCANS reports went well beyond the traditional definition of basic skills as just the basic 3Rs and argued that for success in the 21st Century workplace an expanded set of new basic competencies need to be considered. The following SCANS Workplace Know-How chart has often be quoted:

WORKPLACE KNOW-HOW

The know-how identified by SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance. These include:

COMPETENCIES - effective workers can productively use:

- **Resources** - allocating time, money, materials, space, and staff;
- **Interpersonal Skills** - working on teams, teaching others, serving customers, leading, negotiating, and working well with people from culturally diverse backgrounds;
- **Information** - acquiring and evaluating data, organizing and maintaining files, interpreting and communicating, and using computers to process information;

- **Systems** - understanding social, organizational, and technological systems, monitoring and correcting performance, and designing or improving systems;
- **Technology** - selecting equipment and tools, applying technology to specific tasks, and maintaining and troubleshooting technologies.

THE FOUNDATION - competence requires:

- **Basic Skills** - reading, writing, arithmetic and mathematics, speaking, and listening;
- **Thinking Skills** - thinking creatively, making decisions, solving problems, seeing things in the mind's eye, knowing how to learn, and reasoning;
- **Personal Qualities** - individual responsibility, self-esteem, sociability, self-management, and integrity. (SCANS, 1991, p. iii)

Harvard's Richard Murnane and MIT's Frank Levy, building on the work of SCANS, published *Teaching the New Basic Skills* (Murnane & Levy, 1996) in which they present a list, that includes suggestions based on the research in highly productive businesses, of what they call the "new basic skills." They suggest that the following are the minimum skills needed to secure a middle-class job in the United States today.

- Read at the ninth-grade level or higher.
- Use math at the ninth-grade level or higher.
- Solve semi-structured problems when hypotheses must be formed and tested.
- Work in groups with coworkers from different backgrounds.
- Communicate effectively, both orally and in writing.
- Use personal computers to carry out simple tasks, such as word processing.

The New Mexico Perspective

At the High Desert/High Tech: Forging Critical Skills Development Partnerships in Manufacturing conference held in Albuquerque in October of 2004, <hightech.sandia.gov/> , Jack Jekowski and Marybeth Schubert (2004) presented a graph (Figure 11) showing some of the challenges.

Jekowski and Schubert also presented a look at the New Mexico education pipeline that shows that "less than 35% of NM 9th graders will complete college with a degree sufficient to meet entry level requirements for today's high technology industries". These data are also confirmed by the National Center for Higher Education Management Systems (CHEMS, 2005). Strangely, although New Mexico produces fewer undergraduate credentials than the U. S. average, we are "a net-importer of residents with associate degrees and a net-exporter of residents with bachelor's degrees" <www.higheredinfo.org>.

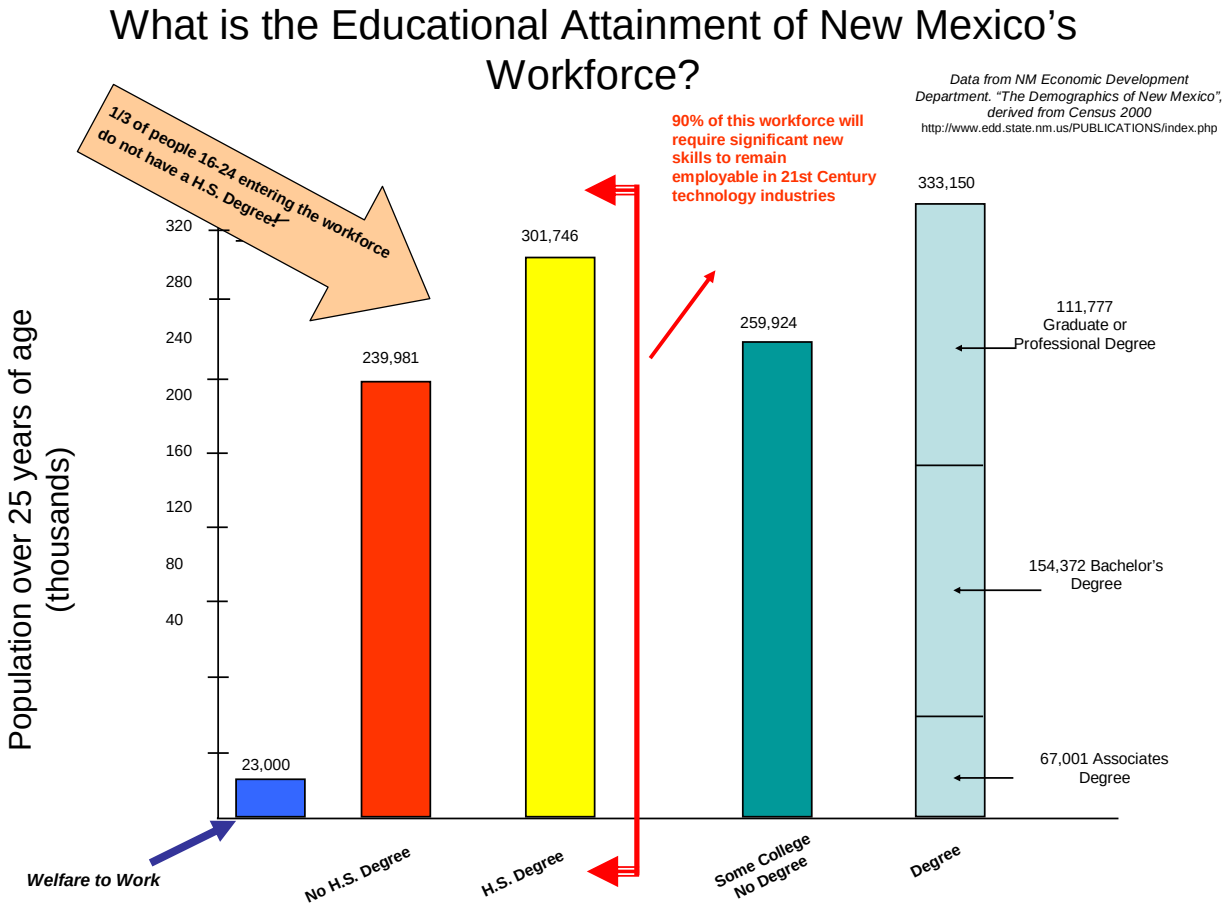
Perhaps the only way to put a positive spin on the pipeline situation is to consider the point of view that Judith Ramaley (2003) tried to promote while at NSF:

We have now pathways, not pipelines.

- Pipeline: a clear and uninterrupted route from high school to college and from college to advanced study

- Pathway: a complex pattern of enrollment that involves multiple institutions and either continuous or interrupted enrollment <www.sunysb.edu/Reinventioncenter/Conference_04/Judith_Ramaley/Challenges_STEM_Education.htm>.

Figure 11



Since 2002 the New Mexico Association of Community Colleges (NMACC) has managed New Mexico' s participation in the *Bridges to Opportunity* initiative, supported by the Ford Foundation. The Bridges project has brought together leaders and stakeholders from various sectors, most recently in March of 2005 in the New Mexico State Summit on 21st Century Competitiveness. Bridges and its partners are pledged to

- Create a statewide strategic vision and plan to guide workforce and economic development.
- Form a confederacy of state agencies responsible for developing human resources and deploy community colleges as the state's primary strategic resource for delivering human capital.
- Draw on business leaders to support *both* agency planning and institutional delivery.

Schubert (2005) chose two metaphor's to describe the workforce challenges in New Mexico: "Iron Man" and "Strike Force". Like the "Iron Man" of triathlons the "Iron Man" worker of the future "must be confident and knowledgeable in math and science concepts and capable of using sophisticated communication, technology, and reasoning skills in dealing with both people and issues on the job. This worker must also master specialized occupational skills and equipment and apply that knowledge to new problems and technologies".

To form a "strike force" on workforce development it would be suggested "to the Governor that he widen the Coordination and Oversight Committee to the State Workforce Development Board to include representatives of small, medium and large employers—including both business and the state's national labs—and a high school, 2-year college, and research university representative, to be tasked with seeking ways to":

- improve integration of the state's education system from P to 20 to workforce;
- increase the commercialization of intellectual property created in New Mexico;
- examine funding formulas for state spending on education;
- seek ways to encourage ninth graders to stay in high school;
- enlist employers to demand high school diplomas;
- create statewide certificates of competence (such as the Work Keys Work Readiness certificate) and other ways to demonstrate the tangible rewards to education;
- identify and celebrate real success stories where community colleges and employers have collaborated successfully and are aggressively seeking to spread the lessons learned to other counties;
- ensure that the state has good jobs to offer its well-educated graduates;
- establish inter-agency programs and policies to ensure collaboration among education, workforce and economic development; and
- prevent the Summit from being another effort that produces more rhetoric than results. (Schubert, 2000, p. 12) <www.nmacc.org/PDFS/summit_report.pdf>

Present Mathematics and Science Projects

Below is a partial list of current New Mexico Mathematics and Science Projects with a notation of main target audience and website. (We apologize for any projects not in the list.) More details on those projects and some past projects are present in Appendix 3.

New Mexico Mathematics, Science, Engineering Achievement (NM MESA) Inc.
Middle and high school students and teachers statewide in selected districts
<www.nmmesa.org/>

Gadsden Mathematics Initiative (GMI)
K-8 mathematics teachers in the Gadsden district
<www.gisd.k12.nm.us/GMIWebsite/GMIHomepage.htm>

Math and Science Academy (MSA)
Elementary and middle school teachers in five northern districts
<www.lanl.gov/education/teachers/mathsci.shtml>

MathStar New Mexico
Middle school mathematics teachers in selected districts statewide
<mathstar.nmsu.edu>

Improved Mentoring, Professional Development, and Recruitment of Educators for Secondary Science and Math (at UNM)
Prospective secondary science and mathematics teachers

New Mexico Alliance for Minority Participation (NM AMP)
Undergraduates in STEM disciplines
<www.nmsu.edu/~nmamp>

Regional Alliance for Science, Engineering and Mathematics (RASEM^2) for Students with Disabilities
Students with disabilities in the STEM disciplines and their teachers
<rasem.nmsu.edu>

The NMSU Computer Science, Engineering, and Mathematics Scholarships (CSEMS) Program
Undergraduates in the STEM disciplines at NMSU

New Mexico Tribal Coalition – Rural Systemic Initiative (NMTC)
K-12 mathematics and science students and teachers in Pueblo schools
<www.tribalcoalition.org>

Reforming Math, Science and Technology Education in Northern NM (Northern NM Network RSI)
K-12 Mathematics and Science students and teachers in schools in the Northern Network
<northernnetwork.unm.edu/>

New Mexico Experimental Program to Stimulate Competitive Research (NM EPSCoR)
Education program on the hydrologic and nanoscale sciences for students and teachers.
<www.nmepscor.org>

APS Math Science Technology Partnership
Math, science and technology high school and feeder middle and elementary school system
<www.mstp.org>

Math and Science Partnerships (MSPs)
Middle school mathematics teachers
<mc2.nmsu.edu> and <http://www.math.unm.edu/~umland/LaMeta/LaMeta.htm>

The Center for Mathematics Education of Latinos/as (CEMELA)
Graduate students in Mathematics Education at UNM, research on Hispanics and Math
<cemela.math.arizona.edu>

The Regional Educational Technology Assistance Program (RETA)
K-12 teachers statewide
<reta.nmsu.edu>

Strengthening Quality in Schools (SQS)
K-12 schools statewide
<www.sandia.gov/sqs/>

Re:Learning New Mexico
K-12 schools statewide
<www.relnm.org>

Summary

Overall, available data indicates Mathematics and Science underachievement in New Mexico, despite having most nationally recommended policies in place and many funded projects working to support achievement. It is probably worth reiterating the situation in the Gadsden Independent School District where an NSF-funded project and district-wide policies that involved gradually implementing NSF-sponsored curricula supported with teacher professional development have helped them to close the achievement gap.

CHAPTER 2

PUBLIC AWARENESS OF THE IMPORTANCE OF MATHEMATICS AND SCIENCE

> Almost 50 years ago, the Soviet Union shocked Americans by launching Sputnik, the first Earth orbit satellite. The U.S. response was immediate and dramatic. Less than a year later, President Eisenhower signed into law the National Defense Education Act, a major part of the effort to restore America's scientific pre-eminence. Today, our nation faces a more serious, if less visible, challenge. One of the pillars of American economic prosperity — our scientific and technological superiority — is beginning to atrophy even as other nations are developing their own human capital. (Business Roundtable, 2005)

Sputnik and the NDEA

Paul Dickson (2001) in *Sputnik: The Shock of the Century* captures the very personal nature of the reaction to the launching of Sputnik when he notes in the Introduction: "For many of us born before the 1950s, the fascination and astonishment engendered by the launch of Sputnik remain fresh in our minds. Like many of my generation, I can recall exactly where I was when I heard about Sputnik's launch" (p. 2). Although the billions of federal dollars dedicated through the National Defense Education Act (NDEA) did much to prepare a generation of scientists and engineers, develop powerful research engines at many universities and land us on the moon, Dickson at least footnotes the strong reemergence of the feud between the sciences and the humanities. It was at that time that C. P. Snow (1959) wrote his famous *The Two Culture and the Scientific Revolution*. Dickson quotes Dael Wolfe, chief executive officer of the American Association for the Advancement of Science (AAAS) as saying in 1959 that "it was not uncommon to hear someone say with smugness and even a touch of pride, 'I don't know a thing about science'" (p. 231). The same tone is often expressed about mathematics.

Dickson points out that Sputnik also gave rise to curriculum projects in mathematics and the sciences, and a reconsideration of teaching methods. "Schools placed new emphasis on the process of inquiry, independent thinking, and the challenging of long-held assumptions" (p. 229). Laboratory and hands-on approaches were promoted, teaching principles were promoted over just teaching facts, and homework was given a new emphasis.

It might be said that these reforms were swept away in the "back to basics movement" of the 1970s. Darling-Hammond (1997) in *The Right to Learn: A Blueprint for Creating Schools that Work* indicates that needed professional development was usually absent so teaching practice remained essentially lecturing with an emphasis on rote learning so that "almost none of the progressive curricula developed in these projects are still in evidence in schools".

TIMSS

TIMSS now stands for "Trends in International Mathematics and Science Study". It formerly was the 1995 Third International Mathematics and Science Study. (Some sources report that TIMSS was a follow-up to the Second International Mathematics and Science Study (SIMSS), and FIMSS. Gonzales (2000) paints a somewhat more complicated landscape. The success of the

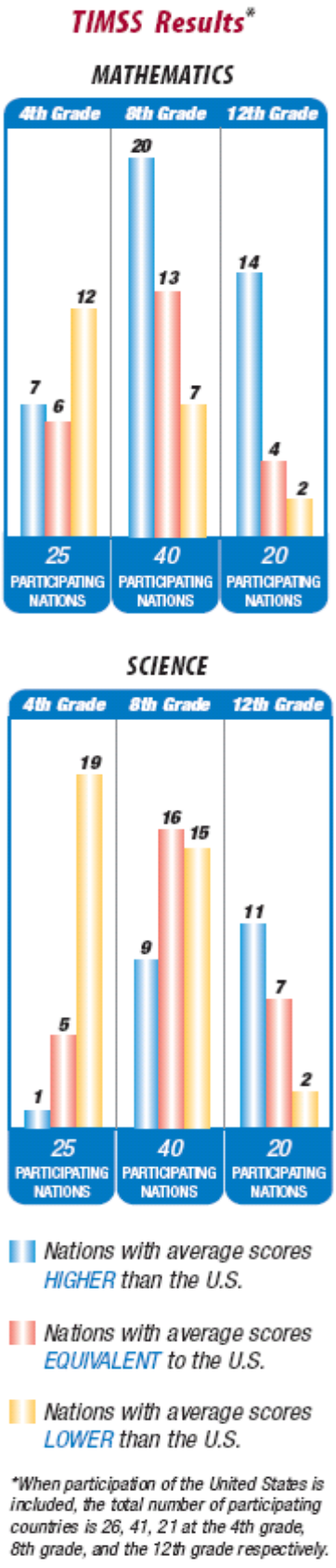
First International Mathematics Study (FIMS) in 1966 led to the First International Science Study in 1970. They were followed by SIMS in 1981-1982 and SISS in 1983-1986.)

As of 2005 we have results from three TIMSS: 1995, 1999 and 2003. The graphs to the right (which appeared in the Glenn Commission report – see below) compare mathematics and science results for the U.S. samples in 4th, 8th, and 12th grade with the results for other participating countries. In general, comparisons are reasonably favorable for the U.S. in 4th grade, in 8th grade we are very much in the middle, and in 12th grade we did not compare favorably at all.

The 8th grade test was repeated in 1999 (called TIMSS-R for repeat). It had been hoped that because of the relatively high performance in 4th grade in 1995 that the 8th grade results would be comparatively higher in 1999. That was, however, not the case. The 8th grade sample in 1999 performed essentially the same as the 8th grade sample in 1995.

The TIMSS 2003 results <timss.bc.edu/timss2003.html> show that the U.S. experienced significant improvement over the 1995 results in both mathematics and science in 8th grade, but the 4th grade results remained flat. As in earlier studies the Asian countries were the top performers.

The TIMSS results have probably done much to communicate the relatively unimpressive performance of U.S. students in comparison with students in many Asian and European countries. TIMSS is quoted in virtually all reports on U.S. academic and economic competitiveness. Among educators, however, it may be the results of the TIMSS video studies that have had the most impact. Stigler and Hiebert (1999) reported in detail in *The Teaching Gap: Best Ideas from the World's Teachers for Improving Education in the Classroom* on the video studies of 8th grade classroom in the United States, Germany and Japan. They present compelling evidence that there are distinctly American, German, and Japanese ways or systems of teaching. The American way of teaching mathematics consisted of going over previous material and homework, showing the students procedures for solving a particular kind of problem, giving them time to practice those procedures, and assigning homework. In contrast, Japanese teaching focused on teaching for conceptual understanding by considering the concepts in previous lessons, presenting a challenging problem, giving students time to work on that challenging problem, discussing student solutions, and



highlighting major points. Stigler and Hiebert (1999) suggest that mathematics is seen by teachers in the U.S. as a set of procedures and therefore is something boring. Japanese teachers, on the other hand, tend to look at mathematics as a set of relationships among concepts, facts and procedures, and therefore it is something that is interesting. Teachers in the U.S. tended to see learning as arriving at a mastery of the subject step by step with a lot of practice, and avoiding confusion and frustration. Japanese teachers tended to see learning emerge by students attempting to solve challenging problems, discussing methods and connections, with confusion and frustration as part of the process. Japanese teachers also were often involved in long-term professional development often called "Lesson Study" which will be considered in Chapter 5. (Some variety of "Lesson Study" was one variable that led to the schools in the Gadsden district that had the highest achievement.)

Bayer Facts of Science Education Surveys

Every year since 1995 the Bayer Corporation has conducted a survey that looks at attitudes to some aspects of science literacy and science education – *Bayer Facts of Science* <www.bayerus.com/msms/news/facts.cfm>. The most current, *Bayer Facts of Science XI – 2005* is subtitled "Parents of Under-Represented Students in Science and Engineering Speak Out on Issue in New National Survey". This survey shows that the vast majority of parents of under-represented students have confidence that their children have what it takes to succeed in science in school and in the workplace; although they also think that a better job needs to be done of communicating opportunities in science.

In the *Bayer Facts of Science Education X – 2004*, "Are the Nation's Colleges and Universities Adequately Preparing Elementary Schoolteachers of Tomorrow to Teach Science?" the data indicated that although there is much rhetoric on how science should be "the 4th R", it is still a "second-tier" subject in the preparation of elementary teachers and in most elementary classrooms. Well over 90% of elementary teachers reported teaching reading and mathematics every day, but only 35% teach science every day and 29% reported teaching science two days or less a week. Also, in elementary teacher preparation, less emphasis on science than on reading and mathematics was indicated. In New Mexico, however, 12 credits of science content are required and only six credits of mathematics content courses. In New Mexico Statutes (22-13-1) the only subjects required to be taught on a daily basis are reading and language arts in grades 1, 2 and 3.

In *Bayer Facts of Science Education IX – 2003,* the general public indicated that the role of science was critical to national security. However, almost 90% expressed concern that low performance on TIMSS indicated that U.S. security and the economy might be negatively affected. In *VIII-2002,* college students expressed the importance of science and technology in the war on terrorism. Most felt that their generation had been adequately prepared in science, but expressed concern about the preparation of the next generation.

In *VII-2001*, "It's Not Your Father's Workplace Anymore," managers expressed concern that the students in schools today might not be prepared for the demands of the jobs of the future. They emphasized the importance for workers of solving unforeseen problems, adapting to change, working well in teams and continuing to improve and expand their skills.

The Glenn Commission Report

Before It's Too Late <www.ed.gov/inits/Math/glenn/index.html> is subtitled *A Report to the Nation from the National Commission on Mathematics and Science Teaching for the 21st Century*. It has been popularly known as the *Glenn Commission Report* after John Glenn who chaired the Commission that was appointed by Secretary of Education Richard Riley during the Clinton Administration. Cindy Chapman from Albuquerque Public Schools was invited to make a presentation before the Commission. Published in September of 2000, the report's primary message was "America's students must improve their performance in mathematics and science if they are to succeed in today's world and if the United States is to stay competitive in an integrated global economy" (p. 7). The report expresses clearly "the deeper value of mathematical and scientific knowledge" (p.15).

- First, mathematics and the sciences bring order, harmony, and balance to our lives.
- Second, science and mathematics continually shape and reshape our history and culture, giving rise to new ideas and inventions.
- Third, as science and mathematics provide human beings with powerful tools for understanding and continually reshaping the physical world itself, they teach us again and again that Nature's secrets can be unlocked – in short that the new is possible.

The Hart-Rudman Report

Road Map for National Security*: *Imperative for Change is often referred to as the *Hart-Rudman Report*, as Gary Hart and Warren Rudman were Co-Chairs of the U.S. Commission on National Security/21st Century (2001) <govinfo.library.unt.edu/nssg/PhaseIIIFR.pdf>. The Commission suggested that "the inadequacies of our systems of research and education pose a greater threat to U.S. national security over the next quarter century than any potential conventional war that we might imagine" (p. ix). They sum up the relationship between education and national security as follows:

> The nation is on the verge of a downward spiral in which current shortages will beget even more acute future shortages of high-quality professionals and competent teachers. The word "crisis" is much overused, but it is entirely appropriate here. If the United States does not stop and reverse negative educational trends—the general teacher shortage, and the downward spiral in science and math education and performance—it will be unable to maintain its position of global leadership over the next quarter century (p. 41).

The World Is Flat

The World Is Flat: *A Brief History of the 21st Century* is *New York Times* columnist Thomas Friedman's (2005) account of how the convergence of technological and political forces has produced a global, Web-enabled, level economic playing field facilitated by multiple forms of collaboration that are not seriously hindered by geography or distance. Among the more notable results of this "flattening" of the world have been the outsourcing of manufacturing to China and aspects of software development to India. Friedman expresses his concerns about the devaluing of mathematics and science in the United States by using a term he borrowed from Shirley Ann Jackson, the current Chair of the American Association for the Advancement of Science (AAAS) and president of Renssalaer Polytechnic Institute. The term, "Quiet Crisis", was coined by Dr. Jackson to indicate the steady erosion of our scientific and engineering base. To explain the "Quiet Crisis" Friedman identifies three "dirty little secrets": the Numbers Gap, the Ambition

Gap and the Education Gap. The Numbers Gap includes all the Sputnik inspired scientists and engineers who are retiring (along with many current mathematics and science teachers), and the decline in the percentage of U.S. degrees in science and engineering. The Ambition Gap refers to the perception that US students and workers are neither particularly motivated nor productive, often have a sense of entitlement, and do not realize the competitive nature of the now flattened world. The Numbers Gap and the Ambition Gap help to explain the Education Gap: "not only is talent abroad cheaper, but a lot of it is as educated as American workers – or even more so" (p. 265). And federal funding as a percentage of GDP for research in mathematics, physical sciences and engineering is declining, as is the percentage of scientific papers written by Americans. American companies are investing many of their research and development dollars abroad. "It appears that young people wanting to be lawyers started to swamp those wanting to be engineers and scientists in the 1970s and early 1980s. Then, with the dot-com boom, those wanting to go to business school and earn MBAs swamped engineering students and lawyers in the 1990s." (p. 273)

The Knowledge Economy

The Knowledge Economy*: *Is The United States Losing Its Competitive Edge? <www.futureofinnovation.org> from the Task Force on the Future of American Innovation presents a set of benchmarks for assessing the United States' international standing in science and engineering. Signs of Trouble (many of them mentioned in *The World Is Flat*) are presented for each of the following:

- Education Benchmarks: Fewer engineering and science (S&E) degrees
- Workforce Benchmarks: U.S. S&E jobs growing faster than S&E degrees, retirements
- Knowledge Creation and New Ideas Benchmarks: Smaller U.S. proportion of S&E papers, citations and patents
- R&D Investment Benchmarks: Private funding increasing faster in Asia, federal funding down (and private funding targeted more at short term)
- High-tech Economy Benchmarks: U.S. share of high tech exports in a 20-year decline, current high tech trade balance in deficit, high tech sector growing faster in Asia
- Sector Benchmarks
    - Nanotechnology: Significant developments in Asia
    - Information Technology: Manufacturing in accelerating decline, U.S. ranked 13th out of 15 highly developed countries in household broadband penetration
    - Energy: Scaled back Fusion Energy Science Program and no plans for nuclear energy
    - Aerospace: Increased sales of foreign-made commercial aircraft to U.S. carriers
    - Biotechnology: China making rapid progress

Broadening Participation in America's Science and Engineering Workforce

This report <www.nsf.gov/od/oia/activities/ceose/reports/ceose2004exec.pdf> from the Committee on Equal Opportunities in Science and Engineering (CEOSE), a congressionally mandated committee established in 1980, advises NSF on policies and programs for increasing the number of underrepresented individuals in the STEM fields. The following quote quite nicely summarizes the committee's way of looking at the valuing of mathematics and science:

> Early efforts to broaden participation focused primarily on encouraging individuals from underrepresented segments of the population to enter STEM disciplines. This "pipeline" metaphor is a way of looking at the persistence of women, minorities, and persons with disabilities in STEM statistically. It emphasizes attracting students into the STEM "pipeline" when they are young, and spotlights the points at which "leaks" occur, differentially draining away individuals from underrepresented groups. Today, many efforts to make science and engineering more inclusive are paying attention instead to the multiplicity of "pathways" by which persons from underrepresented groups can enter and progress through STEM careers. Creating viable pathways requires addressing the tough issues related to what invites children to learn science (attraction), what causes young people to choose to keep learning mathematics and science (retention), and what then leads students to graduate (persistence) and continue into STEM careers (attachment). (pp. 3-4)

CEOSE reports that efforts to broaden participation have been a "slow, complex process" that has been hampered by institutional inertia, hidden biases, and a lack of knowledge about the factors that influence in the attraction, retention, persistence and attachment of an individual to careers in the sciences and engineering.

Tapping America's Potential

Tapping America's Potential*: The Education for Innovation Initiative* <www.itic.org/archives/TAP Statement.pdf> is a statement from fifteen prominent business organizations that sets as a goal for the country to **"double the number of science, technology, engineering and mathematics graduates with bachelor's degrees by 2015"** (p. 1). They cite data on increasing international competition in producing scientists and engineering (particularly in Asia), increasing reliance on foreign talent to work in the United States while at the same time there is reduced availability of such talent, and "alarming domestic trends" in the number of engineering degrees awarded in the United States, and low performance of U.S. students at the 12th grade level in international comparisons of mathematics and science achievement.

A Commitment to America's Future

A Commitment to America's Future: *Responding to the Crisis in Mathematics and Science Education* <www.bhef.com/MathEduReport-press.pdf> prepared by the Business-Higher Education Forum (BHEF) has proposed "a four-part plan in which business, higher education, and policy leaders support P-12 education leaders in achieving comprehensive, coordinated, system-level improvement from pre-kindergarten through postsecondary activity in college and into the workplace". This report uses powerful metaphors to describe the "dimensions of the challenge":

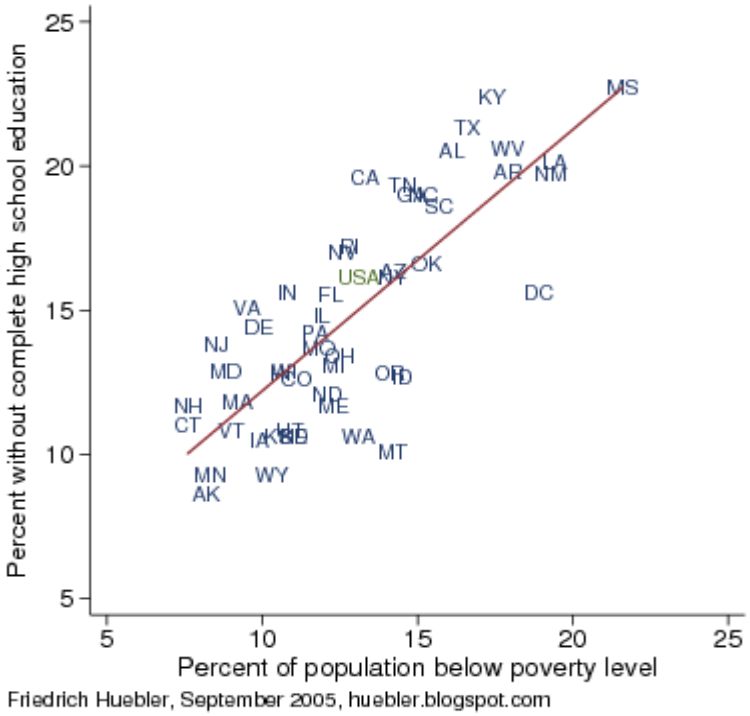
- P-12 Education: **Cracks in the Foundation**,
- Undergraduate Education: **Slowed Start and Fewer Finishes**,
- Graduate Education: **A Foreign Idea**, **Bare Shelves in the Employment Marketplace**, and
- Calling for More Highly Qualified Teachers: **No One at Home**.

The Culture of Poverty

Researchers have established that socio-economic status, whether measured by family income, parent education, or parent occupation, is one of the most powerful predictor of achievement and test score performance (White, 1982). Children of the wealthy are far more likely to become wealthy, become professionals, and attain positions of power than children of the poor (Simonton, 1994). However, the explanation may be more than merely socioeconomic. While differences in family income contribute to the significant gaps in student achievement, family income alone does not entirely explain the reasons for the gap (Kober, 2001).

In the United States, the states with the highest poverty rates are also those with the lowest share of high school graduates <huebler.blogspot.com/2005/09/poverty-and-educational-attainment-in.html> (see Figure 12).

Figure 12: Poverty and High School Completion



The regression line emphasizes the close link between poverty and lack of education in the United States. Mississippi has the poorest and least educated population, with 22% living below the poverty level and 23% not having graduated from high school. New Mexico is among the states with a low share of high school graduates and high poverty rates. In contrast, Alaska, Connecticut, Minnesota, and New Hampshire have the least poor and most educated population in the United States. In the country as a whole, 13% of the population lives below the poverty level and 16% did not graduate from high school (Huebler, 2005).

In 2003, the poverty rate for all individuals in the United States was 12.5%. For children under the age of 18, the poverty rate was 17.6%, and for children under the age of 6, the rate was 20.3% (U.S. Bureau of the Census, 2004). Further statistics show that:

- There were 7.6 million poor families (10%) in 2003, up from 6.4 million (6.7%) in 2000 (U.S. Bureau of the Census, 2004).

- The foreign-born population in the United States has increased 57% since 1990 to a total of 30 million. In 2000, one out of every five children under age 18 in the U.S. was estimated to have at least one foreign-born parent. Immigrant children are twice as likely to be poor as native-born children. Among children whose parents work full

time, immigrant children are at greater risk of living in poverty than native-born children (National Center for Children in Poverty, 2002).

- Regardless of race or ethnicity, poor children are much more likely than non-poor children to suffer developmental delay and damage, to drop out of high school, and to give birth during the teen years (Miranda, 1991).

- Children under age 6 remain particularly vulnerable to poverty. In 2003, children under 6 living in families with a female head of house and no husband present experienced a poverty rate of 53.7%, more than five times the rate for children in married families, 9.7% (U.S. Bureau of the Census, 2004).

- The United States' child poverty rate is substantially higher—often two or three times higher—than that of most other major Western industrialized nations (Payne, 2005).

This phenomenon poses a unique and continuing challenge for New Mexico's educators. Data on student achievement continue to show a persistent achievement gap in student performance, irrespective of the measure (i.e., NAEP, state assessments) despite the existence of a number of federally- and state-initiated reform initiatives. In addition, while family income and parent education help explain aspects of the achievement gap, Kober (2001) found that these factors only account for about one-third of the explanation. Learning Point Associates (2005) summarized key findings from the Kober (2001) report.

- Black, Hispanic, [and Native American] students tend to take less-rigorous courses. Though there are more [minority] students taking academically rigorous courses now than in the past, whites and Asians still tend to be overrepresented in such courses. In part this situation results from the lack of advanced courses at high-minority schools. In particular, researchers have found that schools in high-minority or high-poverty areas often offer a less-rigorous curriculum to begin with. They thereby fail to challenge students, since they cover less material or give less homework. This is a problem because research has found that students enrolled in challenging courses—in topics such as algebra, trigonometry, chemistry, and advanced English—usually have higher test scores than their peers.

- There is a lack of experienced teachers. [Minority] students are more likely to be taught by less-experienced teachers than white students. Researchers have cited this factor as one of the most critical variables for explaining the achievement gap: there is a correlation between higher teacher certification scores and higher student achievement scores. Teachers in districts where there are high percentages of black or Hispanic students tend to have lower scores on their certification tests.

- Teachers set their expectations low. Studies have suggested that teachers sometimes have lower academic expectations for black and Hispanic children than they do for whites or Asians. Kober warns that by setting expectations low, teachers run the risk of perpetuating the achievement gap since they do not encourage black and Hispanic students to follow a rigorous curriculum.

- Resource disparities handicap schools. Low-minority schools tend to be much better funded and have all-around stronger resources than do high-minority schools. The same relationship holds true for schools in low-poverty versus high-poverty areas. There is persuasive evidence that this factor contributes to the achievement gap. For example, data from the National Assessment of Educational Progress show the achievement gap between low-poverty and high-poverty schools increased throughout the 1990s.

- Low-income and minority students tend to be concentrated in certain schools. Kober notes that if a school has high levels of poverty, achievement for all the children in that school is depressed, even if they are from higher income families. This fact hits black, Hispanic, [and Native American] children the hardest, since they are more likely to attend higher poverty schools than are whites or Asians.

- Student performance anxiety hampers minority students. Some research suggests that [minority] students can become anxious about corresponding to negative racial stereotypes in their academic work. The result, researchers say, is a kind of vicious circle: [minority] students can be so worried about seeming stereotypically ungifted academically that their anxiety actually makes them perform less well than they could.

- Peer pressure may cause students to scorn academic success. Kober notes that there is some dispute as to the effects of peer pressure. Some researchers, for example, have pointed to a phenomenon in high-minority schools whereby black students who perform poorly actually criticize their academically successful peers for "acting white." These researchers have charged that black students tend to idolize a youth culture that scorns academic achievement. However, other researchers have argued that such a culture exerts no special power on black students in particular; instead, they claim that black students are no more likely to scorn school than are whites.

- Access to high-quality preschool is a necessity. Since minority children are more likely than whites to live in single-parent households and to enter school already developmentally behind, then high-quality preschool is imperative for these children. Nonetheless, Kober finds, children of lower income households are much less likely to attend preschool than are children of more affluent families.

- The school's disciplinary atmosphere also plays a role. Minority students are less likely than white students to attend schools with good facilities and a well-controlled disciplinary atmosphere. In turn, high-minority schools often have special safety issues that worry the students' parents.

But What Are Public Attitudes toward Science and Mathematics?

The positive aspects of the U.S. response to the Soviet launch of "Sputnik" in 1957 were discussed above. That first manmade object in orbit, passing overhead every 98 minutes, was a reminder and a threat to the majority of Americans – a reminder that the world was growing steadily more technological, and a threat that another country might conquer us through scientific and technological superiority instead of through troop strength and traditional military-industrial

capacity. Thus, Sputnik triggered a prolonged, patriotic focus on science and mathematics education in the U.S.

That focus faded with the end of the Cold War. Today, general public attitude toward science and mathematics literacy and education might be described as a schizophrenic but mostly negative mixture that includes:

- Widespread mistrust of intellectuals and experts.
- Fear that China and India will capture ever more of our high-tech jobs and overwhelm us economically, by virtue of their attention to science and math education.
- Mistrust of immigrants.
- Increasing reliance on immigrants to fill science, math, and technology positions requiring PhD-level education (e.g., university professorships).
- Heavy reliance on technological products of science and mathematics (e.g., communication, energy, transportation, agriculture).
- Attacks of main-stream science that is fueled by fundamentalist Christian anti-evolutionists who conflate science and atheism.
- Mistrust of science that is fueled by vocal individuals and groups who try to gain legitimacy by cloaking their advocacy in the guise of science.
- The belief that scientifically and mathematically literate people are nerdy geeks.

In response, New Mexicans could:

- Publicly honor scientific, mathematical, and technological expertise.
- Emphasize the importance of tech-based jobs in New Mexico and other Western states without widespread agriculture.
- Emphasize the current global nature of competition for high-paying, tech-based jobs.
- Clarify the distinction between science and other ways of knowing (e.g., authority, personal experience) and promote the view that different ways are complementary, not conflicting. When my car won't start, I might note whether it is silent or it makes the familiar, vigorous "ruh, ruh, ruh,..." sound when I turn the key, and use that information to deduce whether the problem lies in the electrical system or the fuel system. This approach is science. I might also ask myself "What did I do to deserve this?" and "What did I do (or forget to do) recently that might explain this?" These alternative approaches to my nonfunctional car are not in conflict with the scientific approach; they are complementary.
- Fight the false conflation of science and atheism by emphasizing the difference between methodological materialism, which is a successful set of rules guiding the scientific approach to knowledge, and philosophical materialism, which is the belief that nothing supernatural exists.

(See "Evolution vs Creationism" by Eugenie Scott (2005) for elaboration of those two points.)

Mathematics and Science in the Popular Media

One may think that the Discovery Channel, the Science Channel (no Math Channel yet?) or public television is where one would go to see mathematics and science in the media. Certainly *Nova*, *Bill Nye the Science Guy*, *Mathnet*, *Square One TV*, and, of course, *Sesame Street* have informed and, in some cases, motivated interest in mathematics and science. However, since prime time television and first run movies reach a much wider audience they may have much more of an impact on what the public values. Keith Devlin (2005), a columnist for the Mathematical Association of America, in commenting on the new CBS prime time crime show, *NUMB3RS*, in which the hero is a mathematician, suggests that:

> For one thing, successful movies or television series have in the past led to a significant upsurge in the numbers of students who opt for various majors at university. Perhaps the most cited instance of this is the large number of AI practitioners who were first inspired to enter the field by the 1968 movie *2001*. And I'm told that criminal forensics got a huge boost as a potential career as a result of the TV series *CSI*.

Since many non-mathematician reviewers found the mathematics in NUMB3RS hard to believe, Devlin is also quick to point out that it is real mathematics that has been used to solve real cases. Texas Instruments in collaboration with CBS has developed a website with mathematics activities for teachers and students based on NUMB3RS <www.cbs.com/primetime/numb3rs/ti/>.

This possible interest in mathematicians is mirrored in several recent movies: *Proof*, *A Beautiful Mind*, *Pi*, and *Good Will Hunting*. A mathematician was also one of the major characters of *Jurassic Park*.

Science in movies and television is somewhat more complicated. Techno gadgets, wild science fiction premises, and portrayals of mad scientists may do much to generate misconceptions and stereotypes. On the other hand, such movies as *Contact*, which starred Jody Foster trying to decipher possible extraterrestrial messages, did have much that was authentic and portrayed a positive image of a female scientist. *October Sky* told the story of future NASA scientist Homer Hickam who was originally motivated by seeing Sputnik move across the sky.

And a valuing of mathematics can appear in unexpected places. The long-running, popular cartoon series *The Simpsons* has spawned a website called simpsonsmath.com. It gives the mathematical credentials of *The Simpsons'* writers (several of whom have mathematics or science degrees from prestigious universities), shows where mathematics has appeared in the show (often ridiculing innumeracy), and gives suggestions for related mathematical activities for students.

The American Mathematical Society (AMS) maintains a website on which it examines examples of "Math in the Media" <www.ams.org/mathmedia/>. That website includes short summaries of articles about mathematics in the popular press, and "reviews of books, plays, movies and television shows that are related to mathematics (but are not aimed solely at the professional mathematician)".

There is also a website called www.scienceinthemovies.com. This website promotes a presentation available for schools and other organizations in which Steve Wolf, a Special Effects Coordinator, "uses his knowledge and experience to help students develop an appreciation and understanding of science".

Corporate Investment

It is generally assumed that money is spent on what is valued. A recent *Education Week* article (Borja, 2005a) indicated that the General Electric Foundation, www.ge.com/foundation, has $100 million that it will distribute to up to five school districts over the next five years to improve mathematics and science education. The IBM International Foundation has established a "Transition to Teaching" program that will pay tuition cost for up to 100 employees who want to become mathematics or science teachers. In announcing the program IBM Foundation officials stressed U.S. Department of Labor predictions of a 51-percent increase in jobs related to science, engineering and technology between 1998 and 2008, and U.S. Department of Education estimates that more than a quarter-million secondary math and science teachers will be needed by the 2008-09 school year.

A related *Education Week* article (Borja, 2005b) reports on a conference where business leaders called for more cooperation in K-12 giving efforts. "A prominent theme was how corporate foundations can leverage the time and money they give to pre-collegiate education so that high school students will have the math, science, problem-solving, and reasoning skills they need after they graduate—skills the conference-goers said public schools do not sufficiently teach" (p.6). Among the companies represented that have charitable arms that contribute to mathematics, science and technology education were Johnson and Johnson, Citigroup, Ford Motor Company (a major sponsor of the conference) and Microsoft.

Appendix 6 provides a list of many private foundations that fund math or science projects.

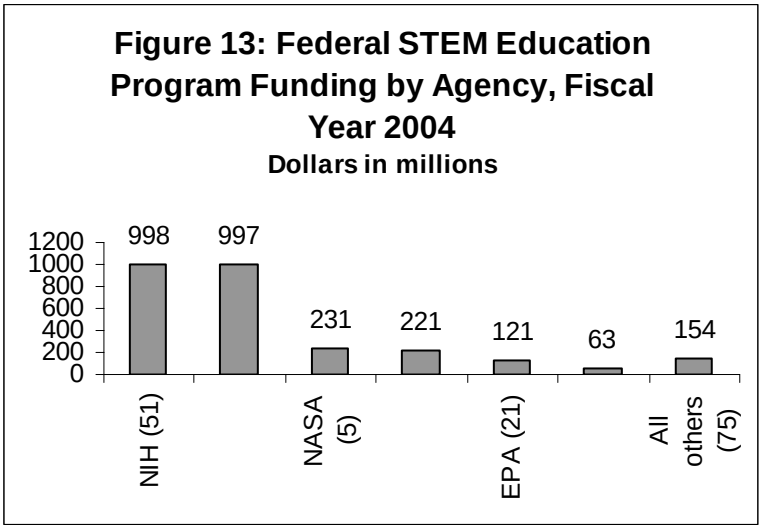
Congressional Initiatives and Federal Spending

Both houses of the U.S. Congress have created a Science, Technology, Engineering and Mathematics Education (STEM Ed) Caucus. Representative Vernon Ehlers (R-MI) and Representative Mark Udall (D-CO) lead the House STEM Ed Caucus. In September they launched a new recruitment effort to encourage their colleagues to join by sending a Dear Colleague Letter all members of the House of Representatives. Senators Norm Coleman and Dick Durbin (D-IL) (R-MN) co-chair the U.S. Senate STEM Ed Caucus. In addition to pushing for legislation to improve STEM education, the STEM Ed Caucus recently sent a letter to the Office of Management and Budget encouraging increased funding for Math and Science Partnerships (MSPs) in both the NSF and USDOEd. As of September 30, 2005, New Mexico Representatives Tom Udall and Heather Wilson were the only members of the New Mexico Congressional delegation that belonged to either of the STEM Ed caucuses. Would STEM Ed caucuses be useful in the New Mexico Legislature?

House Democrats on the Science Committee have established a new section of their website called "Science Education and You" that includes a variety of web-based resources developed with federal funds for science and mathematics educators. The site was developed at the suggestion of Tennessee Representative Bart Gordon and was launched in mid-September.

"Science Education and You" includes an extensive listing of ready-to-use math and science lesson plans and other resources from the Smithsonian Institute and many federal agencies, including the Environmental Protection Agency, the U.S. Geological Survey, and Triangle Coalition members and partners, the U.S. Department of Energy, NASA, the National Oceanographic and Atmospheric Administration, and the National Science Foundation. Student resources include quick links to many NASA resources and opportunities to "Ask a Scientist" questions related to learning. Visit sciencedems.house.gov/resources/science_education.htm for more information.

In light of concerns about the situation with respect to STEM education, the U.S. Government Accountability Office (GAO) in October of 2005 released a Report (GAO, 2005) to the Chairman, Committee on Rules, House of Representatives, on *Higher Education: Federal Science, Technology, Engineering, and Mathematics Programs and Related Trends* <www.gao.gov/new.items/d06114.pdf>. They discovered that for fiscal year 2004 officials from 13 federal civilian agencies indicated that they had spent a total of about $3.8 billion to improve STEM education and increase numbers of STEM students and graduates in 207 education programs (see Figure 13). The agencies reported little about their effectiveness.



The GAO's "Concluding Observations" give an overview of the confusing landscape:

> While the total numbers of STEM graduates have increased, some fields have experienced declines, especially at the master's and doctoral levels. Given the trends in the numbers and percentages of students pursuing STEM degrees, particularly advanced degrees, and recent developments that have influenced international students' decisions about pursuing degrees in the United States, it is uncertain whether the number of STEM graduates will be sufficient to meet future academic and employment needs and help the country maintain its technological competitive advantage. Moreover, it is too early to tell if the declines in international graduate student enrollments will continue in the future. In terms of employment, despite some gains, the percentage of women in the STEM workforce has not changed significantly, minority employees remain underrepresented, and many with degrees in STEM fields are not employed in STEM occupations. (p. 41)

Summary

There seems to be significant consensus that Mathematics and Science education are very important to our economic health and national security, and significant investment to try to

improve them. At the same time, there is serious concern that we may not be reaching the levels of achievement, student interest and motivation that are necessary. There is also some concern that the general public neither understands nor accepts the methods and values of science.

However, despite the evidence presented above, it should be mentioned that in a recent *Education Week* article Honawar (2005) points out that not everyone agrees that school achievement is threatening the U.S. economy. The article paraphrases David Berliner, a professor of educational leadership and policy studies at Arizona State University, in stating that there "is no correlation between school achievement and economic might in industrialized nations" (p. 1). Also, mentioned in the article is Elizabeth Leu, a senior education advisor at the Academy for Educational Development, who has suggested that international tests comparing the U.S. with foreign countries can be misleading because the questions are not always linked to what students are being taught.

CHAPTER 3

PROMOTING THE IMPORTANCE OF MATHEMATICS AND SCIENCE LITERACY

> If President Bush is looking for a similar legacy project [i.e. similar to Kennedy's "put a man on the moon in 10 years"], there is one just crying out – a national science initiative that would be our generation's moon shot: a crash program for alternative energy and conservation to make America energy-independent in ten years (Friedman, 2005, p. 283).

Many of the reports reviewed in Chapter 2 present ideas for promoting the importance of mathematics and science literacy.

National Proposals for Promoting Math and Science Literacy

The **Glenn Commission Report**, *Before It's Too Late,* presented action steps that seven identified stakeholder groups can take to improve K-12 Mathematics and Science achievement. Below for each of those groups are the suggested action steps. Many of them might help to promote the "importance of mathematics and science literacy".

School Board and Superintendent Team

- Develop a common vision, with input from the community, for promoting a high level of student achievement in mathematics and science.
- Use accurate data to develop policies that will improve mathematics and science teaching.
- Commit funding to ensure that all mathematics and science teachers have ongoing collaborative opportunities to improve their skills and knowledge.
- Set a target date for hiring only fully certified teachers of mathematics and science and put in place the policies and programs necessary to meet the target.
- Aggressively recruit high-quality mathematics and science teachers from a nationwide pool, including those certified through alternative pathways (e.g., by offering signing bonuses or giving salary credit for all previous experience).
- Provide competitive salaries to attract and retain the best-qualified mathematics and science teachers.
- Establish induction programs to ensure that new mathematics and science teachers receive the support necessary to be effective.
- Develop mathematics and science teacher leaders who facilitate the continuous learning of their colleagues.
- Provide administrators and teachers with electronic and other forms of access to an ever-expanding knowledge base about mathematics and science teaching.

Principals

- Provide your teachers with significant professional development opportunities to improve their teaching year-round including in-depth study through Inquiry Groups with peers, mentors and outside experts and through Summer Institutes.
- Ensure that teachers and other school staff have electronic and other forms of access to the ever-expanding knowledge base about mathematics and science teaching.
- Ensure that new mathematics and science teachers have frequent interaction with mentor teachers, participate in Inquiry Groups, and have reasonable teaching loads.

- Should you have no option but to assign an out-of-field teacher, be certain that a mentor and other ongoing support is available.
- Ensure that opportunities to pursue careers in mathematics and science teaching are emphasized for students in your school.

Teachers

- Actively seek new knowledge about teaching in your discipline, work with your peers on a continuing basis to improve your skills, and take full advantage of the professional development opportunities offered by your district and state.
- Actively work to improve your knowledge and skills to incorporate educational technology into your learning and teaching.
- Communicate to parents the specific standards that students are to meet at each grade level and update parents on their child's progress in meeting these standards.
- Regularly work with colleagues to compare the achievement level of your students against the standards in your district and state, identify areas for improvement, set goals, and make plans for achieving these goals.
- Actively share your knowledge and experience with new teachers.

Parents

- Learn about the mathematics and science standards that children are required to meet in your state and get a clear picture of how well your child's school is doing in meeting these standards.
- Support the principal's efforts at your child's school to hire well-qualified teachers and to provide them with opportunities to continually improve their skills.
- Support increased funding for programs that support quality mathematics and science teaching.

State Leadership

- Identify the critical professional development needs of the individuals teaching mathematics and science through a district-by-district assessment.
- Develop policies and dedicate funding, based on identified needs, to upgrade content knowledge and improve the skills for all those teaching mathematics and science, K-12.
- Establish and implement a professional development model that addresses the specific needs of mathematics and science teachers and their students through Summer Institutes and Inquiry Groups.
- Establish and enforce high standards for mathematics and science teachers for initial and continuing certification.
- Develop career-long incentives and rewards for effective mathematics and science teachers that encourage them to remain in teaching and to continually upgrade their skills.
- Establish alternative pathways to teacher certification that encourage recent college graduates and people with degrees in mathematics and science to pursue teaching.

Higher Education Institutions

- Work closely with area schools to identify existing and future needs for highly qualified K-12 mathematics and science teachers.
- Ensure that your program meets criteria for exemplary math and science teacher preparation and actively contribute to the knowledge base in support of these criteria.
- Collaborate with area school districts to ensure a quality induction process for new mathematics and science teachers.
- Emphasize recruitment strategies and provide incentives for eligible students to become science and mathematics teachers.
- Evaluate and track teacher performance following graduation and use this information to improve your mathematics and science teacher preparation programs.

Business

- Work to increase the supply and quality of incoming mathematics and science teachers by advocating for policies, programs and investments that will make the teaching profession a more attractive career option.
- "Lend" qualified employees to act as part- or full-time teachers in local schools, without incurring loss of pay or benefits.
- Actively participate in reward and incentive programs that recognize excellence in mathematics and science teaching in local schools as measured by improved student achievement.
- Provide support for National Board for Professional Teaching Standards certification.
- Make regular contributions of time, materials and resources to enhance instruction in mathematics and science education in local schools.

The **Hart-Rudman Report** in its *Road Map for National Security* does not give suggestions for local action, but two of the education and research related strategies for improving the situation could have a positive impact on New Mexico if they were fully implemented (a third strategy has to do with strengthening historically black colleges and universities):

> 11. The President should propose, and Congress should pass, a National Security Science and Technology Education Act (NSSTEA) with four sections: reduced-interest loans and scholarships for students to pursue degrees in science, mathematics, and engineering; loan forgiveness and scholarships for those in these fields entering government or military service; a National Security Teaching Program to foster science and math teaching at the K-12 level; and increased funding for professional development for science and math teachers (p. 41).
>
> 12: The President should direct the Department of Education to work with the states to devise a comprehensive plan to avert a looming shortage of quality teachers. This plan should emphasize raising teacher compensation, improving infrastructure support, reforming the certification process, and expanding existing programs targeted at districts with especially acute problems (p.43).

In ***The World Is Flat,*** Friedman (2005) presents five categories for action so that the United States can "go about maximizing the benefits and opportunities of the flat world, and providing protection for those who have difficulty with the transition, without resorting to protectionism or runaway capitalism" (p. 280). In those five categories (leadership, muscle building, cushioning, social activism, and parenting) are ideas for promoting mathematics and science literacy. From leadership we need politicians who have a basic understanding of the forces that are flattening the world, and educate their constituents about them and work with them on responses. In talking about "muscle building" Friedman also makes an analogy to Kennedy's putting a man on the moon: "My vision is to put every American man or woman on a campus" (p. 290). To accomplish that he sees the need for more government subsidies so that more kids can go to college. Companies also now have a responsibility to offer cross-training opportunities so that employees are less vulnerable to outsourcing.

It is in the area of "parenting" that Friedman (2005, p. 303) perhaps gives our Town Hall his most important advice: "Put simply, we need a new generation of parents ready to administer tough love. There comes a time when you've got to put away the Game Boys, turn off the television set, put away the iPod, and get your kids down to work." Do you remember as a child

being told: “Eat your vegetables. Children are starving in China”? Now parents might well tell their children: “Do your homework. The kids in China are doing theirs’.” Of course, just as our response was “well then, let’s send my vegetables to China”, the response now might be “well then, let me email my homework to them.” And email future high paying jobs to them as well!

***Tapping America’s Potential*:** *The Education for Innovation Initiative* gives specific recommendations to “motivate U.S. students and adults to study and enter science, technology, engineering and mathematics careers, with a special effort geared to those in currently underrepresented groups” (Business Roundtable, 2005, p. 4). The recommendations include

- More scholarship and loan forgiveness programs for those studying STEM two-year, four-year and graduate degrees including those planning to become STEM teachers, particularly those who will work in high-poverty schools.
- Increase retention rates of undergraduate STEM majors by expanding such programs as NSF’s STEP Tech Talent, <www.nsf.gov/funding/pgm_summ.jsp?pims_id=5488>, and the Professional Science Masters, <www.sciencemasters.com>, that provides wider career options than current science masters, and encourage collaboration between industries and universities to “establish clear metrics to increase the number of graduates”.
- Eliminate current security clearance backlog that is delaying entry into some fields.
- Establish “prestigious fellowships” to recent graduates and mid-career STEM professionals to seek licensure and commit to teaching for at least five years.
- Create more opportunities for talented math and science students: immersion programs; corporate internships; charter schools; local, regional and state magnet schools.
- Adopt rigorous mathematics and science curricula, and create real world engineering and science work experiences.

In ***A Commitment to America’s Future*** the Business-Higher Education Forum (BHEF) describes “a Four-Part Strategy for Solving the Problem”:

1. **Establish a P-16 education council in each state.** P-16 council membership should have balanced representation from business, education, and policy leaders. Representation must include P-12 classroom teachers and administrators, since these leaders have unique understanding of what must and might be done to successfully bridge the final inch of the education gap between policies and pupils. Council membership also must include community college leaders, since the number of students taking basic undergraduate courses in mathematics and science at these institutions is both large and increasing. These P-16 education governance structures should be charged with defining, benchmarking, and initiating a statewide P-16 plan for ensuring that all P-12 students successfully complete a high-quality mathematics and science education. (As of 10/1/05 an amendment to HR 609, the higher education bill, would allocate funds to establish such P-16 councils that would “coordinate K-12, higher education, business and teacher credentialing organizations to improve STEM education”. Could the New Mexico Partnership for Math and Science Education serve as New Mexico’s P-16 council?)
2. **Simultaneously address and align the five P-12 system components.** Effective mathematics and science education requires the close alignment of a P-12 system’s content standards, curricula, assessments, teacher preparation, and accountability

practices. It follows that proposed changes in any one of the five aligned components demands attention to resultant effects in the other four. In addition, because P-12 education is impacted by policies and practices of higher education, business, and government, P-12 system changes must be coordinated with changes in those related policies and practices.

3. **Engage business and higher education in more effective P-12 reform roles.** Business needs to accept greater responsibility for leading state P-16 council work and for aligning all corporate education outreach initiatives with the state's vision of standards-based improvement of P-12 mathematics and science education. Higher education needs to implement policies and programs that place the education of teachers — in particular, teachers of mathematics and science — at the center of its mission.
4. **Implement coordinated national and state-specific public information programs.** These professionally designed programs should be based on a common set of core messages that will engage the public in the nationwide effort to strengthen the mathematics and science education of *all* students. The P-16 councils should guide the state-level campaigns to ensure that they both localize and support the core messages of the national campaign.

Rising Above the Gathering Storm

The National Academies Committee on Prospering in the Global Economy of the 21st Century (2005) was asked by several members of Congress, including New Mexico Senators Bingaman and Domenici, to respond to the following questions:

1. What are the top ten actions, in priority order, that federal policy makers could take to enhance the science and technology enterprise so the United States can successfully compete, prosper, and be secure in the global community of the 21st Century?
2. What implementation strategy, with several concrete steps, could be used to implement each of those actions?

The Committees' recommendations and suggested actions became available in October of 2005 in a prepublication from the National Academy Press entitled *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future* <www.nap.edu/catalog/11463.html>. They have been built on the recommendations from past groups, many of which were reviewed above. Four recommendations were made by the Committee along with twenty specific actions to implement them, rather than the ten requested. The recommendations and the specific suggested actions are presented below:

Ten Thousand Teachers, Ten Million Minds

Recommendation A*: Increase America's talent pool by vastly improving K-12 Mathematics and science education.*

Action A-1: Recruit 10,000 teachers, Educate ten million minds.

To attract 10,000 students to get bachelor's degrees in a STEM discipline with concurrent certification as K- 12 mathematics and science teachers it is proposed to offer merit-based scholarships of $10,000–20,000 a year for 4 years with a commitment to teach 5

years (with a $10,000/year bonus if in underserved schools in inner cities and rural areas). The scholarships would be matching grants.

Action A-2: Strengthen 250,000 teachers' skills, Inspire students every day.
Use proven models to strengthen the skills (and thus compensation which is based on education and skill level) of 250,000 *current* K-12 teachers. The four examples given are

Summer institutes with the Merck Institute for Science Education given as a model.

Science and mathematics master's programs that focus on rigorous science and mathematics content and pedagogy over a 5-year period with the University of Pennsylvania Science Teachers Institute as a model.

Advanced Placement (AP), International Baccalaureate (IB), and pre-AP or pre-IB training with the Advanced Placement Incentive Program and Laying the Foundation, a pre-AP program, as models.

K-12 curriculum materials modeled on world-class standards with a national panel to collect, evaluate, and develop rigorous K-12 materials that would be available free of charge as a *voluntary* national curriculum.

Action A-3: Enlarge the pipeline.
Create opportunities and incentives for middle-school and high-school students to pursue advanced work in science and mathematics. By 2010, increase the number of students in AP or IB mathematics or science courses from 1.125 million to 4.5 million, and set a goal of tripling the number who passes those tests, to 700,000, by 2010. Some approaches to improving K-12 science and mathematics education are already in use and should be expanded, including:

Statewide specialty high schools in science, technology, and mathematics.

Inquiry-based learning with more laboratory experience available to all students, along with summer internships and research opportunities for at least 2,000 middle-school and high-school students each year.

Sowing the Seeds
Recommendation B: ***Sustain and strengthen the nation's traditional commitment to the long-term basic research that has the potential to be transformational to maintain the flow of new ideas that fuel the economy, provide security, and enhance the quality of life.***

Action B-1: Increase the federal investment in long-term basic research.

Action B-2: Provide new research grants of $500,000 each annually, payable over 5 years, to 200 of our most outstanding *early-career* researchers.

Action B-3: Institute a National Coordination Office for Research Infrastructure to manage a centralized research-infrastructure fund of $500 million per year over the next 5 years.

Action B-4: Allocate at least 8% of federal research agency budgets to discretionary funding.

Action B-5: Create in DOE an organization like the Defense Advanced Research Project Agency (DARPA) called the Advanced Research Project Agency-Energy (ARPA-E) which would report to the under secretary for science and would be charged with sponsoring specific research and development programs to meet the nation's long-term energy challenges.

Action B-6: Institute a Presidential Innovation Award to stimulate scientific and engineering advances in the national interest.

Best and Brightest

Recommendation C: ***Make the United States the most attractive setting in which to study, perform research, and commercialize technologic innovation so that we can develop, recruit, and retain the best and brightest students, scientists, and engineers from within the United States and throughout the world.***

Action C-1: Increase the number and proportion of US citizens who earn physical and life sciences, engineering, and mathematics bachelor's degrees by providing 25,000 new 4-year undergraduate scholarships each year to US citizens attending US institutions.

Action C-2: Increase the number of US citizens pursuing graduate study "in areas of national need" by funding 5,000 new graduate fellowships each year.

Action C-3: Provide a federal tax credit to encourage employers to make continuing education available (either internally or though colleges and universities) to practicing scientists and engineers.

Action C-4: Continue to improve visa processing for international students and scholars.

Action C-5: Provide a 1-year automatic visa extension to international students who receive doctorates or equivalent in science, technology, engineering, mathematics, or other areas of national need at qualified U.S. institutions to remain in the U.S. to seek employment, and should these students be offered jobs by U.S. based employers and pass a security screening test, provide an automatic work permit, and expedite their residency status.

Action C-6: Institute a new skills-based, preferential immigration option.

Action C-7: Reform the current system of "deemed exports" (i.e. the disclosure of information regarding a controlled technology to some foreign nationals).

Incentives for Innovation

Recommendation D: ***Ensure that the United States is the premier place in the world to innovate, invest in downstream activities, and create high-paying jobs that are based on innovation by modernizing the patent system, realigning tax policies to encourage innovation, and ensuring affordable broadband access.***

Action D-1: Enhance intellectual-property protection for the 21st century global economy.

Action D-2: Enact a stronger research and development tax credit to encourage private investment in innovation.

Action D-3: Provide tax incentives for United States-based innovation.

Action D-4: Ensure ubiquitous broadband Internet access.

The Truth about Science

The National Science Teachers Association (NSTA) publishes a curriculum for middle school called *The Truth about Science: A Curriculum for Developing Young Scientists* (Kelsey & Steel, 2001). The primary goal of this curriculum is "to introduce students to the process of

scientific research" (p. vii). Thus they hope that students will see what the work of scientists is like. Use their creativity and critical thinking. "The curriculum also helps to subvert a common misconception of students – that they will never use the skills learned in math classes (p. vii). This curriculum is also supported by a website: www.nrcse.washington.edu/truth.

Current Efforts in New Mexico

There are many current efforts in New Mexico to promote the importance of Mathematics and Science literacy. Many museums are involved in significant outreach programs.

SEDL Brochures for Parents

A group of New Mexico educators collaborated with the Southwest Educational Development Laboratory (SEDL) and the New Mexico Public Education Department (PED) to develop brochures for parents to give them some perspective on current expectations for mathematics and science education. The simple tri-fold brochures are available for versions from Kindergarten to grade 8, in both English and Spanish. Each grade level brochure has the same format:

- What should [grade level] mathematics and science look like in your school?
- What should I see happening in my child's classroom?
- Big ideas in [grade level] SCIENCE
- Big ideas in [grade level] MATHEMATICS
- Sample ASSESSMENT QUESTIONS in this grade
- What are standards and who should I contact

Copies of the brochures and additional assessment examples are available at mc2.nmsu.edu.

Role of Museums

Perhaps the three museums that are most involved in motivating students in Mathematics and Science are the New Mexico Museum of Natural History and Science (NMMNHS) <museums.state.nm.us/nmmnh>, the Explora Science Center & Children's Museum <www.explora.mus.nm.us>, and the New Mexico Museum of Space History <www.spacefame.org>.

NMMNHS The mission of the Education Division of the NMMNHS "is to provide educational opportunities about natural history and science for the benefit of New Mexico citizens and visitors by connecting where we live and how we live to natural systems and evolving processes". The Education Division divides its work into School Programs, Public Programs and the Sandia Mountain Natural History Center (SMNHC).

School Programs include Bosque Education Guide (an environmental education program to teach about the riparian forest of the Middle Rio Grande Valley), GEMS (Great Explorations in Math and Science (GEMS) from the Lawrence Hall of Science at the University of California, Berkeley), Kits and Materials (teachers borrow from the Education Department Collections), Outreach (trained museum volunteers make presentations at schools), Proyecto Futuro (family science nights and teacher professional development programs to reach parents in underserved communities), School Visit Materials (assignments for students who will be visiting the museum), SERP (Student Ecology Research Program including a home schooling program),

Teachers' Open House, Teachers' Workshops, Topo New Mexico (a grand map-making project for students in the 8th to 12th grades), and Way Out West (a series of videos on ecosystems).

Among the Public Programs are *A Family Guide to Science* (available online, an extensive resource of activities and places to help families motivate their children to learn science), Camp-In, Junior Docent (students learn public presentation skills and science content while they work as educational assistants in the Museum's exhibit halls), Lectures (monthly public lectures by eminent scientists, and currently newsworthy "hot topics" in science), Naturalist Center (an interactive discovery room), Prehistoric Preschool (for 2-5 year old children and their adult partners), Spike's Ride (annual fall bike ride to raise scholarships for the Young Explorer Program), Volunteer Program (training for a large variety of museum volunteers), and Young Explorers (an annual Summer Camp program).

The Sandia Mountain Natural History Center (SMNHC) is owned by Albuquerque Public Schools and operated by the NMMNHS. It is 128 acres in the Cibola National Forest on the east side of the Sandia Mountains not far from Albuquerque. Its main activity is *The Ecology Field Program (EFP)*, a 4 to 4½ hour program where students learn about the basic components of an ecosystem and how all these parts are connected (with priority given to 5th grade classes). SMNHC is building The Eco Casa, a full size model of an environmentally friendly house and is now offering programs open to the public such as "Outdoor Adventure Day" and "Backpacking with a Naturalist". The SMNHC also offers an online "Ask the Expert" program at museums.state.nm.us/nmmnh/edu_smnhcxpert.html.

The **Explora Science Center & Children's Museum**, located in Albuquerque near the NMMNHS, has as its mission "creating opportunities for inspirational discovery and the joy of lifelong learning through interactive experiences in science, technology and art". They offer interactive exhibits at their main location. Among the special programs they offer are "Toddler Time", "Growing a Scientist" which focuses on scientific discovery and incorporating art and literature, "Seasonal Camps" that provide full-day classroom explorations in science, technology and art for 5- through 12-year-olds, "After-School Clubs", "Birthday Parties" with a hands-on science experiment or art project, and "Youth Internships" designed for at-risk high school students <www.explora.mus.nm.us>.

The New Mexico Museum of Space History, located in Alamogordo, includes the space museum, Planetarium, IMAX® Dome Theater, Hubbard Space Science Education Facility and the International Space Hall of Fame. Among its Educational Programs that involve students, teachers and parents are PROJECT ASTRO-NM, Outreach programs to schools (Meet the International Space Station**,** Solar System Exploration, Model Rocketry, the Starlab portable planetarium), In-House Programs for schools visiting the Museum (Catch That Food, The Official NASA Survival Test, Ping Pong Ball Tower, Model Houses, Science or Magic, Oobleck), Museum Camp-Ins, Shuttle Camp, and Family Astro. <www.spacefame.org/>

SNM SEMAA

The Southern New Mexico Science, Engineering, Mathematics and Aerospace Academies (SNM SEMAA) are basically designed to "To inspire the next generation of explorers....as only NASA can!" <education.nmsu.edu/projects/semaa>. Southern New Mexico SEMAA consists of

a combination of school based curriculum enhancements, university organized enrichment activities, and parent outreach. Each component is designed to work seamlessly with the others as a comprehensive program to improve student achievement and increase participation in science, mathematics, engineering, and technology. The major components of the project are as follows:

- Strengthen the K-12 math and science curriculum in southern New Mexico school districts to align with state standards and build student interest in the SEMAT fields.
- Provide academic enrichment and career awareness for K-12 students and develop student interest and success in higher education SEMAT fields through Summer, Saturday, and After School Aerospace Academies and College Experience programs.
- Support student field trips that allow them to experience state of the art technology and engineering and science wonders.
- Engage parents in their children's academic learning and assist with developing pathways for student participation in higher education.

SNM SEMAA has been particularly successful in involving teachers (both pre- and in-service) and students in the after-school academic enrichment and career awareness programs. Many parents and students come on the NMSU campus for the first time for the capstone experiences in the Aerospace Education Lab (AEL).

NASA Efforts

Another important educational outreach program that seeks to motivate students is the New Mexico Space Grant Consortium (NMSGC). NMSGC, <spacegrant.nmsu.edu>, is a member of the Congressionally-funded National Space Grant College and Fellowship Program which has administered by the National Aeronautics and Space Administration (NASA) since 1989. NMSGC's mission is:

- To encourage New Mexicans to participate in the economic, educational, and scientific benefits of aerospace
- To establish commonalities among the programs of consortium partners
- To enrich the educational process of all New Mexico students at all levels of instruction by creating programs and funding research that will encourage students to pursue aerospace science, engineering, technology, and mathematics careers

Summary

Perhaps the above recommendations, suggested actions and current effort can be summarized with the following bullets:

- Strengthen the math and science teacher force by offering undergraduate scholarships, masters' degrees, teacher summer institutes, and collaborative opportunities.
- Adopt rigorous math and science curriculum that teachers are supported in implementing.
- Create more math and science research opportunities at levels through increased investment.
- Educate the public about the importance of math and science education.
- Better align all aspects of the Math and Science education efforts (perhaps with the establishment of a state P-20 Math and Science Education Council).

CHAPTER 4

BEST PRACTICES FOR PROMOTING MATHEMATICS AND SCIENCE LITERACY

> Because there is not a well-developed literature on the effectiveness of K-12 learning and teaching interventions, it is challenging to recommend tried and true programs. (COSEPUP, 2005, p. 5-2)

In this chapter best practices will be considered by presenting an overview of mathematics and science standards, a look at NSF-funded mathematics curricula, the Math Wars, programs in Singapore and Japan, and Physics First.

National Standards

The National Council of Teachers of Mathematics (NCTM, 2000), the largest professional organization of mathematics educators, gives guidance as to best practice in promoting mathematics literacy through its published "Standards". *National Science Education Standards* (NRC, 1996) were developed by a National Committee on Science Education Standards and Assessment under the direction of the National Research Council.

NCTM *Standards*

The current *Principles and Standards for School Mathematics* (NCTM, 2000) is a major revision of the earlier *Curriculum and Evaluation Standards for School Mathematics* (NCTM, 1989). That earlier document was a bold effort to "create a coherent vision of what it means to be mathematically literate" (p. 1). In doing so it promoted active learning over memorization and practice by suggesting that a "constructive, active view of the learning process must be reflected in the way much of mathematics is taught. Thus, instruction should vary and include opportunities for:

- appropriate project work;
- group and individual assignments;
- discussion between teacher and students and among students;
- practice on mathematical methods; and
- exposition by the teacher" (p. 10).

The Principles and Standards for School Mathematics <www.nctm.org/standards> present six principles to guide teachers and principals in the decisions they need to make:

- *The Equity Principle*: Excellence in mathematics education requires equity - high expectations and strong support for all students.
- *The Curriculum Principle*: A curriculum is more than a collection of activities: it must be coherent, focused on important mathematics, and well articulated across the grades.
- *The Teaching Principle*: Effective mathematics teaching requires understanding what students know and need to learn and then challenging and supporting them to learn it well.

- *The Learning Principle*: Students must learn mathematics with understanding, actively building new knowledge from experience and prior knowledge.
- *The Assessment Principle*: Assessment should support the learning of important mathematics and furnish useful information to both teachers and students.
- *The Technology Principle*: Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning.

National Science Education Standards

The *National Science Education Standards* (NRC, 1996) are grouped under six headings:

- *Standards for Science Teaching*
- *Standards for Professional Development of Teachers*
- *Standards for Assessment in Science Education*
- *Standards for Science Content*
- *Standards for Science Education Programs*
- *Standards for Science Education Systems*

Perhaps the most relevant Standards are those presented for Science Education Programs:

Program Standard A

All elements of the K-12 science program must be consistent with the other *National Science Education Standards* and with one another and developed within and across grade levels to meet a clearly stated set of goals.

- In an effective science program, a set of clear goals and expectations for students must be used to guide the design, implementation, and assessment of all elements of the science program.
- Curriculum frameworks should be used to guide the selection and development of units and courses of study.
- Teaching practices need to be consistent with the goals and curriculum frameworks.
- Assessment policies and practices should be aligned with the goals, student expectations, and curriculum frameworks.
- Support systems and formal and informal expectations of teachers must be aligned with the goals, student expectations and curriculum frameworks.
- Responsibility needs to be clearly defined for determining, supporting, maintaining, and upgrading all elements of the science program.

Program Standard B

The program of study in science for all students should be developmentally appropriate, interesting, and relevant to students' lives; emphasize student understanding through inquiry; and be connected with other school subjects.

- The program of study should include all of the content standards.
- Science content must be embedded in a variety of curriculum patterns that are developmentally appropriate, interesting, and relevant to students' lives.
- The program of study must emphasize student understanding through inquiry.
- The program of study in science should connect to other school subjects.

Program Standard C

The science program should be coordinated with the mathematics program to enhance student use and understanding of mathematics in the study of science and to improve student understanding of mathematics.

NSF Curriculum Projects

Schoenfeld (2004) suggests that, after the NSF received significant criticism (political backlash) for funding an elementary school social studies and science curriculum project called *Man: A Course of Studies (MACO)* beginning in the late 1960s, they were very hesitant throughout the 1980s to support large scale K-12 curriculum development. When NCTM filled the curriculum void by publishing the *Standards* in 1989, by 1990 NSF began funding projects based on those *Standards*. Each of the NSF-supported Standards-based curriculum programs was developed in extended research and development cycles that involved pilot tests, revisions, extensive field tests, and evaluations of student achievement during implementation. The NSF Curriculum Centers can be accessed as follows on the web. The K-12 Mathematics Curriculum Center is at <www.edc.org/mcc>, the elementary grades center (The ARC Center – Alternatives for Rebuilding Curriculum) at <www.arccenter.comap.com>, the middle grades Show-Me center at <showmecenter.missouri.edu>, and the high school COMPASS center at <www.ithaca.edu/compass>.

The **K–12 Mathematics Curriculum Center** supports school districts in accomplishing their mathematics curriculum goals. The Center offers services and products designed to:

- increase national awareness of high quality, comprehensive instructional materials developed in response to the NCTM *Standards*;
- assist districts in planning effective selection and implementation processes; and
- help educators build their capacity to make informed decisions about mathematics curriculum and instruction.

The **ARC Center** promotes the wide-scale and effective implementation of standards-based mathematics curricula. The Center consults with schools and districts and provides information and resources to support teacher enhancement, leadership development, and public awareness of mathematics. In New Mexico, they have given workshops and provided support to several districts that have adopted NSF-funded materials. The curricula they represent are:

- Everyday Mathematics (K-6) <www2.edc.org/mcc/cmath.asp>
- Investigations in Number, Data, and Space (K-5) <www2.edc.org/mcc/cinvest.asp>
- Math Trailblazers (K-5) <www2.edc.org/mcc/ctrail.asp>

The **Show-Me Center**:

1. Provides information about four NSF-sponsored comprehensive middle school mathematics curricula.
2. Sponsors conferences showcasing the curricula.

3. Establishes an on-going dialogue with various constituents (teachers, school administrators, and teacher educators) about important issues related to learning, teaching, and assessing middle grade mathematics.
4. Develops and maintains a website to allow a broad range of people to explore the NSF sponsored middle grade mathematics curricula and related resources that support their implementation.
5. Consults with school districts investing in standards-based mathematics curriculum reform at the middle grades.

Several mathematics educators from New Mexico have attended Show-Me Center events.

The Show-Me supported curricula includes:

- Connected Mathematics (6-8) <www2.edc.org/mcc/ccmp.asp>
- Mathematics in Context (5-8) <www2.edc.org/mcc/cmic.asp>
- MathScape: Seeing and Thinking Mathematically (6-8) <www2.edc.org/mcc/cscape.asp>
- MATH Thematics (6-8) <www2.edc.org/mcc/cstem.asp>

COMPASS stands for "Curricular Options in Mathematics Programs for All Secondary Students". Their goal is to assist schools, teachers, administrators, parent groups, and other community members and constituencies interested in improving secondary school mathematics opportunities and experiences for their students. The COMPASS Center supports:

- Contemporary Mathematics in Context (Core-Plus Mathematics Project) (9-12) <www2.edc.org/mcc/ccore.asp>
- Interactive Mathematics Program (9-12) <www2.edc.org/mcc/cimp.asp>
- MATH Connections: A Secondary Mathematics Core Curriculum (9-11) <www2.edc.org/mcc/cconn.asp>
- Mathematics: Modeling Our World (ARISE) (9-12) <www2.edc.org/mcc/cmmow.asp>
- SIMMS Integrated Mathematics: A Modeling Approach Using Technology (9-12) <www2.edc.org/mcc/csimms.asp>

Several high schools in New Mexico are now offering the Interactive Math Program (IMP).

There is a booklet that summarizes all the NSF-funded mathematics curricula available online at www2.edc.org/mcc/images/curricsum8.pdf.

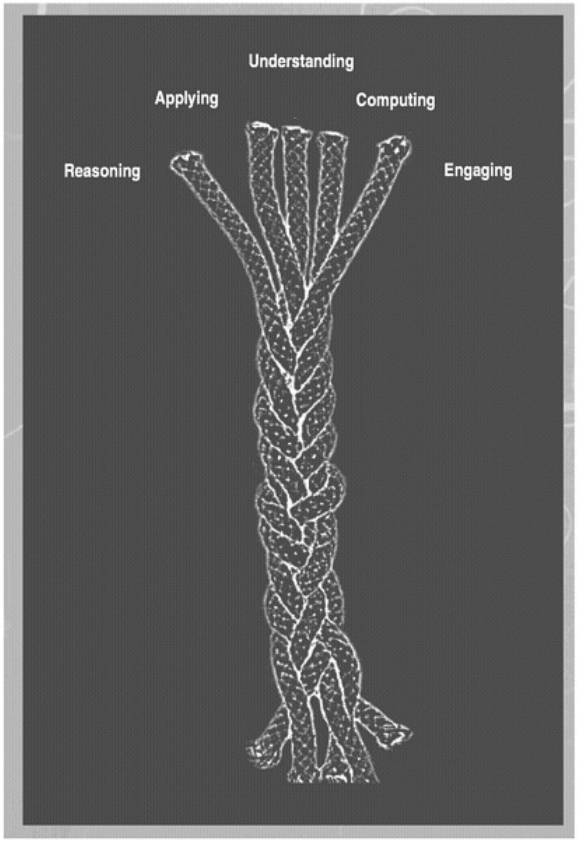
Improvement in Gadsden and the NSF Curricula

The Gadsden Independent School District was highlighted in Chapter 1 because it has made great strides in overcoming achievement gaps in mathematics. Part of what the district did was to select NSF-supported curricula: *Investigations* for grades K-5 and *Connected Math* for grades 6-8. Those curricula have been introduced gradually with significant teacher professional development and support.

Adding It Up

***Adding It Up**: Helping Children Learn Mathematics* was developed by the Mathematics Learning Study Committee. This committee was appointed by the National Academy of Sciences and chaired by Jeremy Kilpatrick of the University of Georgia. The charge to the committee was to synthesize research on pre-kindergarten through eighth-grade mathematics learning in order to provide research-based recommendations for teaching, teacher education, and curriculum for improving student learning, and to identify areas where research is needed, give advice and guidance to educators, researchers, publishers, policy makers, and parents. Casildo Pardo of Albuquerque Public Schools was a member of the Committee. The full version and a condensed version using just the subtitle, *Helping Children Learn Mathematics,* are available online at www.nap.edu/catalog/10434.html.

Their work suggests that "mathematical proficiency has five strands:



1. **Understanding:** Comprehending mathematical concepts, operations, and relations—knowing what mathematical symbols, diagrams, and procedures mean.
2. **Computing:** Carrying out mathematical procedures, such as adding, subtracting, multiplying, and dividing numbers flexibly, accurately, efficiently, and appropriately.
3. **Applying:** Being able to formulate problems mathematically and to devise strategies for solving them using concepts and procedures appropriately.
4. **Reasoning:** Using logic to explain and justify a solution to a problem or to extend from something known to something not yet known.
5. **Engaging:** Seeing mathematics as sensible, useful, and doable—*if* you work at it—and being willing to do the work.

(National Research Council, 2002, p. 8 & 9)

After affirming that "Efforts to Achieve Mathematical Proficiency Must Be Coordinated, Comprehensive, and Informed by Scientific Evidence" they present the following list of actions to "achieve the goal of mathematical proficiency for all" (pp. 33-39).

What Can Parents and Caregivers Do?
Before Children Enter School

Just as parents can help their children be ready to learn to read, they can give children a good start in learning math by helping them develop proficiency with informal math concepts and skills.

- Play games such as dominoes and board games.
- Find natural opportunities to count, to sort objects, to match collections of objects, to identify shapes (while reading bedtime stories, going up stairs, setting the table, etc.).
- Count a collection of objects and use number words to identify very small collections.
- Talk with your child about simple math problems and ideas. (How many spoons do we need to set the table? Give me the cup with the two flowers on it. Find the other circle on this page. Sort the blocks by shape.)

After Children Enter School

- Have high expectations. Children's math achievement is shaped—and limited—by what is expected of them.
- Expect some confusion to be part of the learning process but emphasize that effort, not ability, is what counts. Math is understandable and can be figured out.
- Avoid conveying negative attitudes toward math. Never tell children to not worry about a certain kind of math because it will never be used.
- Ask your child what he or she did in math class today. Ask him or her to give details and to explain.
- Expect your child's homework to include more than simple computation worksheets.
- Give your child meaningful problems that use numbers or shapes while you are going about everyday life. Ask the child to explain what he or she did.
- Be an advocate for the theme of math proficiency in textbooks, assessments, and instruction.
- Advocate allocating and using a regular time each school day for instruction to develop math proficiency.
- Support professional development activities for teachers and administrators.

What Can Teachers Do?

- Be committed to the idea that all children can become proficient in math.
- Develop and deepen your understanding of math, of student thinking, and of techniques that promote math proficiency.
- Emphasize to policy makers, administrators, parents, and students the need for and the achievability of math proficiency.
- Use an instructional program and materials that, based on the best available scientific evidence, support the development of math proficiency.
- Teach mathematics for a sufficient amount of time (e.g., an hour a day).
- Attend professional development activities that integrate math, student thinking, and instructional techniques.
- Advocate for ongoing, sustained, coherent professional development activities that support teaching for math proficiency.
- Organize and participate in study groups at your school that focus on teaching practice.
- Engage in conversations with colleagues about developing proficiency and about students and their math proficiency.
- Become a mentor to a colleague learning to teach for math proficiency.

What Can Administrators Do?

- Embrace the overarching goal of math proficiency for all.

- Promote the idea to teachers and parents that math proficiency for all is both desirable and achievable.
- Become an instructional leader in your school.
- Spend time in math classrooms observing teachers and coaching teachers on teaching for proficiency.
- Provide for a math curriculum aligned with the goal of math proficiency and expect teachers to design their instructional program accordingly.
- Hire one or more math specialists for each elementary school.
- Ensure that sufficient time is allocated for learning math.
- Provide time and resources for ongoing district-wide and school-based professional development focused on math.
- Make available teacher stipends, released time, and other support for substantial and sustained professional development.
- Focus on coherent, multi-year programs.
- Attend staff development activities for administrators to become familiar with math proficiency and with how proficiency is attained.

What Can Policy Makers Do?

- Embrace the overarching goal of math proficiency for all.
- Stress to interested stakeholders the need to accomplish this goal.
- Support the allocation of scarce education resources to bring about needed critical changes.
    - Realign curricula to promote math proficiency.
    - Fund independent groups to assess alignment of textbooks and testing to achieve math proficiency.
    - Encourage the expenditure of time and resources for necessary and sustained teacher professional development.
    - Support the placement of one or more math specialists in each elementary school.
- Maintain consistency with the above by supporting the concept that, whenever possible, education decisions should be based on evidence.
- Take full advantage of the current national focus on and interest in improving education.

"Reaching for Common Ground" to End the Math Wars

Among the controversies over what are best practices for promoting mathematics and science literacy perhaps that most contentious has been the so-called "Math Wars" that raged in the 1990s and into the new millennium. Alan Schoenfeld (2004) of UC, Berkeley, has characterized the Math Wars as a conflict between "traditionalists [who] fear that reform-oriented, 'standards-based' curricula are superficial and undermine classical mathematical values; [and] reformers [who]claim that such curricula reflect a deeper, richer view of mathematics than the traditional curriculum" (p. 253) <epx.sagepub.com/cgi/reprint/18/1/253>.

In early 2005 Richard Schaar of Texas Instruments brought together Deborah Ball, Joan Ferrini-Mundy, Jeremy Kilpatrick, R. James Milgram, and Wilfried Schmid, warriors from both sides, to discuss a truce. The resulting document is called "Reaching for Common Ground in K-12 Mathematics Education" <www.maa.org/common-ground/cg-report2005.pdf>. To reach "common ground" they started by agreeing on three premises:

1. Basic skills with numbers continue to be vitally important for a variety of everyday uses.
2. Mathematics requires careful reasoning about precisely defined objects and concepts.
3. Students must be able to formulate and solve problems.

After much discussion to uncover miscommunication, they arrived at the following seven "Areas of Agreement":

Automatic recall of basic facts: Certain procedures and algorithms in mathematics are so basic and have such wide application that they should be practiced to the point of automaticity.

Calculators: Calculators can have a useful role even in the lower grades, but they must be used carefully, so as not to impede the acquisition of fluency with basic facts and computational procedures.

Learning algorithms: Students should be able to use the basic algorithms of whole number arithmetic fluently, and they should understand how and why the algorithms work. Fluent use and understanding ought to be developed concurrently.

Fractions: Understanding the number meaning of fractions is critical.

Teaching mathematics in "real world" contexts: It can be helpful to motivate and introduce mathematical ideas through applied problems. However, this approach should not be elevated to a general principle.

Instructional methods: Some have suggested the exclusive use of small groups or discovery learning at the expense of direct instruction in teaching mathematics. Students can learn effectively via a mixture of direct instruction, structured investigation, and open exploration.

Teacher knowledge: Teaching mathematics effectively depends on a solid understanding of the material. Teachers must be able to do the mathematics they are teaching, but that is not sufficient knowledge for teaching. Effective teaching requires an understanding of the underlying meaning and justifications for the ideas and procedures to be taught, and the ability to make connections among topics.

Singapore Math

Since Singapore has usually scored at the top of international tests in Mathematics there has been considerable interest in their curriculum. Their curriculum is often referred to in the United State as Singapore Math. Their K-8 textbooks from Mathematics, Science and English have been distributed for some time now via www.singaporemath.com. A recent report from the American Institutes for Research (AIR, 2005) <www.air.org> entitled *What the United States Can Learn from Singapore's World-Class Mathematics System* suggests that the strengths of the Singapore Mathematics program can be summarized as follows:

- **Framework:** The study indicates there is a correlation between focused frameworks such as those used in Singapore and good test performance. Singapore offers an alternative mathematics framework for lower-performing students that covers all the mathematics topics in the regular framework, but at a slower pace and with greater repetition, and with support from expert teachers.

- **Textbooks:** Singapore's textbooks build deep understanding of mathematical concepts while traditional U.S. textbooks rarely get beyond definitions and formulas.
- **Teaching:** Singaporean elementary school teachers are required to demonstrate mathematics skills superior to those of their U.S. counterparts before they begin paid college training to become a teacher. They receive a high level of professional development training (100 hours) each year.
- **Assessment:** Singapore uses more challenging tests and utilizes a value-added approach that rewards schools for individual student progress over time.

The report also emphasizes that the U.S. mathematics programs often have strengths that the Singapore program lacks, including a greater emphasis on 21st Century workforce skills (i.e., NCTM Process Standards of Reasoning and Proof, Communications, Connections, and Representation) and more emphasis on applied mathematics, including Probability and Statistics.

Japan Math

While "Singapore Math" is a term that is being used quite a bit, "Japan Math" is not. However, because of the TIMSS video studies (Hiebert & Stigler, 1999) we actually have more information about how mathematics in taught in Japan, at least at grade 8. The following are a few of what might be considered best practices in Japan:

- A very focused curriculum
- An emphasis on problem solving
- Starting lessons with a challenging problem
- Math considered by teachers to be an interesting set of concepts, facts and procedures
- Confusion and frustration considered to be a natural part of the math learning process
- Students more likely to be offered suggestions rather than complete solutions
- Individual differences considered to be natural and an opportunity for different perspectives
- Teacher professional development an on-going process with collaborative lesson study

NSTA Positions on Science Education by Levels

The National Science Teachers Association (NSTA) has developed position papers on many issues in Science education <www.nsta.org/position>. The position statements on "Elementary School Science", "Science Education for Middle Level Students" and "Learning Conditions for High School Science" give an overview of what the profession views as best practice.

Elementary School Science

- The elementary science program must provide opportunities for students to develop understandings and skills necessary to function productively as problem-solvers in a scientific and technological world.
- Elementary school students learn science best when:
    a. they are involved in first-hand exploration and investigation and inquiry/process skills are nurtured.
    b. instruction builds directly on the student's conceptual framework.

c. content is organized on the basis of broad conceptual themes common to all science disciplines.
d. mathematics and communication skills are an integral part of science instruction.

- The learning environment for elementary science must foster positive attitudes towards self and society, as well as science.
- Elementary school students value science best when:
  a. a variety of presentation modes are used to accommodate different learning styles, and students are given opportunities to interact and share ideas with their peers.
  b. the scientific contributions of individuals from all ethnic origins are recognized and valued.
  c. other subject areas are infused into science.
  d. inquiry skills and positive attitudes are modeled by the teacher and others involved in the education process.
- Teacher preparation and professional development must enable the teacher to implement science as a basic component of the elementary school curriculum.
- Teacher preparation and professional development must provide for:
  a. experiences that will enable teachers to use hands-on activities to promote skill development, selecting content and methods appropriate for their students, and for design of classroom environments that promote positive attitudes toward science and technology.
  b. continuing science inservice programs based on current educational research that encompass content, skills, techniques, and useful materials.
  c. participation in workshops, conferences, and meetings sponsored by local, state, and national agencies.
- The school administrators must be advocates for elementary science.
- Administrators must provide instructional leadership by:
  a. building consensus for an elementary science program that reflects state and national standards.
  b. implementing and monitoring the progress of the science program.
- Administrators must provide support systems by:
  a. supplying appropriate materials, equipment, and space.
  b. recognizing exemplary elementary science teaching.
  c. encouraging special science events.
- The instructional implementation and support system for elementary school science must include the combined efforts of all aspects of the community: parents, educators, businesses, and other organizations.
- The community must be advocates for elementary school science by:
  a. participating in ongoing planning, assessment, and funding of elementary science programs.
  b. promoting informal science learning experiences.
- Assessment must be an essential component of an elementary science program.
- Assessment must be aligned with:

a. what is of value, i.e., the problem-solving model of instruction: concept application, inquiry, and process skills.
b. the curricular objectives and instructional mode.
c. the purpose for which it was intended: grading, diagnosis, student and/or parent feedback, or program evaluation.

- Elementary school science instruction must reflect the application and implementation of educational research.
- Elementary school science programs are improved when:
  a. teachers keep abreast of appropriate science education research.
  b. educational research becomes the premise for change or innovation in elementary school science, and teachers participate in action research in elementary science.

Science Education for Middle Level Students

NSTA recommends that the curriculum of middle level science programs

- Be aligned with the science content and process skills outlined in the *National Science Education Standards*.
- Nurture curiosity about the natural world and include "hands-on, minds-on" inquiry-based science instruction.
- Engage students in laboratory investigations a minimum of 80 percent of the science instruction time as specified in the NSTA position statement *Laboratory Science*.
- Incorporate independent and cooperative group learning experiences during the study of science, and encourage informal learning experiences to support the curriculum.
- Integrate science with other curriculum subjects in a multidisciplinary approach, such as through theme-based learning.

NSTA recommends that the curriculum offer links to the real world by

- Applying content and skills learned in science class to students' own experiences.
- Connecting the classroom to the community through field trips, speakers, and local partnerships.
- Providing students with real-life experiences, such as mentoring and apprenticeships that enable them to develop an awareness of science-based careers and an understanding of how science is relevant to their lives.
- Providing opportunities for decision-making activities (e.g., debate or research papers) and for involvement in community-based problems.
- Promoting societal goals for scientific and technological literacy.

NSTA recommends that the assessment strategies used in middle level science programs

- Include a variety of assessment methods that can be used to evaluate overall student achievement and guide decisions about instruction and practices.
- Be continuous and embedded in the instructional materials.
- Capture the interest of students to better engage them in the assessment process.
- Occur frequently to allow for modification, enrichment, and remediation.
- Include questions that are sensitive to gender and varied cultures.

Learning Conditions for High School Science

- Science teachers should be certified in the science they are teaching.
- New teachers should be assigned master science teachers as mentors.
- Science teaching assignments should provide time for preparations necessary for safe and effective science teaching.
- Science teachers should be scheduled in only one classroom to be able to manage the laboratory safely.
- Science students should learn in classrooms that have the facilities and space for a safe laboratory-oriented program.
- Students need adequate space to work safely. Because of safety considerations and the individual attention needed by students in laboratories, science classes should be limited to 24 students.
- Science rooms/laboratories should be used only for science classes and science activities and should be equipped with:
    - Adequate laboratory space per student and sufficient gas, electrical, and water outlets for student laboratory activities.
    - Safety equipment, such as fire extinguisher, fume hoods, emergency showers, and eyewash stations.
    - Audiovisual equipment such as an overhead projector; videocassette recorder and monitor; slide projector; and one or more computers with Internet access, plus needed software and maintenance service.
    - Sufficient storage for equipment and supplies and preparation space close to the classroom.
    - Support equipment such as photocopying machines, typewriters, word processors, and telephone in a nearby and accessible area.
    - Textbooks for each student, laboratory guides, and references as appropriate and needed.
- Science teachers responsible for classes with special education students in an inclusion setting need:
    - Special education support adequate to safely and successfully meet the individual education plan of each inclusion student in the science classroom.
    - Access to professional development in teaching in an inclusion classroom.
    - Additional planning time with the special education teacher assigned to her or his classroom to modify the learning environment to better facilitate the safe learning process for those students with special needs.
    - Additional resources, professional development, and equipment and materials provided as necessary for inclusion students to be safely and completely involved in the least restricted science learning and activities.

Physics First (PF)

Perhaps the most significant curriculum reform movement in Science education is what has often been called Physics First (PF). Physics Nobel Prize Winner, Leon Lederman, is often considered the leader of that movement. The following letter that he published on the Internet in September of 2005 has captured the spirit and intention of the movement <www-ed.fnal.gov/arise/docs/leon-words.pdf >:

To the leaders of the Physics First movement:

I have been following the post SLC meeting discussions with interest. Here I would like to restate my position. PF (I called it ARISE) is much more than a revision of the sequence from BCP to PCB. It is much more than a change in the curriculum generated by starting with conceptual physics, ending with "capstone" biology (Bybee's term at BSCS – new biology for all students who have had a year of chemistry and a year of physics).

It is, if we do it right, a true revolution in science education. The integrity of the three core disciplines is preserved, but now with the disciplines correctly organized, they can be connected to form a coherent and overarching wholeness which we call science. The disciplines support each other. There are many possible variations to this revision but the essential hierarchy and coherence need to be preserved. This implies the necessity of continuous and collegial professional development. I believe this should ultimately occupy about 20% of teacher time (yes, expensive!). To emphasize that science is a social undertaking, we must recognize that in science, ideas and people stream across the disciplines sharing, where needed, computational and analytic methods and instruments to observe and measure. This is what I call "story telling", so that in this three year sequence, we must teach the process of science; how it works, what it can and cannot do, who did what and how, etc.

Then we must tell about the awesome technologies, beholden to science but then enabling more science and creating wealth to more than pay the required costs of major teacher enhancements and laboratory improvements. I believe that as we gradually implement these (and surely other) reforms, we will create a population of high school graduates who will have acquired a sense of science or a science way of thinking with huge economic and cultural benefits to the nation.

To emphasize Physics First without reference to a three-year sequence may be a mistake. The sense of science is to seek for underlying order in apparent chaos, to see connections and hidden likenesses, it is to change the graduate forever: to install an intuition as to how things work, an attitude of expectation and skepticism, a habit of thought, an encouragement of curiosity, and a respect for innovation and imagination. This sounds like a tall order, but can't we agree on our objectives and can't we find out why it cannot be done?

We are aware that we are, perhaps more than ever, a nation at risk. The eloquent appeals of the CEOs of Microsoft, Intel, IBM, Motorola, and many other technological leaders should give us encouragement to do it right. There is also the terrifying attack on the teaching of science in our schools. This irrational onslaught now affects biology, but it will not be limited to biology. It becomes essential to the preservation of a rational and economically strong society that we be more ambitious. Not all changes can happen at once. The reform we envision must eventually include K-8 and even the first years of college. Our success is bound to influence the social sciences and the humanities. Physics First is a great battle flag; dare we say it leads an evolution of science education?

I will of course welcome comments.

More information about Physics First can be found at the American Renaissance in Science Education (ARISE) website: <www-ed.fnal.gov/arise/index.html>.

Summary

There is considerable consensus in the literature as to what constitutes higher-quality mathematics and science programs across the K-12 spectrum (even if there is not always research to support those programs). In addition, the conclusion to the "math wars" is a strong signal that policy makers, administrators, teachers, and parents must unite around a core set of recommendations to ensure the quantitative and scientific literacy of all students. This section presents a coherent set of recommendations – some will require increased and sustained funding to realize, while others require a concerted effort on the part of multiple players.

CHAPTER 5

MODELS OF TEACHER PREPARATION AND PROFESSIONAL DEVELOPMENT

> Teachers must be able to do the mathematics they are teaching, but that is not sufficient knowledge for teaching. Effective teaching requires an understanding of the underlying meaning and justifications for the ideas and procedures to be taught, and the ability to make connections among topics. (Ball et al., 2005, p. 4)

Teacher Preparation

This section first considers the preparation of teachers in general and then specifically with respect to mathematics and science. In all cases, comments are made on the current situation in New Mexico. Some issues relating to financial aid for future teachers are also considered.

Eight Questions on Teacher Preparation

The Education Commission of the States has published (ECS, 2003) a list of *Eight Questions on Teacher Preparation* with answers from research <www.ecs.org/tpreport>. The eight questions on the whole focus on the most effective strategies for educating and training the nation's teachers. The questions, enumerated below, are followed with the ECS policy implications and a commentary specific to New Mexico.

1. To what extent does subject knowledge contribute to the effectiveness of a teacher?
2. To what extent does pedagogical coursework contribute to a teacher's effectiveness?
3. To what extent does high-quality field experience prior to certification contribute to a teacher's effectiveness?
4. Are there "alternative route" programs that graduate high percentages of effective new teachers with average or higher-than-average rates of teacher retention?
5. Are there any teacher preparation strategies that are likely to increase the effectiveness of new teachers in hard-to-staff and low-performing schools?
6. Is setting more-stringent teacher preparation program entrance requirements, or conducting more-selective screening of program candidates, likely to ensure that prospective teachers will be more effective?
7. Does the accreditation of teacher preparation programs contribute significantly to the likelihood their graduates will be effective and will remain in the classroom?
8. Do institutional warranties for new teachers contribute to the likelihood that recent graduates of those institutions will be effective?

1. To what extent does subject knowledge contribute to the effectiveness of a teacher?

Policy Implications

> Given the variability of requirements for subject minor, and uncertainty about the competence of even those teachers with subject majors, the most surefire way of determining competence would be to require teachers to demonstrate knowledge of a subject through an examination or portfolio. The next-best alternative would seem to be to require a subject major, particularly for secondary school teachers. As for elementary school teachers, who teach multiple subjects, policy alternatives to some demonstration of subject-matter competence are less apparent.

> Educators and policymakers also must find ways to ensure that prospective teachers acquire not only adequate knowledge of a subject, but also some knowledge of how to teach it. The research seems to suggest that preparation in a given subject does not necessarily develop understanding of how particular concepts and procedures related to that subject are best learned.

In New Mexico, middle and high school teachers must demonstrate knowledge of the subjects they teach through an initial licensure content knowledge test from the New Mexico Teacher Assessment. Those with secondary level endorsements must also have at least 24 credit hours in the subject area of which at least 12 must be upper division or graduate. Professional competence is tested with New Mexico Assessment for Teacher Competence at the given level.

2. To what extent does pedagogical coursework contribute to a teacher's effectiveness?

Policy Implications

> It is difficult to draw clear implications from the research other than for policymakers to support beginning teachers' acquisition of whatever critical knowledge and skills they can gain prior to teaching full time. The uncertainty about the ability of pre-service preparation to ensure the solid acquisition of core pedagogical skills opens the door to the consideration of alternative preparation routes, which emphasize on-the-job training, as an option. In addition, the placement of newly minted teachers in challenging situations that require the exercise of well-developed pedagogical skills and knowledge should be avoided.

The ECS document also indicates that "the research provides **limited support** for the conclusion that preparation in pedagogy can contribute significantly to effective teaching, particularly subject specific courses (focused, for example, on how to teach mathematics or science)" (p. 2). Most, but not all, "non-alternative" teacher preparation programs in New Mexico do require such subject specific "methods" courses. Most alternative licensure programs do not. Although no data has been located on the placement of "newly minted teachers", there is a general feeling that they are often placed in the most difficult situations.

3. To what extent does high-quality field experience prior to certification contribute to a teacher's effectiveness?

Policy Implications

> It is difficult to draw clear implications for policy. The absence of solid research may indicate the need to significantly strengthen field experience and ensure its solid integration with pre-service coursework. Thus, a prudent course of action would be to ensure that, whatever model of field experience is incorporated into a teacher preparation program, it reflects the characteristics that the research identifies as important – even though those characteristics have not proven their importance in solid empirical research. On the other hand, the absence of evidence in support of pre-service field experience invites consideration of other options, including alternative route programs in which pre-service field experience is minimal.

Both regular and alternative licensure programs in New Mexico do have mandatory "student teaching" components, but the nature and length of those experiences are determined by each teacher preparation institution. Therefore, how that requirement is handled varies widely. "The characteristics that the research identifies as important" (but "not proven" to result in "greater teacher effectiveness") are: "(1) strong supervision by well-trained teachers and university faculty, and (2) prospective teachers' solid grasp of subject matter and basic understanding of pedagogy prior to student teaching." Some New Mexico teacher education programs do have field placements associated with methods courses and other professional education courses. Also, some content courses specifically designed for future teachers may have a field experience component. One documented example is from Pat Baggett (Baggett & Ehrenfeucht, 2001) of the Department of Mathematical Sciences at NMSU. The content courses are specifically designed for pre-service and in-service teachers where in-service teachers serve as mentors for the pre-

service teachers. The instructional units are designed to provide lesson plans that can be adapted by all for use in elementary and middle school classrooms. This approach essentially eliminates many of the logistical problems faced in arranging field experiences, and avoids much of the mismatch that can occur if teachers and students have different goals and expectations.

4. Are there "alternative route" programs that graduate high percentages of effective new teachers with average or higher-than-average rates of teacher retention?

Policy Implications

The research provides some support for the development of alternative route preparation programs, especially if they are designed to serve a particular school district need. Alternative programs must be adequately staffed and funded, however, to enable them to include all the elements important to their success. Moreover, policymakers must recognize that the limited pre-service component of alternative route programs may hamper the effectiveness of participants early in their teaching assignment.

Although New Mexico now has alternative licensure programs in several universities and two community colleges and many of them work in close collaboration with local school districts, perhaps it is Santa Fe Community College that has worked most closely "to serve a particular school district need". Apparently no data are yet available on retention of teachers with alternative licenses.

The ECS did indicate that the following strategies might be important for success with alternative licensure programs. However, the ECS indicated "that the research is **inconclusive** as to whether these characteristics, in fact, do contribute to better teaching among alternative route graduates:

- Strong partnership between preparation programs and school districts
- Good participant screening and selection process
- Strong supervision and mentoring for participants during their teaching
- Solid curriculum that includes coursework in classroom basics and teaching methods
- As much training and coursework as possible prior to the assignment of participants to full-time teaching."

While these sound like typical suggestions for any teacher preparation program, there has been some concern that the higher education funding formula in New Mexico does not give teacher preparation programs the funding needed to "provide strong supervision and mentoring" for participants in field experiences and student teaching.

5. Are there any teacher preparation strategies that are likely to increase the effectiveness of new teachers in hard-to-staff and low-performing schools?

Policy Implications

The research reviewed for this question is too thin to ground any confident policy recommendations. But policymakers and educators should give some consideration to developing programs that embody the features identified in Question 4 as important to program success, whether alternative or traditional. High-quality field placements in low-performing schools may be particularly helpful.

Some New Mexico teacher education programs do place student teachers in low-performing schools. This may be driven at some institutions by a professed commitment to a social justice agenda.

6. Is setting more-stringent teacher preparation program entrance requirements, or conducting more-selective screening of program candidates, likely to ensure that prospective teachers will be more effective?

Policy Implications

Given the inconclusiveness of the research evidence and the potentially negative impacts of raising admission standards, no confident policy recommendations can be offered.

For the past 20 years New Mexico has been ratcheting up the entrance requirements for regular teacher education programs. Prior to 1986 many institutions required only a 2.0 GPA and no passing scores on any tests. Beginning in 1986 the State mandated higher GPAs and testing, but the teacher preparation institutions were allowed to select the tests and set passing scores (as well as alternatives). Changes in federal law led to the New Mexico Teacher Assessments (NMTA) with more high stakes testing required with the specific tests and pass scores set in New Mexico Administrative Code 6.60.5 (see Appendix 2) which took effect in June of 1999. No research was located to indicate if these more stringent entrance requirements have led to improved teacher effectiveness.

7. Does the accreditation of teacher preparation programs contribute significantly to the likelihood their graduates will be effective and will remain in the classroom?

Policy Implications

No implications for policy can be drawn from the available research.

New Mexico invests significantly in an accreditation process for teacher preparation programs. At the present time ENMU, NMHU, NMSU, UNM and WNMU all have their teacher preparation program approved by NCATE (National Council for the Accreditation of Teacher Education) <www.ncate.org/public/stateInstit.asp?ch=106&state=NM> While teacher education programs in New Mexico do not need to be NCATE accredited, they are all evaluated using NCATE and state competencies. Those that choose to be accredited by NCATE as well as the state are visited by an NCATE team and a state team. Those that choose not to seek NCATE accreditation are visited by a state team only. For more information go to coe.unm.edu/AboutTheCollege/AccredEval/nmsde/ab_sde_intro.cfm.

8. Do institutional warranties for new teachers contribute to the likelihood that recent graduates of those institutions will be effective?

Policy Implications

In the absence of research, no implications for policy can be drawn.

Although programs that warrantee their graduates and assist them if the districts hiring them are not satisfied have been adopted in Georgia and Kentucky (and in a few other specific programs), apparently no program in New Mexico has chosen to offer such warrantees.

A Note on Alternative Licensure Programs

In his 1999 “State-of-the-State Address” then-Governor Gary Johnson (1999) supported the passage of alternative licensure legislation by suggesting that it would be great to have a retired Ph.D. in physics from Los Alamos teaching middle school science, a Certified Public Accountant teaching high school business classes, a Medical Doctor teaching health courses. On the one hand, Governor Johnson got his wish: alternative licensure legislation was passed. On the other, it may not be providing the mid- or second-career individuals that he wanted.

A recent study (Humphrey & Weshler, 2005) that surveyed 1000 of 8000 individuals from seven large alternative licensure programs found that only 5% of them had previously worked in a mathematics or science-related field. Other, perhaps surprising, results were that more than 50% were either recent college graduates or were already working in education either as teacher aides or private school teachers, and 59% of the total got a pay raise by becoming teachers.

New Mexico Competencies and National Pedagogy Standards

The New Mexico Administrative Code 6.61.2 and 6.61.4 mentioned in Chapter 1 and reproduced in Appendix 2 give the list of Competencies that individuals completing teacher preparation programs in elementary and secondary education are supposed to possess. Those Competencies went into effect in November of 1998, after a period of development, review, refinement and approval. At about the same time a document (Dalton, 1998) proposing what were intended to be national standards was published by the Center for Research on Education, Diversity & Excellence (CREDE) at the University of California, Santa Cruz. This document was developed collaboratively with many institutions and funding from the Office of Research and Educational Improvement of the USDOEd <www.cal.org/crede/pubs/research/RR4.pdf>.

That document, entitled *Pedagogy Matters: Standards for Effective Teaching Practice,* defined pedagogy by stating that "teaching or pedagogy means that teachers assist students continuously through interaction and activity in the ongoing social events of the classroom" (p. 7). The five pedagogy standards (designed to be applicable across grade levels, student populations and content areas) are joint productive activity (JPA), language and literacy development (LD), meaning making (MM), complex thinking (CT), and instructional conversation (IC). The "indicators" for each of the five Standards are reproduced below.

Standard I. Joint Productive Activity (JPA): Teacher and Students Producing Together
Facilitate learning through joint productive activity among teacher and students.
Indicators The teacher:

1. designs instructional activities requiring student collaboration to accomplish a joint project.
2. matches the demands of the joint productive activity to the time available.
3. arranges classroom seating to accommodate students' individual and group needs to communicate and work jointly.
4. participates with students in joint productive activity.
5. organizes students in a variety of groupings, such as by friendship, mixed academic ability, language, project, or interests, to promote interaction.
6. plans with students how to work in groups and move from one activity to another, such as from large group introduction to small group activity, for clean-up, dismissal, and the like.
7. manages student and teacher access to materials and technology to facilitate joint productive activity.
8. monitors and supports student collaboration in positive ways. (p. 11)

Standard II. Developing Language and Literacy across the Curriculum (LLD)
Develop competence in the language and literacy of instruction across the curriculum.

Indicators The teacher:

1. listens to student talk about familiar topics such as home and community.
2. responds to students' talk and questions, making "in-flight" changes that directly relate to students' comments.
3. assists language development through modeling, eliciting, probing, restating, clarifying, questioning, and praising, as appropriate in purposeful conversation.
4. interacts with students in ways that respect students' preferences for speaking style, which may be different from the teacher's, such as wait-time, eye contact, turn-taking, spotlighting.
5. connects student language with literacy and content area knowledge through speaking, listening, reading, and writing activities.
6. encourages students to use content vocabulary to express their understanding.
7. provides frequent opportunities for students to interact with each other and with the teacher during instructional activities.
8. encourages students' use of first and second languages in instructional activities.

Standard III. Making Meaning (MM): Connecting School to Students' Lives

Connect teaching and curriculum with experiences and skills of students' home and community.

Indicators The teacher:

1. begins with what students already know from home, community, and school.
2. designs instructional activities that are meaningful to students in terms of local community norms and knowledge.
3. learns about local norms and knowledge by talking to students, parents, and community members, and by reading pertinent documents.
4. assists students to connect and apply their learning to home and community.
5. plans jointly with students to design community-based learning activities.
6. provides opportunities for parents to participate in classroom instructional activities.
7. varies activities to include students' preferences, from collective and cooperative to individual and competitive.
8. varies styles of conversation and participation to include students' cultural preferences, such as co-narration, call-and-response, and choral, among others.

Standard IV. Teaching Complex Thinking (CT)

Challenge students toward cognitive complexity.

Indicators The teacher:

1. assures that students, for each instructional topic, see the whole picture as the basis for understanding the parts.
2. presents challenging standards for student performance.
3. designs instructional tasks that advance student understanding to more complex levels.
4. assists students to accomplish more complex understanding by relating to their real-life experience.
5. gives clear, direct feedback about how student performance compares with the challenging standards.

Standard V. Teaching through Conversation (IC)
Engage students through dialogue, especially the Instructional Conversation.
Indicators The teacher:

1. arranges the classroom to accommodate conversation between the teacher and a small group of students on a regular and frequent schedule.
2. has a clear academic goal that guides conversation with students.
3. ensures that student talk occurs at higher rates than teacher talk.
4. guides conversation to include students' views, judgments, and rationales, using text evidence and other substantive support.
5. ensures that all students are included in the conversation according to their preferences.
6. listens carefully to assess levels of students' understanding.
7. assists students' learning throughout the conversation by questioning, restating, praising, encouraging, and so forth.
8. guides the students to prepare a product that indicates the Instructional Conversation's goal was achieved.

Considerations for Teacher Preparation Directly Related to Math and Science

There appears to be agreement (if not sufficient research to satisfy the ECS) that teachers of mathematics and science must not only be prepared in the content areas that they will teach, but also in what is often now called "pedagogical content knowledge". The term *pedagogical content knowledge* (PCK) was introduced by Lee Shulman (1986, 1987). It involves having a deep and flexible understanding of the content that helps teachers make it accessible to students.

The Mathematical Education of Teachers The American Mathematical Society (AMS) in cooperation with the Mathematical Association of America (MAA) has published a document on *The Mathematical Education of Teachers* (CBMS, 2001) <www.cbmsweb.org/MET_Document/>.

Recommendation 1. Prospective teachers need mathematics courses that develop a deep understanding of the mathematics they will teach.

While it is sometimes stated that teachers need to know the Mathematics beyond what they teach, it is perhaps Liping Ma (1999) who most highlighted the lack of what she called "profound understanding of fundamental mathematics (PUFM)" among many elementary teachers in the United States, particularly when compared to counterparts in China. The problems Ma had teachers solve included subtraction with regrouping, multi-digit multiplication, division by fractions, and perimeter and area of a closed figure. Even those U.S. teachers who could solve the problems could often not give an adequate explanation of how they solved it. Ma suggested that part of the problem was that U.S. knowledge tended to be just procedural and lacked conceptual understanding.

Recommendation 2. Although the quality of mathematical preparation is more important than the quantity, the following amount of mathematics coursework for prospective teachers is recommended.

1. Prospective elementary grade teachers should be required to take at least 9 semester-hours on fundamental ideas of elementary school mathematics.

2. Prospective middle grades teachers of mathematics should be required to take at least 21 semester-hours of mathematics, that includes at least 12 semester-hours on fundamental ideas of school mathematics appropriate for middle grades teachers.
3. Prospective high school teachers of mathematics should be required to complete the equivalent of an undergraduate major in mathematics that includes a 6-hour capstone course connecting their college mathematics courses with high school mathematics.

As indicated in Chapter 1 and Appendix 2, NMAC 6.61.2.8 requires all graduating elementary teachers to have only six credits of mathematics rather than the recommended nine. UNM does require nine and WNMU requires twelve in some of its programs. Middle grades teachers are now required to have 24 credits to be "highly qualified", but as explained in Chapter 1 there are alternatives to that requirement for teachers already in the field. Although prospective high school teachers who have mathematics as their first teaching endorsement take the equivalent of an undergraduate major, a mathematics endorsement can be added with just 24 credits (12 of which have to be upper division or graduate) and therefore more equivalent to an undergraduate minor rather than major.

Recommendation 3. Courses on fundamental ideas of school mathematics should focus on a thorough development of basic mathematical ideas. All courses designed for prospective teachers should develop careful reasoning and mathematical "common sense" in analyzing conceptual relationships and in solving problems. Here "attention to the broad and flexible applicability of basic ideas and modes of reasoning is preferable to superficial coverage of many topics" (p. 8).

Recommendation 4. Along with building mathematical knowledge, mathematics courses for prospective teachers should develop the habits of mind of a mathematical thinker and demonstrate flexible, interactive styles of teaching.

Although there is insufficient data from which to accurately generalize, it is suspected that some courses for prospective teachers in New Mexico are still taught with a "teach by telling" lecture approach. Hiebert and Stigler (1999) in *The Teaching Gap* presented data that much of grade 8 mathematical teaching is very procedural and does little to engage students in developing an understanding of mathematical concepts.

Recommendation 5. Teacher education must be recognized as an important part of the mathematics departments' mission at institutions that educate teachers. More mathematicians should consider becoming deeply involved in K-12 mathematics education.

The NM CETP program (Appendix 3) worked on this issue, but university reward structures are complicated. All of the state teacher preparation institutions in New Mexico do have mathematicians involved in courses for prospective teacher. Mathematicians from NMSU, UNM and WNMU are involved with mathematics educators and school districts in Math and Science Partnerships (MSPs) (see Appendix 3).

Recommendation 6. The mathematical education of teachers should be seen as a partnership between mathematics faculty and mathematics education faculty.

Earlier through NM CETP and now through the MSPs some of these partnerships have been strengthened.

Recommendation 7. There needs to be greater cooperation between two-year and four-year colleges in the mathematical education of teachers.

NM CETP also encouraged cooperation between two- and four-year colleges, and SJC is collaborating with NMSU on the MSP. Senate Bill 161 from the 2005 Legislative Session calls for more collaboration across all higher education institutions on course numbering and content. Although specific courses for prospective teachers are not yet being dealt with, they may be eventually. (Apparently Math for Liberal Arts, College Algebra, and Calculus I are the first courses being considered.)

Recommendation 8. There needs to be more collaboration between mathematics faculty and school mathematics teachers.

The MSPs are encouraging such interaction. One of the provisions of the Education Reform Bill (HB 212) of 2003 requires that "high school curricula and end-of-course tests shall be aligned with the placement tests administered by two- and four-year public educational institutions in New Mexico". This effort has apparently not progressed very far and does seem to imply the need for a significant collaboration between mathematics faculty and school mathematics teachers.

Recommendation 9. Efforts to improve standards for school mathematics instruction, as well as for teacher preparation accreditation and teacher certification, will be strengthened by the full-fledged participation of the academic mathematics community.

There has been participation of a few members of the "academic mathematics community" in the work on K-12 *Standards* and teacher competencies, but perhaps not to the level being suggested.

Recommendation 10. Teachers need the opportunity to develop their understanding of mathematics and its teaching throughout their careers, through both self-directed and collegial study, and through formal coursework.

Although NMAC 6.60.10 does require that all beginning teachers have a mentorship of from one to three years, there is no evidence that those programs are able to focus on mathematics and its teaching. Various projects listed in Chapter 1 and Appendix 3 do provide some opportunity for professional development. Most of the universities do offer some graduate programs with some mathematical coursework specifically for teachers. The MSPs are offering such opportunities for middle school mathematics teachers. NMSU now offers an online Master of Arts in Teaching (MAT) in Mathematics, and is collaborating with the Gadsden Independent School District in providing an MAT in Elementary Mathematics and with the Northern New Mexico Math and Science Academy (NM MSA) in providing an MAT in Elementary Math/Science.

Recommendation 11. Mathematics in middle grades (grades 5-8) should be taught by mathematics specialists.

As discussed in Chapter 1, New Mexico is now moving towards having all middle school mathematics teachers be "highly qualified". However, in most Grade 5 situations students are taught in a self-contained classroom by an elementary generalist rather than by a mathematics specialist.

NSTA Standards for Science Teacher Preparation In 2003 NSTA undertook a revision of the Standards for Science teachers <www.nsta.org/main/pdfs/NSTAstandards2003.pdf>. Below the basic Standards are reproduced, along with a few comments on their implementation in New Mexico.

Standard 1: Content Teachers of science understand and can articulate the knowledge and practices of contemporary science.

As indicated in Chapter 1, undergraduates working on degrees that lead to K-8 licensure must take 12 credit hours. Although particularly UNM has for years offered a special integrated Natural Science sequence of courses specifically designed for elementary education majors, many new elementary teachers in New Mexico may have had few opportunities to see the "unifying concepts" and "interdisciplinary perspectives" that NSTA calls for. Also, it is doubted that all prospective elementary teachers have confronted the content in biology, physical sciences, and earth and space sciences encouraged by NSTA. For the past two decades for grade 7-12 licensure there had been just one General Science endorsement. Some universities do try to offer majors that that cover all general science areas and then offer concentrations in areas such as Biology, Chemistry, Physics and Earth Science. NSTA has some general Standards for all science teachers, but then sets specific Standards for Biology, Chemistry, Earth and Space Science, and Physics teachers.

Standard 2: Nature of Science Teachers of science engage students effectively in studies of the history, philosophy, and practice of science.

Standard 3: Inquiry Teachers of science engage students both in studies of various methods of scientific inquiry and in active learning through scientific inquiry.

Standard 4: Issues Teachers of science recognize that informed citizens must be prepared to make decisions and take action on contemporary science- and technology-related issues of interest to the general society.

Standard 5: General Skills of Teaching Teachers of science create a community of diverse learners who construct meaning from their science experiences and possess a disposition for further exploration and learning.

Standard 6: Curriculum Teachers of science plan and implement an active, coherent, and effective curriculum that is consistent with the goals and recommendations of the *National Science Education Standards*.

Standards 7: Science in the Community Teachers of science relate their discipline to their local and regional communities, involving stakeholders and using the individual, institutional, and natural resources of the community in their teaching.

Standards 8: Assessment Teachers of science construct and use effective assessment strategies to determine the backgrounds and achievements of learners and facilitate their intellectual, social, and personal development.

Standard 9: Safety and Welfare Teachers of science organize safe and effective learning environments that promote the success of students and the welfare of all living things.

The New Mexico Competencies (see Appendix 2) do address most of the above Standards, although in less detail than NSTA. It is up to each institution to decide in which courses they will achieve these competencies.

Standard 10: Professional Growth Teachers of science strive continuously to grow and change, personally and professionally, to meet the diverse needs of their students, school, community, and profession.

There has been some concern that with the current emphasis on reading and mathematics there is not much professional development money being dedicated to the professional growth of science teachers.

Financial Aid for Teacher Education Students

Students who have received a Federal Perkins Loan qualify for cancellation (discharge) of up to 100% if they have served full time in a public or nonprofit elementary or secondary school system as a teacher in a school serving students from low income families **or** work as a special education teacher **or** work in mathematics, science, foreign language or bilingual education <studentaid.ed.gov/PORTALSWebApp/students/english/cancelperk.jsp?tab=repaying>.

Students who received Direct and FFEL Stafford Loans may qualify for cancellation of up to $17,500 if they teach mathematics or science in a high poverty school <studentaid.ed.gov/PORTALSWebApp/students/english/cancelstaff.jsp?tab=repaying>.

Both Perkins and Stafford loans are awarded based on need.

New Mexico does have the “Southeastern New Mexico Teachers' Loan-For-Service”, but only students in Lea, Chaves, Otero, Eddy, and Roosevelt counties are eligible. Efforts to expand it have not been successful.

The federally funded Robert C. Byrd Honors Scholarship Program gave approximately 400 four-year awards of $1500 to graduating seniors in 2005. As part of the reauthorization of the Higher Education Act (HR 609) Representative McKeon (R-CA) has an amendment approved that would rewrite the Byrd Scholarship program to:

1. award 1,000 large scholarships (coming close to, if not equaling total cost of attendance) to top students to study math and science education for both their undergraduate and graduate degrees;
2. allocate funds for states to establish P-16 councils that coordinate K-12, higher education, business and teacher credentialing organizations to improve STEM education; and
3. provide up to $5,000 in forgiveness on the interest for all students who agree to teach or work in the STEM fields upon graduation for five consecutive years <http://www.nctm.org/advocacy/update/2005/2005_0722.htm>.

As noted in Chapter 3, the Committee on Prospering in the Global Economy of the 21st Century (2005) with *Rising Above the Gathering Storm* is proposing even more and more generous scholarships for future mathematics and science teachers.

Professional Development

> Changing one's practice in any professional field requires examining the old and new practices, making the appropriate modifications, and learning to carry out new practices effectively (Stigler & Hiebert, 1999, p. 142).

The professional preparation and continuing development of teachers has taken center stage in contemporary reform efforts as one essential condition to better meet the learning needs of an increasingly diverse student population. This recognition of the importance of professional development emerges prominently in the literature and is based on the belief that the "single most important determinant of student achievement is the expertise and qualifications of teachers" (Darling-Hammond, 1997). The *No Child Left Behind Act*, enacted into law in January 2002 by the United States Congress, makes specific reference to professional development throughout its 1,184 pages (Richardson, 2002), intensifying public education's focus on quality professional learning opportunities for teachers. However, much remains to be learned about professional development as a process that contributes to a more proactive pedagogy that fundamentally alters current classroom culture and significantly impacts student learning and achievement.

Guskey (2000) provided a compelling framework for conceptualizing professional development.

> [Professional development] is a purposeful and intentional process. It is a consciously designed effort to bring about positive change and improvement. Professional development is not, as some perceive it to be, a set of random, unrelated activities that have no clear direction or intent. True professional development is a deliberate process, guided by a clear vision of purposes, and planned goals. (p. 17)

Given the socio-political climate for increased accountability and student achievement, teachers must satisfy demands that they update their content knowledge, better understand a growing diverse student population, and incorporate digital tools to enhance learning options. While there is strong consensus in the literature on the benefits of quality professional development, there does not appear to be consensus on approaches as evidenced by Guskey's (2000) assertion that "reviews of the professional development literature typically do a better job of documenting inadequacies than prescribing solutions" (p. 32). Other challenges to developing quality professional development also exist.

Sparks (2000) noted that in order for professional development to be effective it must also affect the organizational structures and culture within which the performance of teachers is embedded; it must consider leadership and organizational practices; and it must be attentive to fundamental belief systems about teaching and learning. However, the reality is that teacher professional development, unlike professional training in the private sector, has not been functionally imbedded into the daily routine of the classroom professional (Ball & Cohen, 1999; Boss, 1999; Corcoran, 1995; Darling-Hammond, 1997; Fullan, 1993). The lack of differentiated models available to teachers and the time required for adaptation, adjustment, and refinement of new skills and attitudes contributes to this dilemma (Darling-Hammond & Sykes, 1999). Classroom professionals need time to reflect on their individual beliefs as they gain understanding of how these beliefs impact the very process of teaching and learning.

A review of the literature reveals a growing consensus that common professional development practices are not adequate (Darling-Hammond, 1998; Darling-Hammond & McLaughlin, 1995; Dilworth & Imig, 1995; Fullan, 1993; Guskey, 2000). One-day events isolated from school and classroom realities, inadequate funding, limited teacher involvement in planning, resistance to the use of emerging technologies, inattention to significant diversity issues, and lack of leadership to coordinate essential follow-up and support are often cited as causes for professional development not positively impacting constructive classroom practice (Guskey, 2000). However, a growing body of evidence supports the belief that the introduction of digital age technologies may assist practitioners to carefully examine traditional beliefs about teaching and learning. As described by Tiene and Ingram (1997/2001), this examination "can lead, over time, to a real revolution in how teachers and students learn" (p. 257). This transformation will require substantial effort on the part of educators, administrators, community members, and policy makers.

The literature indicates a growing consensus regarding the characteristics that define effective professional development (Abdal-Haqq, 1996; Boss, 1999; Clair & Adger, 1999; Gonzales et al., 2001; Peixotto & Fager, 1999; Sparks, 2000; U.S. Department of Education Professional Development Team, 1995). Darling-Hammond and McLaughlin (1995) summarized these characteristics as strategies that succeed in improving teaching:

- Engage teachers in concrete tasks of teaching, assessment, observation, and reflection that illuminate the processes of learning and development;
- Grounded in inquiry, reflection, and experimentation that are participant driven;
- Collaborative, involving a sharing of knowledge among educators and a focus on teachers' communities of practice rather than on individual teachers;
- Connected to and derived from teachers' work with their students;
- Sustained, ongoing, intensive, and supported by modeling, coaching, and the collective solving of specific problems of practice; and
- Connected to other aspects of school change. (p. 1)

These strategies underscore the importance of a learning environment where teachers and administrators develop common goals, share ideas, and work together to achieve established goals. "This kind of teaching and learning would require that teachers become serious learners in and around their practice, rather than amassing strategies and activities (Ball & Cohen, 1999, p. 4). Effective professional development then requires time for observation, practice, reading, reflection, dialogue with colleagues, and support for these practices at the district, state, and federal levels (Abdal-Haqq, 1996; Boss, 1999).

Summary

We can summarize the needs with respect to teacher preparation and professional development by quoting the conclusions on "Teachers and Teaching" from the National Research Council publication (NRC, 2000) on *How People Learn: Brain, Mind, Experience, and School* <books.nap.edu/catalog/9853.html>:

- Teachers need expertise in both subject matter content and in teaching.
- Teachers need to develop understanding of the theories of knowledge (epistemologies) that guide the subject-matter disciplines in which they work.
- Teachers need to develop an understanding of pedagogy as an intellectual discipline that reflects theories of learning, including knowledge of how cultural beliefs and the personal characteristics of learners influence learning.
- Teachers are learners and the principles of learning and transfer for student learners apply to teachers.
- Teachers need opportunities to learn about children's cognitive development and children's development of thought (children's epistemologies) in order to know how teaching practices build on learners' prior knowledge.
- Teachers need to develop models of their own professional development that are based on lifelong learning, rather than on an "updating" model of learning, in order to have frameworks to guide their career planning.

National Staff Development Council (2001)
Standards for Staff Development

Context Standards

Learning Communities: Improves the learning of all students and organizes adults into learning communities whose goals are aligned with those of the school and district.
Leadership: Improves the learning of all students and requires skillful school and district leaders who guide continuous instructional improvement.
Resources: Improves the learning of all students and requires resources to support adult learning and collaboration.

Process Standards

Data-Driven: Improves the learning of all students and uses disaggregated student data to determine adult learning priorities, monitor progress, and help sustain continuous improvement.
Evaluation: Improves the learning of all students and uses multiple sources of information to guide improvement and demonstrate its impact.
Research -Based: Improves the learning of all students and prepares educators to apply research to decision making.
Design: Improves the learning of all students and uses learning strategies appropriate to the intended goal.
Learning: Improves the learning of all students and applies knowledge about human learning and change.
Collaboration: Improves the learning of all students and provides educators with the knowledge and skills to collaborate.

Content Standards

Equity: Improves the learning of all students and prepares educators to understand and appreciate all students, create safe, orderly and supportive leaning environments, and hold high expectations for their academic achievement.
Quality Teaching: Improves the learning of all students and deepens educators' content knowledge, provides them with research-based instructional strategies to assist students in meeting rigorous academic standards, and prepares them to use various types of classroom assessments appropriately.
Family Involvement: Improves the learning of all students and provides educators with knowledge and skills to involve families and other stakeholders appropriately.

CHAPTER 6

OTHER STRATEGIES FOR ACHIEVING MATH AND SCIENCE LITERACY

In this chapter a few strategies are presented that did not seem to fit easily into the other chapters. Some of the strategies are directly related to math and science, and some are more general.

Educational Games – The Future of Learning Now

> It is amazing to me how in all the hoopla and debate these days about the decline of education in the US we ignore the most fundamental of its causes. ***Our students have changed radically. Today's students are no longer the people our educational system was designed to teach***. (Prensky, 2001, p. 1)

A convergence of forces is causing educators to question traditional methodologies. In today's instructional environment, accountability is the watchword, with specific attention to student achievement as evidenced through passing high stakes exams. However, teachers and administrators are constantly battling apathy in the classroom which impacts achievement. Today's students have ways of learning that have developed as a result of growing up in a technologically rich environment – true digital natives.

> Today's students – K through college – represent the first generations to grow up with this new technology. They have spent their entire lives surrounded by and using computers, videogames, digital music players, video cams, cell phones, and all the other toys and tools of the digital age. Today's average college grads have spent less than 5,000 hours of their lives reading, but over 10,000 hours playing video games (not to mention 20,000 hours watching TV). Computer games, email, the Internet, cell phones and instant messaging are integral parts of their lives. (Prensky, 2001, p. 1)

While the scope of this section is not to debate the merits of this mind-set, the reality is that educators on a daily basis face students whose experiences are very different from their own. Thus, the pivotal question for the educational establishment becomes: Are there tools and methodologies that educators can use to address the individual needs of students for relevance and engagement while ensuring that students reach the achievement goals that have been set?

Shaffer, Squire, Halverson, and Gee (2004) contend that "to understand the future of learning, we have to look beyond schools to the emerging arena of video games" (p. 2). They argue that "video games matter because they present layers with simulated worlds: worlds which, if well constructed, are not just about facts or isolated skills, but embody particular social practices" (p. 2). While Shaffer et al. (2004) do not suggest that video games are a panacea because of undesirable aspects associated with many commercially available video games, they do ask the question: "How can we use the power of video games as a constructive force in schools, homes and at work?" (p. 3). Moving from an agenda that portrays video games as mere

entertainment to crafting rich virtual worlds that can provide powerful contexts for learning is an exciting frontier.

Traditionally, the use of technology in the classroom and other educational settings has focused on taking the present methodologies and merely applying emerging technologies to them. For example, early developers took a syllabus and a few other course materials and placed them online or adapted math drill and conceptual instruction into a game format with limited relevance to application. However,

> In game worlds, learning no longer means confronting words and symbols separated from the things those words and symbols are about in the first place. The inverse square law of gravity is no longer something understood solely through an equation; students can gain virtual experience walking on worlds with smaller mass than the earth, or plan manned space flights that require understanding the changing effects of gravitational forces in different parts of the solar system. In virtual worlds, learners experience the concrete realities that words and symbols describe. (Shaffer et al., 2004, p. 4)

Three examples of available media:

Tabula Digita, <www.tabuladigita.com>, a company from New York's Silicon Valley, has developed a game methodology that the creators report rivals any commercial entertainment game available today. Dimenxian™, the first product created by Tabula Digita, is a 3-dimensional immersive educational experience that focuses on Algebra I. The learning modules seamlessly integrate concepts tested in high stakes exams and builds on an educational philosophy based on experiential learning where students learn through interaction and involvement. For example, the first module for Algebra I is focused on graphing linear equations. Kep, the game's lead character will face a mission in which he is to find Darienne and learn as much as possible about the island. He is equipped with weapons as well as math tools with which he will solve problems. To be successful, Kep will need to navigate and explore the island (based upon mathematical principles), overcome various challenges and barriers, and provide solutions to math problems in an immersive and virtual world context.

A simple search on Google (key words "virtual dissection") yields a number of sites available on the Internet to students. Froguts <www.froguts.com/flash_content/> allows students to virtually dissect a frog. While the entire program is available for a subscription cost, the web site does have an engaging demonstration of the process. Other virtual dissection sites include: fetal pig, cow's eye, cat, squid, earthworm, crayfish, cockroach, rat, and sheep brain.

Another search (key words "virtual math lab") yields yet another impressive list of online tools. For example, The Math Forum @ Drexel <mathforum.org/students/index.html> includes multiple interactive links for elementary, middle, and high school students.

NMSU recently received $1.2 million in a subcontract from the Ohio State University for a $15 million USDOEd-funded project called "Middle School Achievement through Technology-Rich Interventions". Various groups at NMSU will be collaborating to create game environments on iPods and other hand-held technologies that will help students learn mathematical concepts and skills.

Supplemental Educational Services

Supplemental Educational Services (SES) is a component of Title I of the Elementary and Secondary Education Act (ESEA) as reauthorized by the *No Child Left Behind Act* (NCLB) that provides additional academic instruction in the areas of mathematics, reading, and language arts to students who attend schools in need of improvement. Students from low-income families who are attending Title I schools that are in their second year of school improvement (i.e., have not made AYP for three or more years), in corrective action, or in restructuring status are eligible to receive these services. During the 04-05 school year, 53 New Mexico schools (Appendix 5) qualified for SES.

A school must continue offering supplemental educational services to its eligible students until the school is no longer identified for school improvement, corrective action, or restructuring. By definition, a school is no longer identified for improvement, corrective action, or restructuring if it has made AYP for two consecutive years.

SES providers are approved by the NM Public Education Department. Services may include academic assistance such as tutoring, remediation, and other educational interventions, provided that such approaches are consistent with the content and instruction used by the local educational agency (LEA) and are aligned with the State's academic content standards. NCLB requires that SES be provided outside the regular school day and that these services be high-quality, evidence-based, and specifically designed to increase academic achievement. The Public Education Department and local districts are required to ensure that children have access to supplemental educational services and that parents are provided sufficient information to select a provider that best meets the needs of their child.

A provider of supplemental educational services may be any public or private (non-profit or for-profit) entity that meets the State's criteria for approval. Potential providers include public schools (including charter schools), private schools, LEAs, educational service agencies, institutions of higher education, faith- and community-based organizations, and private businesses. A public school or an LEA that is in need of improvement may not be a provider. A provider must ensure that it:

- Has a demonstrated record of effectiveness in increasing student academic achievement;
- Can document that its instructional strategies are of high quality, based upon research, and designed to increase student academic achievement;
- Is capable of providing supplemental educational services that are consistent with the instructional program of the LEA and State academic content standards,
- Is financially sound, and
- Abides by all applicable Federal, State, and local health, safety, and civil rights laws *[Section 1116(e)(12)(B) and Section 1116(e)(5)(C)]*.

Currently, there are 22 approved SES providers in New Mexico. Table 2 in Appendix 4 provides an overview of the services available to students, as described by the providers <sde.state.nm.us/fedpro/sess.html>.

The Public Education Department contracted the Center for Education and Study of Diverse Populations (CESDP) to evaluate providers' services in the 2003-2004 school year. Conclusions from the evaluation study indicate that

> Eight vendors operated during 2003-04, the initial year of the program. Along with working on the details of contract and invoice issues, districts also focused on recruitment procedures. They expressed concern regarding appropriate student recruitment and referral practices by vendors. In general, parents and students expressed satisfaction with the content and rapport of the tutoring sessions, noting increased motivation and interest in school or reading. However, parents articulated dissatisfaction with the time delay between request for services and the start of services. Many parents knew little about the scope of the tutoring session, a plan for their child's progress, or information on student progress. Parents wanted regular reporting on student progress and the opportunity to learn how to support their child's education. Tutoring observations suggested that tutors demonstrated good content knowledge, but were lacking in strategies to work with culturally and linguistically diverse students, who accounted for about 93% of the participating students. Tutors identified several areas in which they would like training. These included additional information on SES and its requirements, interpretation of assessment scores and how to use assessment information to guide instruction, and strategies for instruction with bilingual students. Teachers were generally unaware of the SES participation of students in their classroom, as little to no communication existed between vendors and teachers. (CESDP, 2004, p. 1-2)

The CESDP report further notes that

> About 2,000 students received services in the fall of 2003. Of these, 70% were Hispanic, 21% were American Indian, and 6% were Caucasian with other ethnicities making up the remaining percentages. Males accounted for 55% of the students participating and about 50% of the total number of students participating were state-classified as English Language Learners. Most services were provided to elementary students, accounting for 75% of the students receiving services. Most tutoring was focused on reading or language arts, with some support in mathematics. (Ibid., p. 2)

During one of the vendor meetings, the PED announced that "only 10 percent of eligible students were being served by SES providers" (Elizabeth Ethelbah, personal communication, July, 2005). Given the significant achievement gap that exists between sub-populations, SES may be an untapped resource, especially in the area of mathematics.

Virtual Labs

Mannix (2000) has suggested that "Web-based laboratories allow students to conduct detailed experiments any time they want - and cost far less to create and maintain than the real thing." The New Mexico Legislature in 2004 passed House Joint Memorial 8 that required the Public Education Department to study the use of virtual anatomy as an acceptable alternative

method of study. Affectionately known as the "Froggie Bill" it did lead to a study that Richard Reif (2004) presented to the Legislative Education Study Committee (LESC). Reif's report gave details on the New Mexico science *Standards*, surveys of science teachers regarding dissection, position papers of professional organizations, research on the effectiveness, and cost of alternatives. He concluded that, although the *Standards* do not call specifically for dissections, virtual alternatives could satisfy any *Standards* that might be met using dissections and noted that teachers strongly support the inclusion of actual dissection in their curriculum. He also indicated that research on the effectiveness of alternatives to dissection is not conclusive. He specifically recommended allowing virtual alternatives for students with ethical, moral, cultural, or religious objections to dissection, but also recommended the continued inclusion of real dissection in life sciences curriculum. His recommendations led to the following addition to New Mexico Administrative Code (NMAC 6.30.2.10.I) in which:

> (8) All science classes that include dissection activities as part of the curriculum must provide virtual dissection techniques as alternative activities for any student who is opposed to real dissections for ethical, moral, cultural, or religious reasons. Alternative techniques shall approximate the experience of real dissection activities as closely and appropriately as possible. A virtual dissection technique means carrying out dissection activities using computer 2-D or 3-D simulations, videotape or videodisk simulations, take-apart anatomical models, photographs, or anatomical atlases.

College-Prep as Default High School Curriculum

At least three states - Arkansas, Indiana and Texas - have moved to make the college-prep curriculum required for "all" students. While it is too soon to have research results from these programs, besides the intended consequences, some fear unintended consequences such as increased dropout rates or watered down courses.

Arkansas calls its program "Smart Core". It will be required beginning with the 2010 graduating class. It is supported by two initiatives to prepare students for the higher expectations: "Smart Start" (the Arkansas K-4 Initiative - <arkedu.state.ar.us/smart_start/index.html>) and "Smart Step" for Grades 5-8 <arkedu.state.ar.us/smart_step/index.htm>. Among the ideas in "Smart Start" are "Refrigerator Curricula" (overviews of grade-level Standards for families to post on refrigerators), Math professional development based on collaborative lesson planning and use of data-driven decisions, and increasing to 16 the number of K-6 Math Specialists (51 state literacy specialists and 10 secondary Math specialists), but their K-4 Action Plan does not mention Science. The "Smart Step" Action Plan is very similar to the one for "Smart Start". The "Smart Core" requires that students take four units of Math, at least one Math course in the junior or senior year, and three units of Science with laboratory experience <arkedu.state.ar.us/standards/pdf/Final%20Smart%20Core%20(Videoconference)2.ppt>.

Core 40 is Indiana's recommended high school curriculum for all students <www.doe.state.in.us/core40/welcome.html>. While for a "Minimum High School Diploma" Indiana students only have to take the equivalent of two Math units and two Science units, the recommended "Core 40 Diploma" requires at least three units of Math (Algebra I & II and Geometry) and three units of Science.

Texas now has a "Minimum Graduation Plan" and a "Recommended High School Program" similar to Indiana's <www.tea.state.tx.us/curriculum/seg9-04.doc>. One apparent difference is that all students "shall enroll in the courses necessary to complete the curriculum requirements for the recommended high school program" unless they have family, and school counselor or administrator consent to follow the minimum plan.

No Child Left Behind Act of 2001

> Three years ago, President George W. Bush signed into law the *No Child Left Behind Act* (NCLB), which reauthorized the *Elementary and Secondary Education Act* (*ESEA*), a law first passed in 1965. The new law reflected an unprecedented, bipartisan commitment to ensuring that all students, regardless of their background, receive a quality education. To reach this goal, *NCLB* refocused federal education programs on the principles of stronger accountability for results, more choices for parents and students, greater flexibility for states and school districts, and the use of research-based instructional methods. (U.S. Department of Education, 2005, p. 1)

Under the Act's accountability provisions, states must describe how they will close the achievement gap and make sure all students, including those who are disadvantaged, achieve academic proficiency. They must produce annual state and school district report cards that inform parents and communities about state and school progress. Schools that do not make progress must provide supplemental services, such as free tutoring or after-school assistance (see above and Appendix 5 for a description of SES services in New Mexico); take corrective actions; and, if still not making adequate yearly progress after five years, make dramatic changes to the way the school is run.

NCLB established deadlines for states to develop annual assessments aligned to state standards and to use achievement on these tests as the primary measure of district and school accountability. Assessments must include the participation of all students, including those with disabilities and limited English proficiency. Test results must include individual student scores and be reported by race, income, and other categories to measure not just overall trends, but also gaps among, and progress of, various subgroups of students. Key implementation deadlines follow.

By the 2002-2003 school year:

- States and districts must issue report cards to the public (New Mexico school report cards are posted by the PED at <sde.state.nm.us/div/acc.assess/accountability/2005%20data/School_Accountability_Report_2005/>
- Correction actions apply to any school identified as in need of improvement (A NM school designation report is posted by the PED at <sde.state.nm.us/div/acc.assess/accountability/dl/school.designations.01.03.05.pdf>
- States must set an adequate yearly program "starting point" based on 2001-2002 data. According to information posted on the PED web site, the following conditions are necessary for a school to meet AYP (See Figure 12).
    - Achieve a 95% participation rate in state reading and math assessments.
    - Reach targets for either proficiency or decrease in non-proficiency in reading and math.
    - Reach targets for one other indicator – attendance rate for elementary and middle schools, or graduation rate for high schools.

- Districts must assess Limited English Proficiency students for their English proficiency.
- All states must participate in the National Assessment of Educational Progress (NAEP) 4th and 8th grade reading and math tests.

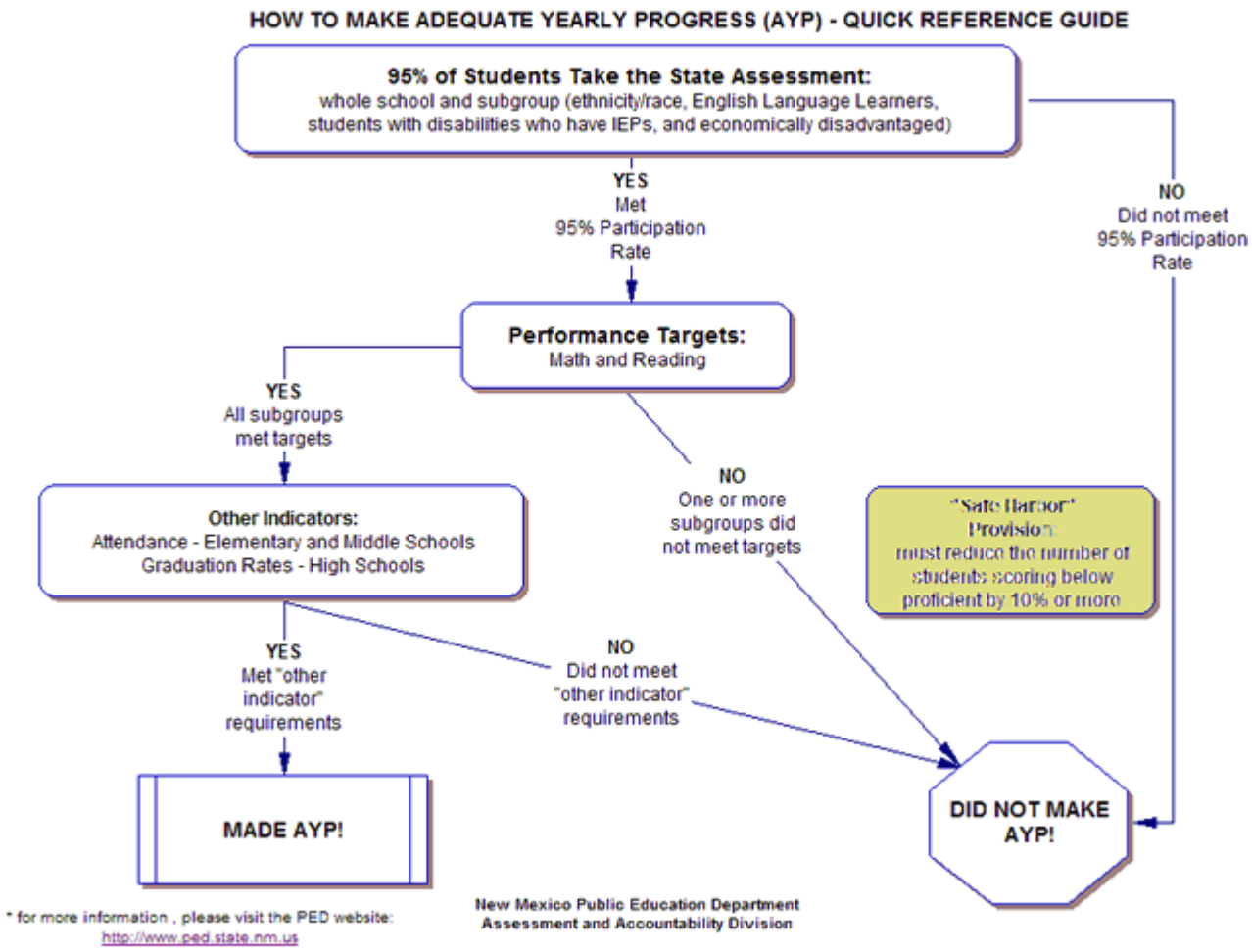
By the 2005-2006 school year:

- States must have adopted standards for science (NM Science Content Standards, Benchmarks, and Performance Standards were adopted by the State Board of Education on August 28, 2003.)
- Annual statewide assessments for reading and mathematics in grades 3-8 must be in place.

By the 2007-2008 school year:

- Annual science assessments must be in place for each of the following grade spans: 3-5, 6-9, and 10-12.

Figure 14



Graphing Calculators

(A special thank you to Karen Trujillo for her work on this section.)

The NCTM (2000) Technology Principle states that technology is an essential part of both teaching and learning mathematics. Technology allows students to visualize, analyze and investigate mathematics at a deeper level than is otherwise possible. Although it is not possible to get computers in the hands of every student, it is possible to ensure that every student has access to an even more fundamental tool of mathematics: the graphing calculator.

It is true that many schools have access to graphing calculators for use in the mathematics classroom. However, the supply rarely meets the demand. In most schools in our area (both large and small) there are between 15 and 30 graphing calculators available for teacher and student use. In a school with over 2000 students, this is not nearly enough. As a result, the students in the advanced classes (calculus) are the only students who are able to access this technology on a regular basis, with other students getting occasional exposure and the majority of the students not getting any. This violates the NCTM (2000) Equity Principle.

Last year during the NMSBA, there was a question about what types of calculators would be allowed during the test. The decision was handed down the first day of the testing window and each district interpreted the regulation differently. Some districts allowed students to use "whatever calculator they were used to using" which in some cases was a graphing calculator and in others a scientific calculator. Other districts only allowed a four function calculator regardless of what the students were used to. This also violates the Equity Principle.

Many lower division math courses at New Mexico institutions of higher education use graphing calculators as an integral part of the curriculum. Students familiar with the technology from high school would be better prepared for entrance into college math courses. As stated in the Technology Principle:

> Technology also supports effective mathematics teaching and can dramatically increase the possibilities for engaging students with challenging content using visualization, simulation, graphing, and advanced computing. In this context, technology is not used as a replacement for basic understandings and intuitions; rather, it can and should be used to foster greater understanding. (p. 26)

The graphing calculator would not be used to replace the teaching and learning of basic skills, but instead it could be used to foster the higher level mathematics that is outlined in both the content and process standards.

Using the data provided by the NM PED, in 2004 there were 98,183 high school students in the state of New Mexico. Using the Las Cruces Public Schools as a model, the number of high school students in the district divided by the number of teachers was used to determine the average student load for a high school math teacher. There are 7095 high school students in Las Cruces and approximately 50 high school math teachers. Dividing these two numbers yields an approximate student load of 140 students per teacher. If there are 98,183 students then there are approximately 600 high school math teachers in the state. A classroom set of 30 graphing calculators with an overhead component is approximately $3000. The cost of purchasing this type of a set up for each high school teacher would be $1,800,000. If the decision was made to

purchase a classroom set of an upgraded calculator with wireless capabilities and software the price could be as much as $2,500,000. However, it is possible that a contract could be written with one of the calculator companies to reduce the price of each individual unit.

As far as professional development is concerned, most of the companies who sell this technology offer training online or as part of a contract with the purchaser. Other possible avenues for training include the MSPs (see Appendix 3). If the professional development were offered by an independent contractor at a cost of $150 per teacher, this would amount to approximately $93,000.

As a state, we will be adopting textbooks and materials for mathematics for the 2007-2008 school year. In some districts we are witnessing a shift from the traditional text to a more standards-based curriculum. These curricula focus more on the problem solving, the real life application, the representation and the communication of mathematics. The mathematics that is written in the *Standards* is expected to be taught with depth for understanding and not only through algorithms. In order to ensure that this is the case for all students in the state, it is a must that the graphing calculator technology be accessible to all students. Ideally, each student would have a graphing calculator throughout high school. That would cost over $12 million and it is not necessary. For about $2 million, each high school math teacher would have a classroom set of this technology so that all students would have access in the classroom. They will be able to see the mathematics, solve real world problems, and be better prepared for college level mathematics upon graduation. Calculators will not solve all of the problems we face in math education, but they will make the playing field more even and they have the potential to enrich the mathematics experience for all students and not just those who are fortunate enough to afford the technology.

Graphing calculators also have significant applications in science classrooms, particularly when used with Calculator-Based Laboratory (CBL) devices.

After-School Programs

"After-school programs" is a catch-all term that includes before-school, weekend and summer programs. The Southern NM Science, Engineering, Math and Aerospace Academy (SNM SEMAA), a successful after-school program, was presented in Chapter 2 in the discussion of promoting the importance of Math and Science literacy. A recent publication of Public/Private Venture (P/PV) entitled *Challenges and Opportunities in After-School Programs: Lessons for Policymakers and Funders* (Grossman, Walker & Raley, 2001) indicates that "while the need for enrichment opportunities exists everywhere, their availability is not universal" (p. 3) <www.ppv.org/ppv/publications/assets/120_publication.pdf>. While the report emphasizes that after-school programs can have positive academic, social and recreational functions, they do face significant challenges in terms of funding and facilities. Below some of the most important challenges are presented:

- The current notion that school buildings are under-used resources, open for only six or seven hours during the school day and not all in summer, is too simplistic.
- Limited resources for maintaining the school's physical facilities and equipment lead administrators to limit the building's use.
- Targeted efforts are needed to attract the most disadvantaged students.

- Older children are less attracted to after-school programs than are elementary school children.
- Programs' inability to provide transportation home is a major barrier to participation for a large proportion of students.
- The cost of transportation significantly increases programs' need for resources.
- Many of the programs have opted to serve more children less intensively (programming one or two days a week for each age group) rather than fewer children more intensively (three to five days a week). Less frequent participation lessens the likelihood of positive impacts.

Early Childhood Education, Art, Health and Physical Education

During the past few New Mexico Legislative sessions there has been increased attention to funding Early Childhood Education (the Pre-K Initiative), Art in the Schools, school-based health centers, and physical education. All these efforts can enhance the promotion of Mathematics and Science literacy.

The 2005 New Mexico Legislature appropriated $5,000,000 for the Pre-K Initiative. The Request for Proposals for the Pre-K Initiative indicated that two of its purposes were to provide developmentally appropriate activities for New Mexico children and focus on school readiness <www.cyfd.org/RFP/RFP7083-PreK.pdf>. The *Principles and Standards for School Mathematics* (NCTM, 2000) provides content standards beginning with Pre-K. The following paragraph perhaps captures the spirit of what Mathematics education can be in the Pre-K years:

> High-quality learning results from formal and informal experiences during the preschool years. "Informal" does not mean unplanned or haphazard. Since the most powerful mathematics learning for preschoolers often results from their explorations with problems and materials that interest them, adults should take advantage of opportunities to monitor and influence how children spend their time. Adults can provide access to books and stories with numbers and patterns; to music with actions and directions such as up, down, in, and out; or to games that involve rules and taking turns. All these activities help children understand a range of mathematical ideas. Children need things to count, sort, compare, match, put together, and take apart (p.75).

Although perhaps not often made explicit, there are many links between art and mathematics. The Math Forum Internet Mathematics Library maintains links to hundreds of resources relating mathematics and art <http://mathforum.org/library/topics/art/>.

Action for Healthy Kids, <www.ActionForHealthyKids.org>, suggests that "many studies show a direct link between nutritional intake and academic performance, as well as between physical activity and academic achievement." We can expect that healthy, physically active kids will be more able to meet the challenges of the rigorous Math and Science education that the nation's economic health and national security demand.

Appendix 1

Selected New Mexico State Statutes

<www.conwaygreene.com/nmsu/lpext.dll?f=templates&fn=main-h.htm&2.0>

22-13-1. Subject areas; minimum instructional areas required; accreditation.

A. The department shall require public schools to address department-approved academic content and performance standards when instructing in specific department-required subject areas as provided in this section. A public school or school district failing to meet these minimum requirements shall not be accredited by the department.

B. All kindergarten through third grade classes shall provide daily instruction in reading and language arts skills, including phonemic awareness, phonics and comprehension, and in mathematics. Students in kindergarten and first grades shall be screened and monitored for progress in reading and language arts skills and students in second grade shall take diagnostic tests on reading and language arts skills.

C. All first, second and third grade classes shall provide instruction in art, music, a language other than English and instruction that meets content and performance standards shall be provided in physical education and health education.

D. In fourth through eighth grades, instruction that meets academic content and performance standards shall be provided in the following subject areas:

(1) reading and language arts skills, with an emphasis on writing and editing for at least one year and an emphasis on grammar and writing for at least one year;

(2) mathematics;

(3) language other than English;

(4) communication skills;

(5) science;

(6) art;

(7) music;

(8) social studies;

(9) New Mexico history;

(10) United States history;

(11) geography;

(12) physical education; and
(13) health education.

E. In fourth through eighth grades, school districts shall offer electives that contribute to academic growth and skill development and provide career and technical education.

F. In ninth through twelfth grades, instruction that meets academic content and performance standards shall be provided in health education.

22-13-1.1. Graduation requirements.

A. At the end of grades eight through eleven, each student shall prepare an interim next-step plan that sets forth the coursework for the grades remaining until high school graduation. Each year's plan shall explain any differences from previous interim next-step plans, shall be filed with the principal of the student's high school and shall be signed by the student, the student's parent and the student's guidance counselor or other school official charged with coursework planning for the student.

B. Each student must complete a final next-step plan during the senior year and prior to graduation. The plan shall be filed with the principal of the student's high school and shall be signed by the student, the student's parent and the student's guidance counselor or other school official charged with coursework planning for the student.

C. An individualized education program that meets the requirements of Subsections A and B of this section and that meets all applicable transition and procedural requirements of the federal Individuals with Disabilities Education Act for a student with a disability shall satisfy the next-step plan requirements of this section for that student.

D. A local school board shall ensure that each high school student has the opportunity to develop a next-step plan and is reasonably informed about:

(1) curricular and course options;

(2) opportunities available that lead to different post-high-school options; and

(3) alternative opportunities available if the student does not finish a planned curriculum.

E. The secretary shall:

(1) establish specific accountability standards for administrators, counselors, teachers and school district staff to ensure that every student has the opportunity to develop a next-step plan;

(2) promulgate rules for accredited private schools in order to ensure substantial compliance with the provisions of this section;

(3) monitor compliance with the requirements of this section; and

(4) compile such information as is necessary to evaluate the success of next-step plans and report annually, by December 15, to the legislative education study committee and the governor.

F. Successful completion of a minimum of twenty-three units aligned to the state academic content and performance standards shall be required for graduation. These units shall be as follows:

(1) four units in English, with major emphasis on grammar and literature;

(2) three units in mathematics, at least one of which is equivalent to the algebra 1 level or higher;

(3) two units in science, one of which shall have a laboratory component; provided, however, that with students entering the ninth grade beginning in the 2005-2006 school year, three units in science shall be required, one of which shall have a laboratory component;

(4) three units in social science, which shall include United States history and geography, world history and geography and government and economics;

(5) one unit in physical education;

(6) one unit in communication skills or business education, with a major emphasis on writing and speaking and that may include a language other than English; and

(7) nine elective units and eight elective units for students entering the ninth grade in the 2005-2006 school year that meet department content and performance standards. Student service learning shall be offered as an elective.

G. The department shall establish a procedure for students to be awarded credit through completion of specified career technical education courses for certain graduation requirements.

H. Final examinations shall be administered to all students in all classes offered for credit.

I. A student shall not receive a high school diploma who has not passed a state graduation examination in the subject areas of reading, English, mathematics, writing, science and social science. The state graduation examination on social science shall include a section on the constitution of the United States and the constitution of New Mexico. If a student exits from the school system at the end of grade twelve without having passed a state graduation examination, the student shall receive an appropriate state certificate indicating the number of credits earned and the grade completed. If within five years after a student exits from the school system the

student takes and passes the state graduation examination, the student may receive a high school diploma.

J. As used in this section:

(1) "final next-step plan" means a next-step plan that shows that the student has committed or intends to commit in the near future to a four-year college or university, a two-year college, a trade or vocational program, an internship or apprenticeship, military service or a job;

(2) "interim next-step plan" means an annual next-step plan in which the student specifies post-high-school goals and sets forth the coursework that will allow the student to achieve those goals; and

(3) "next-step plan" means an annual personal written plan of studies developed by a student in a public school or other state-supported school or institution in consultation with the student's parent and school counselor or other school official charged with coursework planning for the student.

K. The secretary may establish a policy to provide for administrative interpretations to clarify curricular and testing provisions of the Public School Code.

22-13-1.2. High school curricula and end-of-course tests; alignment.

High school curricula and end-of-course tests shall be aligned with the placement tests administered by two- and four-year public post-secondary educational institutions in New Mexico. The department shall collaborate with the commission on higher education in aligning high school curricula and end-of-course tests with the placement tests.

Appendix 2

Selected New Mexico Administrative Code (NMAC)
<www.nmcpr.state.nm.us/nmac/>

6.24.4 Competencies for Entry-Level Mathematics Teachers

TITLE 6 PRIMARY AND SECONDARY EDUCATION
CHAPTER 64 SCHOOL PERSONNEL - COMPETENCIES FOR LICENSURE
PART 4 COMPETENCIES FOR ENTRY-LEVEL MATHEMATICS TEACHERS

6.64.4.1 ISSUING AGENCY: State Board of Education
[07-15-99; 6.64.4.1 NMAC - Rn, 6 NMAC 4.7.1.3.1, 10-31-01]

6.64.4.2 SCOPE: Chapter 64, Part 4, governs the competencies that will be used by New Mexico institutions of higher education to establish a curriculum for persons seeking an endorsement in mathematics to a New Mexico educator license.
[07-15-99; 6.64.4.2 NMAC - Rn, 6 NMAC 4.7.1.3.2, 10-31-01]

6.64.4.3 STATUTORY AUTHORITY: Sections 22-2-1, 22-2-2, and 22-10A-3, NMSA 1978.
[07-15-99; 6.64.4.3 NMAC - Rn, 6 NMAC 4.7.1.3.3, 10-31-01; A, 09-30-03]

6.64.4.4 DURATION: Permanent
[07-15-99; 6.64.4.4 NMAC - Rn, 6 NMAC 4.7.1.3.4, 10-31-01]

6.64.4.5 EFFECTIVE DATE: July 15, 1999, unless a later date is cited at the end of a section or paragraph.
[07-15-99; 6.64.4.5 NMAC - Rn, 6 NMAC 4.7.1.3.5, 10-31-01]

6.64.4.6 OBJECTIVE: This regulation is adopted by the State Board of Education (hereinafter the "State Board") for the purpose of establishing entry-level mathematics competencies that are based on what beginning mathematics teachers must know and be able to do to provide effective mathematics programs in New Mexico schools. The competencies were developed to ensure alignment with the New Mexico's Content Standards and Benchmarks for mathematics and with the national standards of the National Council of Teachers of Mathematics.
[07-15-99; 6.64.4.6 NMAC - Rn, 6 NMAC 4.7.1.3.6, 10-31-01]

6.64.4.7 DEFINITIONS: [Reserved]

6.64.4.8 REQUIREMENTS:

A. Beginning teachers seeking an endorsement in mathematics to an initial level I New Mexico teaching license, must satisfy all of the requirements of the license as provided in state board of education rule for that license, which includes, among other requirements, 24-36 semester hours in mathematics and passage of a content area test in mathematics.

B. Teachers seeking to add an endorsement in mathematics to an existing New Mexico teaching license of any level where the candidate has less than five full academic years of teaching experience, shall meet one of the following requirements:

(1) pass the content knowledge test(s) of the New Mexico teacher assessments as provided in 6.60.5.8 NMAC, or predecessor New Mexico teacher licensure examination or accepted comparable licensure test(s) from another state in mathematics; or

(2) successfully complete an undergraduate academic major (24-36 semester hours), or coursework equivalent to an undergraduate major or a graduate degree in mathematics; or

(3) obtain certification in mathematics for the appropriate grade level of New Mexico licensure from the national board for professional teaching standards.

C. Persons seeking to add an endorsement in mathematics to an existing New Mexico teaching license of any level where the candidate has at least five full academic years of teaching experience, may do so by meeting the requirements of Paragraphs (1), (2) or (3) of Subsection B of 6.64.4.8 NMAC, or by demonstrating the teaching competencies for entry level mathematics teachers as provided in 6.64.4.9 NMAC through the state's high objective uniform standard of evaluation (HOUSE) for demonstrating competence in the core academic subjects and other endorsement areas as set forth in 6.69.4.9 NMAC.
[07-15-99; 6.64.4.8 NMAC - Rn, 6 NMAC 4.7.1.3.8, 10-31-01; A, 09-30-03]

6.64.4.9 COMPETENCIES FOR ENTRY-LEVEL MATHEMATICS TEACHERS

A. Teachers will understand and use Mathematics in Problem-Solving.

(1) Teachers for grades K-8 will be able to:

(a) Use problem-solving approaches to investigate and understand mathematical content.
(b) Formulate and solve problems from both mathematical and everyday situations.
(c) Identify, select and use appropriate problem-solving strategies; as well as develop and apply their own strategies.
(d) Verify and interpret solutions to problems.
(e) Use mathematical language and symbolism to model problem situations.

(2) Teachers for grades 5-9 will be able to meet the Standards set for K-8 teachers.

(3) Teachers for grades 7-12 will be able to:
(a) Use a problem solving approach to investigate and understand mathematical concepts.
(b) Formulate and solve problems from both mathematical and everyday experiences.
(c) Develop their own processes and techniques for solving problems.

B. Teachers will understand and use Mathematics in Communication.

(1) Teachers for grades K-8 will be able to:
(a) Identify and define mathematical concepts in a variety of situations.
(b) Communicate mathematical ideas both verbally and in writing.
(c) Use drawings, discussion, reading, and listening to learn and communicate mathematical ideas.
(d) Use a variety of electronic media and manipulatives to explore and communicate mathematical concepts and problem solutions.

(2) Teachers for grades 5-9 will be able to meet the Standards set for K-8 teachers.

(3) Teachers for grades 7-12 will be able to:
(a) Develop skills in both written and oral communication of mathematical concepts.
(b) Learn to communicate effectively at various levels of formality and with people who have differing levels of mathematical understanding.

C. Teachers will understand and Use Mathematics in Reasoning.

(1) Teachers for grades K-8 will be able to:
(a) Describe logical conclusions.
(b) Use information sources, models and known facts to explain mathematical thinking.
(c) Make and evaluate mathematical conjectures and validate their own mathematical thinking.
(d) Recognize and construct logical arguments for mathematical statements, concepts, and principles.
(e) Apply a variety of reasoning processes to include deductive and inductive reasoning.

(2) Teachers for grades 5-9 will be able to meet the Standards set for K-8 teachers.

(3) Teachers for grades 7-12 will be able to:
(a) Recognize patterns, make and refine conjectures and definitions, and construct both formal and heuristic proofs.
(b) Judge the validity of mathematical arguments.
(c) Formulate counterexamples.

D. Teachers will understand and use Mathematical Connections.

(1) Teachers for grades K-8 will be able to:
(a) Show an understanding of the interrelationships within mathematics.
(b) Connect mathematics to other disciplines and everyday situations.

(2) Teachers for grades 5-9 will be able to meet the Standards set for K-8 teachers.

(3) Teachers for grades 7-12 will be able to:
(a) Develop an understanding of the interrelationships within mathematics and an appreciation of its unity.
(b) Understand and appreciate the power of mathematical language and symbolism in the development of mathematical concepts.
(c) Explore the connections between mathematics and other disciplines.
(d) Apply mathematics learned in one context to other contexts.

E. Teachers will understand and use numbers, and their relationships, systems and theory.

(1) Teachers for grades K-8 will be able to:
(a) Construct number meanings through everyday experiences and the use of physical materials.
(b) Understand prenumeration concepts.
(c) Describe and compare ancient and modern numeration systems by relating counting, grouping, and place value concepts.
(d) Develop number sense.
(e) Identify different sets of numbers in the real number system.
(f) Understand representations of numbers, including mixed numbers, fractions, decimals, and scientific notation.
(g) Demonstrate ability to use models to explore and explain relationships among fractions, decimals, percents, ratios, and proportions.
(h) Use the relations of equality and inequality.

(2) Teachers for grades 5-9 will be able to meet the Standards set for K-8 teachers.

(3) Teachers for grades 7-12 will be able to: Explore and discuss the properties, relations, and extensions of the real and complex numbers.

F. Teachers will understand and use computation and estimation.

(1) Teachers for grades K-8 will be able to:

(a) Model, explain, and develop proficiency with the basic number facts and algorithms, including addition, subtraction, multiplication and division.

(b) Recognize alternative algorithms for the four basic operations.

(c) Select and use computation techniques appropriate to specific problems and determine the reasonableness of solutions.

(d) Use estimation strategies.

(e) Recognize when estimates are appropriate.

(2) Teachers for grades 5-9 will be able to meet the Standards set for K-8 teachers.

(3) Teachers for grades 7-12 will be able to:

(a) Understand and apply numerical computational and estimation techniques and extend them to symbolic expressions.

(b) Use estimation to assess the reasonableness of solutions.

G. Teachers will have a foundation in geometric concepts.

(1) Teachers for grades K-8 will be able to:

(a) Describe, model, draw and classify geometric figures.

(b) Investigate, predict, and describe the results of combining, subdividing and changing shapes.

(c) Develop spatial sense and relationships.

(d) Relate geometric and measurement ideas.

(e) Use geometric concepts and relationships to describe and model mathematical ideas and relationships to the world.

(f) Solve simple problems in two- and three-dimensional geometry involving parallelism, perpendicularity, congruence, similarity, translation, reflection, rotation, symmetry, and incidence.

(2) Teachers for grades 5-9 will be able to meet the Standards set for K-8 teachers.

(3) Teachers for grades 7-12 will be able to:

(a) Understand the role of axiomatic systems in geometry.

(b) Develop both synthetic and algebraic geometric concepts using coordinates and vectors.

(c) Use geometry as a source of mathematical models for a variety of applications.

(d) Employ geometric reasoning as a problem solving strategy.

(e) Model features of the real world using different geometries.

H. Teachers will understand and use measurement.

(1) Teachers for grades K-8 will be able to:

(a) Determine what needs to be measured, select an appropriate unit of measurement, and then select an appropriate tool with which to measure.

(b) Use standard and nonstandard units for measurement to an appropriate degree of accuracy.

(c) Use estimation, informal procedures, and formulas to solve problems involving linear measures, area, volume, mass, and temperature by using both traditional and metric systems.

(2) Teachers for grades 5-9 will be able to meet the Standards set for K-8 teachers.

(3) Teachers for grades 7-12 will be able to:

(a) Identify and use the appropriate units, tools of measurement, and degree of accuracy required in particular problems, making calculations of relative error as necessary.

(b) Apply measurement as a tool in other disciplines.

I. Teachers will understand and use statistics and probability.

(1) Teachers for grades K-8 will be able to:

(a) Collect data from real world experiences or surveys, organize and display data using various charts/graphs manually and by using appropriate technology, analyze and interpret the data, and write convincing arguments based on the data.

(b) Solve elementary statistical problems relating to measures of central tendency, measures of dispersion, regression equations, and non-linear regression.

(c) Critically examine and analyze data for reliability and validity.

(d) Demonstrate an understanding of randomness by conducting sampling experiments.

(e) Find experimental and theoretical discrete probabilities using sample spaces, tree diagrams, and other representations.

(f) Plan and conduct simulations to determine experimental probabilities.

(g) Compute the mathematical expectation of simple games and lotteries.

(h) Solve simple problems involving probability, inference, and the testing of hypotheses.

(i) Use simple combinations and permutations to solve counting problems.

(2) Teachers for grades 5-9 will be able to meet the Standards set for K-8 teachers.

(3) Teachers for grades 7-12 will be able to:

(a) Understand measures of central tendency, variability, and correlation.
(b) Collect, display, analyze, and interpret sample data in a variety of situations.
(c) Investigate the role of estimation and probability in statistical analysis.
(d) Use experimental and theoretical probabilities to formulate and solve problems.
(e) Develop strategies for reasoning and making decisions based on uncertainty.
(f) Explore the probabilistic nature of statistical analyses including hypothesis testing, correlation, analysis of variance, and nonparametric methods.

J. Teachers will understand and use patterns and functions.
(1) Teachers for grades K-8 will be able to:
(a) Recognize, describe, extend, and create a wide variety of patterns.
(b) Represent relationships with manipulatives, tables, graphs, verbal and written statements, and formulas.
(c) Describe what a function means both intuitively and using formal mathematical language.
(d) Demonstrate a basic understanding of classes of functions and their properties; e.g. linear, exponential, polynomial, and periodic.
(2) Teachers for grades 5-9 will be able to meet the Standards set for K-8 teachers.
(3) Teachers for grades 7-12 will be able to:
(a) Use multiple representations of functions, including symbolic expressions, verbal descriptions, tables, and graphs, and relate one representation to another.
(b) Use the language of functions to describe and model change.
(c) Use the concept of function in the study of mathematics and other disciplines.

K. Teachers will understand and apply algebraic concepts.
(1) Teachers for grades K-8 will be able to:
(a) Explore and use variables and open sentences to express mathematical relationships.
(b) Solve real world problems involving linear and quadratic equations and inequalities by using traditional techniques and graphing methods that use technology.
(2) Teachers for grades 5-9 will be able to meet the Standards set for K-8 teachers.
(3) Teachers for grades 7-12 will be able to:
(a) Understand and apply the major concepts of linear and abstract algebra.
(b) Use theoretical results to understand tangible situations.

L. Teachers will understand and apply concepts of calculus.
(1) Not required of teachers for grades K-8.
(2) Teachers for grade 5-9 will be able to:
(a) Recognize particular types of change such as linear, quadratic and exponential.
(b) Use graphs, diagrams, charts, physical models, and graphing technology to explore the notions of limit, differentiation, and integration, and interpret the relationships among them.
(c) Construct infinite sequences and series, relating them to non-terminating decimals and the approximation of functions.
(d) Solve real world problems involving average and instantaneous rates of change, area, volume, and curve length, and relate those to differentiation and integration.
(3) Teachers for grades 7-12 will be able to:
(a) Investigate the phenomenon of change as a limiting process.
(b) Explore intuitively and in depth the concepts of limit, continuity, differentiation, and integration.
(c) Demonstrate an understanding of the underlying theory of analysis.
(d) Use properties and techniques of calculus to model phenomena in diverse settings.

M. Teachers will understand and apply discrete processes.
(1) Not required of teachers for grades K-8.
(2) Not required of teachers for grades 5-9.
(3) Teachers for grades 7-12 will be able to: Understand concepts and applications of discrete mathematics, such as graph theory, recurrence relations, linear programming, difference equations, and combinatorics.

N. Teachers will understand the use of technology.
(1) Teachers for grades K-8 will be able to:
(a) Use calculators and computers to represent mathematical ideas and construct different representations of mathematical concepts.
(b) Use calculators and computers to develop and use alternate strategies for solving problems.
(c) Use networking and information technologies to solve problems and broaden the scope of inquiry.
(2) Teachers for grades 5-9 will be able to meet the Standards set for K-8 teachers.
(3) Teachers for grades 7-12 will be able to:
(a) Engender a broad array of mathematical modes of thinking through the use of powerful computing tools (including function graphers, curve fitters, symbolic manipulators, dynamic geometric software, and programming languages).
(b) Use calculators, spreadsheets, and statistical packages to solve problems.
(c) Use technology to explore probabilities through simulations.
(d) Use graphing calculators and computer algebra systems in the study and application of the calculus.

O. Teachers will develop perspectives on mathematics as a human endeavor.

(1) Teachers for grades K-8 will be able to:

(a) Understand the dynamic nature of mathematics and its increasingly significant role in social, cultural, and economic development.

(b) Develop an appreciation for the contributions made by various cultures to the growth and development of mathematical ideas.

(c) Investigate the contributions made by individuals, both female and male, and from a variety of cultures, in the development of ancient, modern, and current mathematical topics.

(d) Gain an understanding of the historical development of major school mathematics concepts.

(2) Teachers for grades 5-9 will be able to meet the Standards set for K-8 teachers.

(3) Teachers for grades 7-12 will be able to:

(a) Explore the dynamic nature of mathematics and its increasingly significant role in social, cultural, and economic development.

(b) Gain an understanding of the historical development of major school mathematics concepts.

(c) Understand the historical development of non-Euclidean geometries and the questions relating to the parallel postulate involved in this development.

(d) Develop an appreciation of the contributions made by the various cultures to the growth and development of mathematical ideas.

(e) Investigate the contributions made by individuals, both female and male, and from a variety of cultures, in the development of ancient, modern, and current mathematical topics.

[07-15-99; 6.64.4.9 NMAC - Rn, 6 NMAC 4.7.1.3.9, 10-31-01]

6.64.4.10 IMPLEMENTATION: Institutions of higher education that prepare teachers shall deliver the competencies in a State Board approved endorsement program within a range of twenty-four (24) to thirty-six (36) semester hours of credit twelve (12) semester hours of which must be upper division credit.

[07-15-99; 6.64.4.10 NMAC - Rn, 6 NMAC 4.7.1.3.10, 10-31-01]

6.64.5 Competencies for Entry-Level Science Teachers

TITLE 6 PRIMARY AND SECONDARY EDUCATION
CHAPTER 64 SCHOOL PERSONNEL - COMPETENCIES FOR LICENSURE
PART 5 COMPETENCIES FOR ENTRY-LEVEL SCIENCE TEACHERS

6.64.5.1 ISSUING AGENCY: State Board of Education

[01-14-00; 6.64.5.1 NMAC - Rn, 6 NMAC 4.7.1.4.1, 07-31-01]

6.64.5.2 SCOPE: All institutions of higher education in New Mexico that establish or maintain a curriculum for persons seeking an endorsement in science to a state educator license.

[01-14-00; 6.64.5.2 NMAC - Rn, 6 NMAC 4.7.1.4.2 & A, 07-31-01]

6.64.5.3 STATUTORY AUTHORITY: Sections 22-2-1, 22-2-2, and 22-10A-3, NMSA 1978.

[01-14-00; 6.64.5.3 NMAC - Rn, 6 NMAC 4.7.1.4.3 & A, 07-31-01; A, 09-30-03]

6.64.5.4 DURATION: Permanent

[01-14-00; 6.64.5.4 NMAC - Rn, 6 NMAC 4.7.1.4.4, 07-31-01]

6.64.5.5 EFFECTIVE DATE: January 14, 2000, unless a later date is cited in the history note at the end of a section.

[01-14-00; 6.64.5.5 NMAC - Rn, 6 NMAC 4.7.1.4.5 & A, 07-31-01]

6.64.5.6 OBJECTIVE: This regulation establishes entry-level science competencies that are based on what beginning science teachers must know and be able to do to provide effective science programs in New Mexico schools. These competencies should be incorporated into all college or university curricula for persons seeking a science endorsement to their state educator license. The competencies were developed to ensure alignment with the New Mexico's Content Standards and Benchmarks for science and with the national standards of the National Science Teachers Association. In addition, the National Science Education Standards developed by National Research Council and the American Association for the Advancement of Science Benchmarks were used as guidelines for the development of the entry-level science competencies.

[01-14-00; 6.64.5.6 NMAC - Rn, 6 NMAC 4.7.1.4.6 & A, 07-31-01]

6.64.5.7 DEFINITIONS:

A. "applied science" means such disciplines as agriculture, health fields, forensics, engineering and technology.

B. "design technology" means developing the ability to design a solution to a problem and understanding the relationship of science and technology and the way people are involved in both. This standard helps establish design as the

technological parallel to inquiry in science. Like the science as inquiry standard, this standard begins the understanding of the design process, as well as the ability to solve simple design problems.

C. "inquiry" means a multifaceted activity that involves making observations; posing questions; examining books and other sources of information to see what is already known; planning investigations; reviewing what is already known in light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations, and predictions; and communicating the results. Inquiry requires identification of assumptions, use of critical and logical thinking and consideration of alternative explanations. Students will engage in selected aspects of inquiry as they learn the scientific way of knowing the natural world, but they also should develop the capacity to conduct complete inquiries.

[01-14-00; 6.64.5.7 NMAC - Rn, 6 NMAC 4.7.1.4.7 & A, 07-31-01]

6.64.5.8 REQUIREMENTS:

A. Beginning teachers seeking an endorsement in science to an initial level I New Mexico teaching license, must satisfy all of the requirements of the license as provided in state board of education rule for that license, which includes, among other requirements, 24-36 semester hours in science and passage of a content area test in science.

B. Teachers seeking to add an endorsement in science to an existing New Mexico teaching license of any level where the candidate has less than five full academic years of teaching experience shall meet one of the following requirements:

(1) pass the content knowledge test(s) of the New Mexico teacher assessments as provided in 6.60.5.8 NMAC, or predecessor New Mexico teacher licensure examination or accepted comparable licensure test(s) from another state in science; or

(2) successfully complete an undergraduate academic major (24-36 semester hours), or coursework equivalent to an undergraduate major or a graduate degree in science; or

(3) obtain certification in science for the appropriate grade level of New Mexico licensure from the national board for professional teaching standards.

C. Persons seeking to add an endorsement in science to an existing New Mexico teaching license of any level where the candidate has at least five full academic years of teaching experience, may do so by meeting the requirements of Paragraphs (1), (2) or (3) of Subsection B of 6.64.5.8 NMAC, or by demonstrating the teaching competencies for entry level science teachers as provided in 6.64.5.9 NMAC through the state's high objective uniform standard of evaluation (HOUSE) for demonstrating competence in the core academic subjects and other endorsement areas as set forth in 6.69.4.9 NMAC.

[01-14-00; 6.64.5.8 NMAC - Rn, 6 NMAC 4.7.1.4.8 & A, 07-31-01; A, 09-30-03]

6.64.5.9 COMPETENCIES FOR ENTRY-LEVEL SCIENCE TEACHERS:

A. Instruction and Assessment: Preparation to teach science shall involve:

(1) Inquiry, Including the Scientific Method

(a) Select and use a variety of instructional strategies and materials for teaching science meeting the needs of all students.

(b) Implement active inquiry based learning activities conducive to the development of scientific processes, critical thinking skills, and problem solving skills.

(c) Implement design technology/scientific method: identify a problem; propose a solution; implement proposed solutions; evaluate product or design; communicate a problem, design, and solution.

(d) Implement technology, including computers, interactive video, telecommunication, scientific instrumentation, and others.

(2) Content Integration

(a) Develop student understanding of the interconnectedness of the sciences and relate the major concepts of chemistry, earth and space science, physics, and biology to the teaching of science.

(b) Develop meaningful application of all content areas, including math, technology, language arts, social studies, and arts, in the delivery of science instruction.

(3) Designing and Managing Learning Environment

(a) Fulfill the professional and legal obligations of teaching.

(b) Incorporate the proper use of science tools, materials, media, and technological resources.

(c) Establish and maintain safety in all areas related to science instruction.

(d) Use and care for living organisms in an ethical and appropriate manner.

(4) Effective and Ongoing Assessment to Improve Student Learning

(a) Use assessment techniques such as performance testing, interviews, portfolios, and observations, for assessing student outcomes which are aligned with instruction and consistent with contemporary assessment.

(b) Use assessment tasks which may be appropriately modified to accommodate the needs of students with physical disabilities, learning disabilities, limited English proficiency, and cultural diversity.

B. History and Nature of Science: Preparation to teach science shall include:

(1) Diversity and Human Endeavor

(a) Describe science careers and reasons why people choose science as a career, including the impact of culture, gender, and other, factors.

(b) Describe the science contributions of people from a variety of social and ethnic backgrounds who have diverse interests, talents, qualities, and motivations.

(c) Develop student understanding of the relationships among science, technology, and cultural values.

(d) Recognize and respond to student diversity and encourage all students to participate fully in science learning.

(2) Empirical Observation

(a) Explain that science distinguishes itself from other bodies of knowledge through the use of empirical standards, logical argument, and skepticism.

(b) Explain that scientific ideas depend on experimental and observational confirmation.

(3) Historical Perspectives

(a) Understand that the body of scientific knowledge is continually being expanded and refined.

(b) Explain how theories and ideas throughout the history of science are refined or discarded as new evidence becomes available.

(c) Explain how Western, non-European, and New Mexican cultures have developed scientific ideas and contributed to scientific knowledge.

C. Content Categories: The following areas are designed to allow potential science teachers to construct their pre-service education with an emphasis in one content area, while insuring they receive science education in any area which they might be required to teach. Preparation to teach science shall enable the teacher to understand and be able to teach within at least one of these emphases:

(1) Life Science Emphasis: All science teachers, grades K-12 will be able to identify and understand the relationship among major concepts and principles of biology, including anatomy, physiology, ecology, behavior of organisms, evolution, genetics, cell biology, microbiology, classification, and human biology.

(a) Teachers know and understand the characteristics that are the basis for classifying organisms.

(i) Teachers for grades K-4 will demonstrate an awareness of living things including basic cellular functions and processes, structures, the roles of organisms in systems comprised of living and non-living components and describe life cycles of plants and animals.

(ii) Teachers for grades 5-8 will use information about functions and cell structures to explain replication, reproduction, heredity, and disease, and categorize organisms based on methods of reproduction and offspring development.

(iii) Teachers for grades 9-12 will apply information about cell structures and functions to the world in which they live including understanding of DNA, RNA, natural selection processes, and diversity in plants and animals and use biological classifications to understand how organisms are related.

(b) Teachers will know and understand the synergy among organisms and the environments of organisms.

(i) Teachers for grades K-4 will explain how an organism's behavior is related to its physical environment; describe the roles of plants and animals in the flow of energy; describe how environmental pressures may accelerate changes in organisms; describe populations, communities, and systems; describe the impact humans have on the environment; understand natural resources (renewable versus non-renewable) and how each relates to humans' basic needs, and describe elements essential to good health.

(ii) Teachers for grades 5-8 will understand organisms' physical and behavioral adaptations and how changes occur over time; describe how organisms meet their needs, grow, and reproduce while sustaining stable local surroundings within an ever-changing larger environment; predict organisms' behaviors that may result from external stimuli; use information about variation and diversity to explain population changes over time; categorize organisms based on their roles within the ecosystem in which they live; examine the impact humans have on the living and non-living world including issues related to overpopulation; illustrate the relationships among renewable and non-renewable resources and population, and model responsible health practices including issues relating to nutrition and exercise.

(iii) Teachers for grades 9-12 will explain cellular responses to environmental threats to the organism ranging from the production of antibodies to changes in coloration; understand the pathways of energy within a living organism; predict an organism's behavioral responses to internal and external changes and to external stimuli as a function of inherited and acquired characteristics; create models that mimic a population's response to internal and external environment pressures; predict the impact humans might have on a species or system including resource depletion and over population, and interpret the relationships between personal choices and health.

(2) Physical Science Emphasis: All science teachers, grades K-12, will be able to identify and understand the relationships among chemistry concepts including organic, inorganic, analytical, physical, and biochemical and identify and understand the relationships among physical concepts including mechanics, electricity, magnetism, thermodynamics, waves, optics, atomic, and nuclear physics.

(a) Teachers will be able to know and understand the properties of matter.

(i) Teachers for grades K-4 will describe the observable properties of common items and substances and explain that elements are the basic units of all matter.

(ii) Teachers for grades 5-8 will identify the properties of elements and compounds such as density, boiling point, and solubility and that these characteristics are independent of amount of the sample and articulate that chemical reactions occur in a predictable fashion and that the formation of compounds adheres to imperatives as conservation of matter.

(iii) Teachers for grades 9-12 will compare and contrast elements and compounds based upon the knowledge of the atomic/subatomic structures of matter and predict how atoms interact based upon sharing or transference of outer electrons.

(b) Teachers will know and understand the properties of fields, forces, and motion.

(i) Teachers for grades K-4 will describe how an object may be described with regard to its relative position to other objects; explain that an object's motion may be described by indicating change over time and describe how the earth's gravity pulls objects toward it.

(ii) Teachers for grades 5-8 will illustrate how Newton's Laws describe objects in motion; describe quantitatively how an object's position, speed and motion explain motion and compare and contrast forces affecting the physical world.

(iii) Teachers for grades 9-12 will apply knowledge of the constancy of energy in the universe and the forms that energy take in daily life; predict the motion of an object based on the net applied force applied to the object and explain and graphically describe that a specific mass exerts a force on others masses (velocity and acceleration).

(c) Teachers will know and understand the concepts of energy and energy transformation.

(i) Teachers in grades K-4 will describe the basic characteristics of light, heat, sound, and electromagnetism, and explain that energy exists in many forms and can be transformed and describe the process of chemical reactions and how time is a factor in chemical reactions.

(ii) Teachers in grades 5-8 will apply knowledge of energy and energy transformation to science problems; explain how chemical reactions can take place over periods of time and explain how concentration, pressure, temperature, and catalysts may affect chemical reactions.

(iii) Teachers in grades 9-12 will demonstrate their understanding of energy by identifying examples of transformations within and outside the school environment and devise scientific investigations demonstrating the impact of temperature and other variables on chemical reactions.

(3) Earth and Space Science Emphasis: All science teachers, grades K-12, will know and understand properties of earth and space science.

(a) Teachers in grades K-4 will describe the physical and chemical properties of earth's materials and the states of matter; describe the uses of earth's materials as resources and the sun as the major source of energy; describe changes in the earth's surface; describe changes in weather; recognize that fossils provide a record of animals and plants that lived long ago; represent the school and local community using symbols and maps; describe basic components of and movements within the solar system; identify the types of instruments and vehicles used for space exploration and describe human's movement toward space from early observations to recent explorations.

(b) Teachers in grades 5-8 will explain how earth's materials can be transformed from one state to another; experiment with earth's materials using them as resources; model natural resources that shape the earth's surface; observe, measure, and record weather changes; explain how fossils are formed and how fossils provide evidence of complexity and diversity over time; use rectilinear coordinate systems such as latitude and longitude to locate points on the earth's surface; describe the interactions among the earth's lithosphere, hydrosphere, atmosphere, and biosphere; explain simple data derived from recent remote and direct observations in the solar system and space beyond; model the predictable patterns of the sun and planets in the solar system and cite benefits from continued exploration of space.

(c) Teachers in grades 9-12 will evaluate information about earth's materials, energy, and geochemical cycles; model the interaction between the earth's internal and external energy sources; use tectonic theory to predict changes in the earth's surface; model weather patterns and other natural cycles related to the movement of matter driven by the earth's internal and external sources of energy; use fossil and other evidence to investigate how the earth changes; extend mapping techniques to learning in science and other content areas; explain the evolution of earth in terms of the interactions among the geosphere, hydrosphere, atmosphere, and biosphere; model interactions between components of the earth based on the understanding of the earth as a system containing a fixed amount of each stable chemical or element; trace the development of space exploration and discuss how recent missions impact understanding of the earth; evaluate the hierarchy of structures in the universe from atoms to galaxies and identify the pros and cons of various scientific theories for the origin of the universe based on scientific evidence.

(4) Environmental Science Emphasis: All science teachers, grades K-12, will be able to identify and apply major concepts of environmental science such as ecosystems, energy flow, population ecology, natural resources, meteorology, geology, oceanography, and conservation.

D. Environmental, Personal and Social Implications: Preparation to teach science shall enable teachers to understand and be able to teach:

(1) Personal, community, New Mexico and global environmental issues;
(2) The approaches to evaluate the ethical implications of new developments in science;
(3) Personal and community health issues;
(4) Decision-making and value-analysis skills for investigating science-related societal problems;
(5) Ethical use and care of living organisms.

E. Professionalism: Teacher education programs shall develop reflective practitioners who:

(1) Foster in their students scientific interest and curiosity.
(2) Participate in professional scientific organizations.
(3) Serve as representatives of the scientific community.
(4) Engage students in coherent, focused, student centered science curriculum, consistent with state and national standards.
(5) Identify and use a variety of community resources including local expertise, industry, local environmental settings, and families.

(6) Take advantage of collaborative planning among colleagues, scientists, and science teacher educators, so that science, science methods, and other program components are mutually reinforcing.

(7) Explore and evaluate the process of curriculum and instructional implementation.

[01-14-00; 6.64.5.9 NMAC - Rn, 6 NMAC 4.7.1.4.9 & A, 07-31-01]

6.64.5.10 IMPLEMENTATION: Institutions of higher education that prepare teachers shall deliver the competencies in a State Board approved endorsement program within a range of twenty-four (24) to thirty-six (36) semester hours of credit, twelve (12) semester hours of which must be upper division credit.

[01-14-00; 6.64.5.10 NMAC - Rn, 6 NMAC 4.7.1.4.10 & A, 07-31-01]

6.61.2. Licensure for Elementary Education, Grades K-8

TITLE 6 PRIMARY AND SECONDARY EDUCATION
CHAPTER 61 SCHOOL PERSONNEL - SPECIFIC LICENSURE REQUIREMENTS FOR INSTRUCTORS
PART 2 LICENSURE IN ELEMENTARY EDUCATION, GRADES K-8

6.61.2.1 ISSUING AGENCY: Public Education Department

[11-14-98, 7-30-99; 6.61.2.1 NMAC - Rn, 6 NMAC 4.2.3.2.1, 10-31-00; A, 05-28-04]

6.61.2.2 SCOPE: Chapter 61, Part 2 governs licensure in elementary education, grades K-8, for those persons seeking such licensure. [11-14-98; 6.61.2.2 NMAC - Rn, 6 NMAC 4.2.3.2.2, 10-31-00]

6.61.2.3 STATUTORY AUTHORITY: Sections 22-1-1, 22-1-1.1, 22-1-1.2, 22-2-1, 22-2-2, 22-10A-3, 22-10A-4, and 22-10A-6, NMSA 1978. [11-14-98; 6.61.2.3 NMAC - Rn, 6 NMAC 4.2.3.2.3, 10-31-00; A, 06-01-02; A, 05-28-04]

6.61.2.4 DURATION: Permanent

[11-14-98; 6.61.2.4 NMAC - Rn, 6 NMAC 4.2.3.2.4, 10-31-00]

6.61.2.5 EFFECTIVE DATE: November 14, 1998, unless a later date is cited in the history note at the end of a section. [11-14-98; 6.61.2.5 NMAC - Rn, 6 NMAC 4.2.3.2.5 & A, 10-31-00]

6.61.2.6 OBJECTIVE: This regulation governs licensure requirements in elementary education for persons seeking such licensure.

[11-14-98; 6.61.2.6 NMAC - Rn, 6 NMAC 4.2.3.2.6, 10-31-00]

6.61.2.7 DEFINITIONS:

A. "A highly qualified beginning elementary teacher," under this rule, means a teacher who is fully qualified for teaching in grades K-8, who is new to the profession, who has pursued a standard route to licensure, and who:

(1) meets all the requirements for elementary K-8 licensure required by Subsections A or B in Section 8 of this rule, and

(2) has no licensure requirements waived on an emergency or temporary basis, or for any other reason, and

(3) has passed all applicable competency or teacher testing requirements for licensure in 6.60.5.8 NMAC (Competency Testing for Licensure).

B. "A highly qualified beginning middle or junior high school teacher holding elementary K-8 licensure," under this rule, means a teacher who is fully qualified to teach the core academic subjects in a public middle or junior high school , who is new to the profession, who has pursued a standard route to licensure, and who:

(1) meets all the requirements for elementary K-8 licensure required by Subsections A or B of Section 8 of this rule, and

(2) has no licensure requirements waived on an emergency or temporary basis, or for any other reason, and

(3) has passed all applicable competency or teacher testing requirements for elementary K-8 licensure in 6.60.5.8 NMAC (Competency Testing for Licensure), and

(4) has passed the content knowledge test(s) of the New Mexico teacher assessments or comparable licensure tests from another state in each core academic subject the teacher teaches and in which the teacher is required to have a licensure endorsement, or

(5) has successfully completed an undergraduate academic major or coursework equivalent to an undergraduate major, or a graduate degree in each core academic subject the teacher teaches and in which the teacher is required to have a licensure endorsement.

C. "Core academic subjects" means English, language arts, reading, mathematics, science, modern and classical languages, except the modern and classical Native American languages and cultures of New Mexico tribes and pueblos, the arts, including music and visual arts, and social studies, which includes civics, government, economics, history, and geography.

D. "Undergraduate academic major" under this rule, means twenty-four (24) to thirty-six (36) semester hours in a core academic subject area.
[6.61.2.7 NMAC - N, 06-30-03; A, 05-28-04]

6.61.2.8 REQUIREMENTS:

A. Persons seeking licensure in elementary education pursuant to the provisions of this regulation shall meet the requirements enumerated in Subsection A or Subsection B of this section.

(1) bachelor's degree from a regionally accredited college or university and including, for those students first entering a college or university beginning in the fall of 1986, the following:

(a) twelve (12) semester hours in English;
(b) twelve (12) semester hours in history including American history and western civilization;
(c) six (6) semester hours in mathematics;
(d) six (6) semester hours in government, economics or sociology;
(e) twelve (12) semester hours in science, including biology, chemistry, physics, geology, zoology, or botany;
(f) six (6) semester hours in fine arts; and

(2) credits from a regionally accredited college or university which include thirty to thirty-six (30-36) semester hours of professional education in an elementary education program approved by the public education department ("department"), including completion of the department's approved functional areas and related competencies in professional education; and

(3) a mandatory student teaching component; and

(4) twenty-four to thirty-six (24-36) semester hours in one teaching field such as mathematics, science(s), language arts, reading, and social studies (or other content related areas). Individuals must also complete the department's approved functional areas and related competencies in the teaching field; and

(5) in addition to the requirements specified in Subsection A, Paragraphs (1), (3), (4), (6) and (7) of 6.61.2.8 NMAC, six (6) hours in the teaching of reading for those who have first entered any college or university on or after August 1, 2001 regardless of when they graduate or earn their degree; and

(6) pass all required portions of the New Mexico teacher assessments or any successor teacher examination adopted by the department; and

(7) if new to the profession after June 30, 2006, or hired after the first day of school of the 2002-2003 school year and assigned to work in a Title I targeted assistance program or a Title I school-wide, and teaching in an elementary school, satisfy the requirements of a highly qualified beginning elementary teacher, and

(8) if new to the profession after June 30, 2006, or hired after the first day of school of the 2002-2003 school year and assigned to work in a Title I targeted assistance program or a Title I school-wide teaching the core academic subjects in a middle or junior high school, satisfy the requirements of a highly qualified beginning middle or junior high school teacher holding elementary K-8 licensure, or

B. Persons seeking licensure in elementary education grades K-8 pursuant to the provisions of this rule must possess a valid certificate issued by the national board for professional teaching standards for the appropriate grade level and type.
[11-14-98; 6.61.2.8 NMAC - Rn, 6 NMAC 4.2.3.2.8 & A, 10-31-00; A, 06-01-02; A, 06-30-03; A, 05-28-04]

6.61.2.9 [Reserved]
[11-14-98; 6.61.2.9 NMAC - Rn, 6 NMAC 4.2.3.2.9, 10-31-00; Repealed, 06-30-03]

6.61.2.10 REFERENCED MATERIAL: Competencies for entry level elementary teachers

A. Professionalism

(1) The teacher reflects on, analyzes, and evaluates the effect of his or her choices and actions on others, including students, parents, and other professionals in the learning community, and will be able to use this knowledge to improve the learning process.

(2) The teacher is aware of the need to actively seek out opportunities to grow professionally, including participation in professional organizations and professional development such as conferences, workshops, classes and research, and use this information to improve professional practices and to become a life-long learner.

(3) The teacher participates in an on-going process of researching current educational issues and practices, applying them in the classroom, and monitoring their effects.

(4) The teacher understands his or her role in the educational decision-making process as an advocate for children, school, district, community, and self.

(5) The teacher is aware of and adheres to the educator code of ethics and professional standards.

(6) The teacher demonstrates an awareness of relevant legal requirements of teachers and schools.

(7) The teacher demonstrates an awareness of the structure of local, state, and federal agencies and educational systems.

(8) The teacher critically reviews, selects, and adapts materials, resources, and technologies and analyzes them for:

(a) age appropriateness;

(b) developmental level;
(c) cultural and linguistic background;
(d) exceptionalities;
(e) biases and stereotypes;
(f) content appropriateness in regard to curriculum;
(g) reading level;
(h) relevance to students.

B. Instructional planning and implementation:

(1) The teacher understands learning theory, subject matter, and curriculum development and uses this knowledge in planning instruction to meet curriculum goals.

(2) The teacher takes into account the physical, social, emotional, cognitive, and linguistic development of students when planning instruction.

(3) The teacher plans learning opportunities, recognizing the various learning styles of individuals/groups, according to the nature of the content being taught.

(4) The teacher creates short- and long-term plans that are linked to student needs, performance, and learning styles.

(5) The teacher becomes familiar with students' families, cultures and communities, and plans related learning activities.

(6) The teacher plans lessons that provide for the success of students with exceptionalities, including learning disabilities, visual and perceptual difficulties, and physical or mental challenges.

(7) The teacher integrates a variety of technologies into planned activities including software, applications, and other learning tools.

(8) The teacher plans activities to promote higher order thinking skills, creativity, and independent thinking.

(9) The teacher plans and uses assessment strategies and instruments appropriate to the learning outcomes being evaluated.

(10) The teacher evaluates lesson plans by observing classroom interactions, questioning, and analyzing student work.

(11) The teacher develops sequential lessons that include knowledge of the discipline, student diversity, the local community, and the district/state curriculum goals.

C. Classroom management:

(1) The teacher knows effective models of classroom management and has the opportunity to observe these in classroom situations.

(2) The teacher develops and implements a classroom management plan.

(3) The teacher responds to children as individuals.

(4) The teacher provides a safe classroom environment where individual differences are respected.

(5) The teacher arranges the classroom environment for optimal learning and students' success.

(6) The teacher seeks student understanding and input for classroom procedures, rules, and consequences.

(7) The teacher models and encourages positive social interaction.

(8) The teacher collaborates with specialists, support personnel, parents, and administrators in an interdisciplinary manner for the success of the individual student.

(9) The teacher uses data collection techniques to document classroom management.

(10) The teacher manages time and materials effectively to minimize distractions and disruptions.

(11) The teacher develops activities and transitions that guide students to be focused.

D. Assessment:

(1) The teacher understands and uses formal and informal assessment strategies to evaluate and ensure the continuous intellectual, social, physical, and aesthetic development of the learner.

(2) The teacher develops valid evaluation tools to measure student outcomes.

(3) The teacher selects materials and means for measuring progress.

(4) The teacher assesses students' current knowledge in order to plan instruction.

(5) The teacher uses assessment of student learning to improve his or her own teaching and to revise curriculum.

(6) The teacher interprets and uses results of standardized instruments, including and understanding of percentiles, means, stanines, grade equivalence, and item analysis.

(7) The teacher uses observation skills for informal assessment.

(8) The teacher is able to use effective questioning techniques to better assess the student's knowledge.

(9) The teacher recognizes developmental levels of student knowledge and skills including typical and atypical patterns.

(10) The teacher recognizes unethical, illegal, and otherwise inappropriate assessment methods and uses of assessment information.

(11) The teacher demonstrates familiarity with a variety of assessment tools, including but not limited to portfolios, performance-based assessment, and student writing.

(12) The teacher uses student responses, explanations, and demonstrations, to analyze misunderstandings that led to errors (error analysis).

(13) The teacher is aware that there may be a variety of methods, strategies, or procedures that will give a correct answer.

(14) The teacher is skilled in communicating assessment results to students, parents, lay audiences, and other educators.

E. Technology:

(1) Basic computer and technology operations and concepts - the teacher uses computer systems to: run software, access, generate, and manipulate data; and publish results. The teacher evaluates performance of hardware and software components of computer systems and applies basic troubleshooting strategies as needed.

(a) operates a multimedia computer system with related peripheral devises to successfully install and use a variety of software packages;

(b) uses terminology related to technology appropriate to the teaching field in written and oral communication;

(c) describes and implement basic troubleshooting techniques for multimedia computer systems with related peripheral devices;

(d) uses imaging devices;

(e) demonstrates knowledge of uses of computers and technology in business, industry, and society;

(f) operates a variety of audio-visual devices.

(2) Personal and professional use of technology - the teacher will apply tools for enhancing his/her own professional growth and productivity. The teacher will use technology in communicating, collaborating, conducting research, and solving problems. In addition, the teacher will plan and participate in activities that encourage lifelong learning and will promote equitable, ethical, and legal use of computer and technology resources.

(a) uses productivity tools for word processing, database management, and spreadsheet applications when developmentally appropriate;

(b) applies productivity tools for creating a multimedia presentation;

(c) uses computer-based technologies including telecommunications to access information and enhance personal and professional productivity;

(d) uses computers to support problem solving, data collection, information management, communications, presentations, and decision making;

(e) demonstrates awareness of resources for adaptive assistive devices and software for students with special needs;

(f) demonstrates awareness of resources for culturally and linguistically diverse students;

(g) demonstrates knowledge of equity, ethics, legal, and human issues concerning use of computers and technology;

(h) demonstrates awareness of computer and related technology resources for facilitating lifelong learning and emerging roles of the learner and the educator;

(i) demonstrates awareness of broadcast instruction, audio/video conferencing, and other distant learning applications.

(3) Application of technology to support teaching and learning - the teacher applies computers and related technologies to support teaching and learning in the grade level and subject areas. The teacher will integrate a variety of software, applications, and learning tools in the teaching and learning process. Lessons developed must reflect effective grouping and assessment strategies for diverse populations.

(a) explores, evaluates, and uses technology resources including applications, tools, educational software, and assorted documentation;

(b) describes best practice and appropriate assessment as related to the use of technology resources in the curriculum;

(c) designs, implements, and assesses learning activities that integrate technology for a variety of grouping strategies for diverse populations;

(d) designs learning activities that foster equitable, ethical, and legal use of technology by students;

(e) practices responsible, ethical, and legal use of technology, information, and software resources.

F. Diversity:

(1) The teacher understands how students differ in their approaches to learning and creates instructional opportunities that are adapted to diverse learners.

(2) The teacher organizes and manages varied learning groups as appropriate in each of the disciplines as appropriate to the needs and/or interests of students and the goals of the lesson.

(3) The teacher is aware of and can apply current research findings regarding individual differences such as linguistic backgrounds, developmental levels, exceptionalities, and gender.

(4) The teacher identifies stereotypes in curriculum materials and adapts instruction appropriately.

(5) The teacher helps students develop critical perspectives on biased materials.

(6) The teacher identifies and develops appropriate responses to differences among language learners.

(7) The teacher demonstrates sensitivity to New Mexico's unique linguistic and cultural diversity.

G. Family and community:

(1) The teacher is aware of the culture, history, and values of the community in which he or she teaches.

(2) The teacher understands, respects, and values the central role that community and family play in the learning process of a child and will be able to utilize these experiences to enhance learning.

(3) The teacher understands that there must be a reciprocal relationship between the school and the community.

(4) The teacher values and utilizes the knowledge that all community members have something to contribute to the classroom to assist in the educational process.

(5) The teacher recognizes that families and community can be used as teaching resources to enhance learning and children's self value.

(6) The teacher communicates to parents and community members student progress, important events, and school activities.

(7) The teacher understands the importance of inviting parents and community members to participate in classroom and school curriculum development and the decision making process.

(8) The teacher conveys and demonstrates to students the importance of being an active part of the community.

H. Inclusion:

(1) The teacher understands special education regulations.

(2) The teacher understands the differing levels of disabilities.

(3) The teacher understands the development and use of individualized education plans (IEPs).

(4) The teacher understands his/her responsibilities in implementing objectives set in an IEP.

(5) The teacher develops lessons according to IEPs.

(6) The teacher monitors achievement and growth as set by an IEP and recommends changes when necessary.

(7) The teacher collaborates with special education teachers for individualized program implementation.

(8) The teacher adjusts lessons and strategies for students with exceptionalities with regard to academic levels, physical environment, and emotional needs.

(9) The teacher understands the social, emotional, physical, and academic needs of students with exceptionalities.

(10) The teacher assists students to understand social responsibilities.

(11) The teacher assists students with exceptionalities to have positive experiences in the regular classroom.

I. Development of student:

(1) The teacher understands various theories of cognitive, social, aesthetic, emotional and physical development.

(2) The teacher understands how children learn and develop, and provides learning opportunities that support their cognitive, social, aesthetic, emotional, and physical development.

(3) The teacher develops curriculum and implements instructional strategies appropriate to the developmental level of each child, leading to continuous progress.

J. Knowledge of content:

(1) Mathematics

(a) The teacher understands mathematical concepts including but not limited to:

(i) the arithmetic of real numbers and their subsets of rational numbers, integers, and whole numbers;

(ii) three dimensional geometry based on the concept of distance, and two dimensional geometry as a method of drawing plans and representing three dimensional objects;

(iii) elements of algebra including elementary functions;

(iv) measurement of length, angles, time, weights, and temperature; and

(v) handling money problems such as cost and unit price.

(b) The teacher demonstrates skill including but not limited to:

(i) mental computations and proper use of four operation and non-programmable scientific calculators in the context of problem-solving;

(ii) constructions of solids, measurements of their volumes and surface areas, drawing their projections, and making plans for their construction;

(iii) defining relevant variables and writing formulas describing their relationships in problem-solving activities; and

(iv) using measurement tools and appropriate techniques for recording data and displaying results.

(c) The teacher demonstrates adequate communication skills to be able to discuss mathematical ideas verbally and in writing.

(d) The teacher knows a variety of teaching techniques and chooses ones appropriate to the topic of study and the level and needs of students.

(e) The teacher constructs situations in which students learn to use a variety of mathematical skills and concepts, including problem solving, reasoning, and logic.

(f) The teacher provides opportunities for students to learn how to use tools, technology, and manipulatives in problem solving.

(g) The teacher uses measurements and other data gathered by students as a basis for classroom activities.

(h) The teacher provides a classroom environment in which students develop skills in communicating, discussing, and displaying mathematical ideas.

(i) The teacher provides enough open-ended problems and activities to allow students to expand creatively on the material learned in classrooms.

(2) Reading and language arts:

(a) Foundations: the teacher understands the foundations of reading and language arts development, including but not limited to:

(i) research on reading;

(ii) how children learn to speak, read, write, and listen;

(iii) cultural, linguistic, environmental, and physiological factors in reading and language arts development;

(iv) children's developmental processes;

(v) characteristics of proficient and non-proficient readers;

(vi) relationship between oral and written language;

(vii) language structure including graphophonics, semantics, syntax, and pragmatics systems.

(b) Assessment:

(i) The teacher understands the use of classroom reading assessment to diagnose students' instructional needs and modify instruction appropriately.

(ii) The teacher links assessment and instruction to New Mexico language arts content standards, benchmarks and performance standards.

(c) Methods of instruction: the teacher differentiates methods of instruction based on needs of students and designs instruction based on the following reading and language arts components:

(i) oral language development;

(ii) phonemic awareness and phoneme manipulations, such as blending, segmentation, and substitution;

(iii) phonics instruction, including a variety of strategies such as systematic, explicit instruction and the use of phonics in reading and writing;

(iv) vocabulary development, including both explicit instruction and indirect vocabulary development through authentic literature and students' experiences;

(v) comprehension strategies, including: instruction on predicting, re-reading, questioning, sequencing, summarizing, retelling, reading for pleasure and analytical and critical reading; activities to develop fluency, the ability to read text accurately and rapidly; and study strategies, for example, planning, accessing and organizing information from a variety of texts and sources;

(vi) writing instruction, including: different types of writing for different audiences and purposes; spelling generalizations; grammar instruction within authentic contexts; and writing processes, including drafting, revising, and editing;

(d) Teacher designs comprehensive reading and writing instruction that results in students becoming proficient in the language arts content standards, benchmarks, and performance standards, including:

(i) the use of culturally relevant pedagogy that promotes an understanding of the importance of resources students bring to the classroom;

(ii) evaluation of text for quality, cultural, and linguistic appropriateness;

(iii) connecting identified needs of students based on data with appropriate research-based resources and materials;

(iv) creation of opportunities for students to consider, respond to and discuss spoken and written materials;

(v) the use of a variety of reading materials, including children's literature, non-fiction, technological media, stories, poems, biographies, texts from various subject areas;

(3) Science:

(a) The teacher knows, understands, and uses the fundamental concepts in the subject matter of science including physical, life, and earth and space sciences as well as concepts in science and technology, science in personal and social perspectives, the history and nature of science, the unifying concepts of science, and the inquiry process scientists use in discovery of new knowledge to build a base for scientific inquiry.

(b) The teacher is familiar with the scientific method and uses it to develop students' abilities to identify and communicate a problem, and to design, implement, and evaluate a solution.

(c) The teacher integrates a variety of technologies into planned science activities.

(d) The teacher helps children build understanding about science and technology.

(e) The teacher recognizes and responds to student diversity and encourages all students to participate fully in science learning.

(4) Social studies:

(a) The teacher understands the principles of teaching and learning processes that underlie social studies concepts and can translate these into meaningful learning activities focusing on inquiry, authenticity, and collaboration.

(b) The teacher understands that the social studies encompass history, geography, anthropology, archeology, economics, political science, psychology, sociology, and the interdisciplinary relationship of all facets of the social studies.

(c) The teacher understands that the definition of social studies requires that students are socially aware of and are active participants in local, state, national, and global issues.

(d) The teacher helps students understand the relationship between social studies and other disciplines.

(e) The teacher helps students to recognize and respect diverse local and global perspectives concerning cultures other than their own.

(f) The teacher implements a variety of strategies for helping students use multiple resources including primary (e.g., documents, artifacts/regalia, direct observation, human resources, personal background) and secondary (e.g. books, newspapers, internet) as part of the inquiry/research process.

(g) The teacher constructs experiences that provide opportunities for students to appreciate the historical development of democratic values, institutions, nations, and cultures.

(h) The teacher engages students in activities that require them to formulate, analyze, synthesize, and critique issues by using well-reasoned, clearly supported arguments, policies, and positions.

(i) The teacher constructs activities that encourage students to present social studies knowledge using a variety of sign systems including writing, charts, graphs, maps, art, music, drama, dance, and technology.

(5) Arts:

(a) The teacher understands and implements arts activities such as history, art making, appreciation, and criticism through dance, music, theater, and the visual arts, appropriate to students developmental levels.

(b) The teacher uses the arts as interdisciplinary units and themes.

(c) The teacher understands distinctions and connections between arts disciplines and arts experiences, and encourages study and active participation that leads to skill development and appreciation.

(d) The teacher enables students to communicate at a basic level in the four art disciplines of dance, music, theater, and visual arts, including knowledge and skills in the use of basic vocabularies, materials, tools, techniques, and thinking processes of each discipline.

(e) The teacher enables students to develop and present basic analyses of works of art from structural, historical, and cultural perspectives.

(f) The teacher exposes students to exemplary works of art from a variety of cultures and historical periods and provides opportunities for students to discuss and respond to them.

(g) The teacher relates basic types of arts knowledge and skills within and across the arts disciplines and makes connections with other disciplines.

K. Communication:

(1) The teacher uses knowledge of effective verbal, nonverbal, technological, and media communication techniques to foster active inquiry, collaboration, problem solving, and supportive interaction in the learning community.

(2) The teacher effectively communicates orally and in writing using appropriate standard written and spoken English with a variety of audiences (e.g., peers, school, community) and encourage this in students.

(3) The teacher understands communications theories, language development, and the role of language in student learning.

(4) The teacher understands how to use a variety of strategies to facilitate language acquisition and development.

(5) The teacher recognizes that the conventions and skills of language need to be taught in meaningful and authentic contexts rather than in isolation.

(6) The teacher recognizes that writing is critical to other areas of language acquisition, cognitive growth, and expression.

(7) The teacher recognizes that the focus of reading is communication of meaning through interaction between the reader and the text.

(8) The teacher recognizes that humans communicate through a variety of verbal and non-verbal sign systems and can provide exposure to and experiences in multiple expressive modes across the curriculum.

(9) The teacher recognizes that social interaction enhances thinking and learning.

(10) The teacher understands how cultural, dialectic, and gender differences affect communication and encourage expression that is context appropriate.

(11) The teacher encourages culturally sensitive communication by and among all students.

(12) The teacher is a thoughtful and responsive listener and encourages this quality in students.

(13) The teacher understands the role of multiple questioning strategies and student inquiry as communication tools.

(14) The teacher recognizes the importance of technology as a tool for learning and communication.

[11-14-98; 6.61.2.10 NMAC - Rn, 6 NMAC 4.2.3.2.10 & A, 10-31-00; A, 05-28-04]

HISTORY OF 6.61.2 NMAC:

PRE-NMAC HISTORY:

The material in this Part was derived from that previously filed with the State Records Center and Archives under: SBE Regulation No. 67-1.1 Certification Requirements Five Year Elementary Certificate, filed August 28, 1978;
SBE Regulation No. 71-28 Continuing Five Year Elementary Certificate, filed August 28, 1978;
SBE Regulation No. 71-29 Professional Elementary Licensure, filed August 28, 1978;
SBE Regulation No. 76-3 Four Year Standard Elementary Certificate filed March 26, 1976;
SBE Regulation No. 78-19 Four Year Standard Elementary Certificate, filed September 29, 1978;
SBE Regulation 78-19 Amendment No. 1 Four Year Standard Elementary Certificate, filed November 28, 1978;

SBE Regulation No. 78-23 Certification Requirements for Ten Year Professional Elementary Licensure, filed November 29, 1998;
SBE Regulation No. 81-7 Four Year Standard Elementary Certificate, filed September 23, 1981;
SBE Regulation No. 86-8 Licensure in Elementary Education, Grades K-8, filed January 19, 1987;
SBE Regulation 86-8 Amendment No. 1 Licensure in Elementary Education, Grades K-8, filed December 4, 1990;
SBE Regulation No. 86-8 Amendment 2 Licensure in Elementary Education, Grades K-8, filed April 3, 1995.

6.61.4. Licensure for Secondary Education, Grades 7-12

TITLE 6 PRIMARY AND SECONDARY EDUCATION
CHAPTER 61 SCHOOL PERSONNEL - SPECIFIC LICENSURE REQUIREMENTS FOR INSTRUCTORS
PART 4 LICENSURE IN SECONDARY EDUCATION, GRADES 7-12

6.61.4.1 ISSUING AGENCY: State Board of Education
[11-14-98, 7-30-99; 6.61.4.1 NMAC – Rn, 6 NMAC 4.2.3.4.1, 10-31-00]

6.61.4.2 SCOPE: Chapter 61, Part 4 governs licensure in secondary education, grades 7-12, for those persons seeking such licensure.
[11-14-98; 6.61.4.2 NMAC – Rn, 6 NMAC 4.2.3.4.2, 10-31-00]

6.61.4.3 STATUTORY AUTHORITY: Sections 22-2-1, 22-2-2 and 22-2-8.7, NMSA 1978.
[11-14-98; 6.61.4.3 NMAC – Rn, 6 NMAC 4.2.3.4.3, 10-31-00; A, 06-01-02]

6.61.4.4 DURATION: Permanent
[11-14-98; 6.61.4.4 NMAC – Rn, 6 NMAC 4.2.3.4.4, 10-31-00]

6.61.4.5 EFFECTIVE DATE: November 14, 1998, unless a later date is cited in the history note at the end of a section.
[11-14-98; 6.61.4.5 NMAC – Rn, 6 NMAC 4.2.3.4.5 & A, 10-31-00]

6.61.4.6 OBJECTIVE: This regulation governs licensure requirements in secondary education for grades 7-12 for persons seeking such licensure. It waives the requirement of this licensure for persons already holding a valid state secondary license as of June 30, 1989.
[11-14-98; 6.61.4.6 NMAC – Rn, 6 NMAC 4.2.3.4.6 & A, 10-31-00]

6.61.4.7 DEFINITIONS:

A. "Core academic subjects" means English, language arts, reading, mathematics, science, the arts, including music and visual arts, social studies, which includes civics, government, economics, history, and geography, and modern and classical languages, except the modern and classical Native American languages and cultures of New Mexico tribes or pueblos.

B. "A highly qualified beginning secondary teacher", under this rule, means a teacher who is fully qualified to teach the core academic subjects in grades 7-12, who is new to the profession, who has pursued a standard route to licensure and who:

(1) meets the requirements for secondary 7-12 licensure in Subsections A or B of 6.61.4.8 NMAC, and
(2) has no licensure requirements waived on an emergency or temporary basis, or for any other reason, and
(3) has passed all applicable teacher testing requirements for licensure in 6.60.5.8 NMAC.

[6.61.4.7 NMAC – N, 08-15-03]

6.61.4.8 REQUIREMENTS:

A. Persons seeking licensure in secondary education pursuant to the provisions of this regulation shall meet the requirements of Subsection A or Subsection B of 6.61.4.8 NMAC.

(1) Bachelor's degree from a regionally accredited college or university and including, for those students first entering a college or university beginning in the fall of 1986, the following:

(a) twelve (12) semester hours in English;
(b) twelve (12) semester hours in history including American history and western civilization;
(c) six (6) semester hours in mathematics;
(d) six (6) semester hours in government, economics or sociology;
(e) twelve (12) semester hour in science, including biology, chemistry, physics, geology, zoology, or botany;
(f) six (6) semester hours in fine arts; and

(2) Credits from a regionally accredited college or university which include twenty-four to thirty (24-30) semester hours of professional education in a secondary education program approved by the state board of education ("state board")

including completion of the state board's approved functional areas and related competencies in professional education; and including:

(3) A mandatory student teaching component; and

(4) Twenty-four to thirty-six (24-36) semester hours in at least one teaching field such as mathematics, science(s), language arts, reading, and social studies (or other content related areas), twelve (12) hours of which must be in upper division courses as defined by the college or university. Individuals must also complete the state board's approved functional areas and related competencies in the teaching field; and

(5) In addition to the requirements specified in Subsection A, Paragraphs (1), (3), (4), (6) and (7) of 6.61.4.8 NMAC, three (3) hours in the teaching of reading for those who have first entered any college or university on or after August 1, 2001 regardless of when they graduate or earn their degree; and

(6) Passage of all portions of the current SBE-approved teacher test; and

(7) If new to the profession after June 30, 2006, or hired after the first day of school of the 2002-2003 school year and assigned to work in a Title I targeted assistance program or a Title I school-wide, satisfy the requirements of a highly qualified beginning secondary teacher; or

B. Possess a valid certificate issued by the National Board for Professional Teaching Standards for the appropriate grade level and type.

[11-14-98; 6.61.4.8 NMAC – Rn, 6 NMAC 4.2.3.4.8 & A, 10-31-00; A, 06-01-02; A, 08-15-03]

6.61.4.9 [RESERVED]

[11-14-98; 6.61.4.8 NMAC – Rn, 6 NMAC 4.2.3.4.9, 10-31-00; Repealed 08-15-03]

6.61.4.10 REFERENCED MATERIAL: Competencies for Entry Level Secondary Teachers

A. Professionalism

(1) The teacher is knowledgeable of and understands the expectations for educators as positive community members.

(2) The teacher reflects on, analyzes, and evaluates the effect of choices and actions on others, including students, parents, and other professionals in the learning community, and uses this knowledge to improve the learning process.

(3) The teacher seeks opportunities to grow professionally, including participation in professional organizations and development opportunities such as conferences, workshops, classes and research, and uses this information to improve professional practices.

(4) The teacher researches current educational issues then practices and applies them in the classroom.

(5) The teacher understands his/her role in the educational decision-making process as an advocate for children, school, district, community, and self.

(6) The teacher is aware of and adheres to the New Mexico Code of Ethics for Educators.

(7) The teacher demonstrates awareness of relevant legal requirements of teachers and schools.

(8) The teacher demonstrates an awareness of the structure of local, state, and federal agencies and educational systems.

(9) The teacher utilizes professional organizations as a learning tool to increase professional knowledge.

(10) The teacher interacts as a member of a school- and/or district-wide instructional team.

B. Instructional Planning and Implementation

(1) The teacher understands learning theory, subject matter, and curriculum development and uses this knowledge in planning instruction to meet curriculum goals.

(2) The teacher takes into account the physical, social, emotional, cognitive, and linguistic development of students when planning instruction.

(3) The teacher plans learning opportunities, recognizing the various learning styles of individuals/groups, according to the nature of the content being taught.

(4) The teacher creates short- and long-term plans that are linked to student needs, performance, and learning styles.

(5) The teacher integrates into all curriculum planning, delivery, assessment strategies, and materials that recognize and build upon the strengths of diverse cultures, languages, traditions, environment, and background.

(6) The teacher understands areas of exceptionality in learning.

(7) The teacher integrates a variety of technologies into planned activities.

(8) The teacher plans activities to promote creativity and independent thinking.

(9) The teacher prepares and uses assessment strategies and instruments appropriate to the learning outcomes being evaluated.

(10) The teacher evaluates lesson plans through observation of classroom interactions, questioning, and analysis of student work.

(11) The teacher utilizes diagnostic data to help develop instructional programs as part of an instructional team.

(12) The teacher integrates and applies content area concepts across all areas of the curriculum.

(13) The teacher understands that federal statutes, state statutes, state board regulations, and local curriculum guidelines are the basis for instruction for all content areas.

(14) The teacher demonstrates the ability to use academic content in planning, implementation, instruction, and assessment.

C. Classroom Management

(1) The teacher arranges the physical environment for optimal learning and safety.

(2) The teacher provides a safe classroom environment where individual differences are respected.

(3) The teacher develops and implements effective classroom management techniques.

(4) The teacher demonstrates an awareness of classroom interactions.

(5) The teacher demonstrates effective use of preventive management techniques.

(6) The teacher uses various signals and cues to assist in effective classroom management.

(7) The teacher effectively manages transition times.

(8) The teacher models and expects positive social interaction with students that encourages a productive learning environment.

(9) The teacher uses techniques that develop positive self-esteem, social and emotional skills, and character traits necessary for healthy, productive individuals and positive social interactions.

(10) The teacher manages time and materials effectively to minimize distraction and disruptions for optimal student involvement.

(11) The teacher collaborates with specialists, support personnel, parents, and administrators in an interdisciplinary manner for the success of the individual student.

(12) The teacher uses data collection techniques to document student behavior.

D. Assessment

(1) The teacher understands and uses formal and informal aptitude and interest assessment strategies to evaluate and ensure the continuous development of the learner.

(2) The teacher develops valid evaluation tools to measure student outcomes.

(3) The teacher selects materials and means for measuring progress.

(4) The teacher determines the entry level of students in a learning continuum.

(5) The teacher uses assessment of student learning to improve his or her own teaching and to revise curriculum.

(6) The teacher interprets and uses results of standardized instruments, including and understanding of percentiles, means, stanines, grade equivalence, and item analysis.

(7) The teacher is aware of transition processes including different diploma choices in New Mexico as it relates to students with special needs.

(8) The teacher uses formal and informal observation skills for information gathering.

(9) The teacher is able to use effective questioning techniques to better assess the student's knowledge.

(10) The teacher designs assessment strategies which are specific to the developmental levels of student knowledge and skills including typical and atypical patterns.

(11) The teacher employs only ethical, legal, and otherwise appropriate assessment methods and uses of assessment information.

(12) The teacher demonstrates familiarity with a variety of assessment tools, including but not limited to portfolio, performance-based assessment, and student writing.

(13) The teacher uses student responses, explanations, and demonstrations, to analyze misunderstandings that led to errors.

(14) The teacher is aware of and accepts that there may be a variety of methods or procedures that will give a correct answer.

(15) The teacher maintains useful and meaningful records of student work and communicates results to students, parents, and other educators.

(16) The teacher uses effective questioning techniques to better assess the student's knowledge.

E. Technology

(1) Basic Computer and Technology Operations and Concepts - the teacher uses computer systems to: run software, access, generate, and manipulate data; and publish results. The teacher evaluates performance of hardware and software components of computer systems and applies basic troubleshooting strategies as needed.

(a) Operates a multimedia computer system with related peripheral devises to successfully install and use a variety of software packages.

(b) Uses terminology related to technology appropriate to the teaching field in written and oral communication.

(c) Describes and [implements] basic troubleshooting techniques for multimedia computer systems with related peripheral devices.

(d) Uses imaging devices.

(e) Demonstrates knowledge of uses of computers and technology in business, industry, and society.

(f) Operates a variety of audio-visual devices.

(2) Personal and Professional Use of Technology – the teacher will apply tools for enhancing his/her own professional growth and productivity. The teacher will use technology in communicating, collaborating, conducting research, and solving problems. In addition, the teacher will plan and participate in activities that encourage lifelong learning and will promote equitable, ethical, and legal use of computer and technology resources.

(a) Uses productivity tools for word processing, database management, and spreadsheet applications.
(b) Applies productivity tools for creating a multimedia presentation.
(c) Uses computer -based technologies including telecommunications to access information and enhance personal and professional productivity.
(d) Uses computers to support problem solving, data collection, information management, communications, presentations, and decision making.
(e) Demonstrates awareness of resources for adaptive assistive devices and software for students with special needs.
(f) Demonstrates awareness of resources for culturally and linguistically diverse students.
(g) Demonstrates knowledge of equity, ethics, legal, and human issues concerning use of computers and technology.
(h) Demonstrates awareness of computer and related technology resources for facilitating lifelong learning and emerging roles of the learner and the educator.
(i) Demonstrates awareness of broadcast instruction, audio/video conferencing, and other distant learning applications.

(3) Application of Technology to Support Teaching and Learning – the teacher applies computers and related technologies to support teaching and learning in the grade level and subject areas. The teacher will integrate a variety of software, applications, and learning tools in the teaching and learning process. Lessons developed must reflect effective grouping and assessment strategies for diverse populations.
(a) Explores, evaluates, and uses technology resources including applications, tools, educational software, and assorted documentation.
(b) Describes best practice and appropriate assessment as related to the use of technology resources in the curriculum.
(c) Designs, implements, and assesses learning activities that integrate technology for a variety of grouping strategies for diverse populations.
(d) Designs learning activities that foster equitable, ethical, and legal use of technology by students.
(e) Practices responsible, ethical, and legal use of technology, information, and software resources.

F. Diversity
(1) The teacher responds to students as individuals.
(2) The teacher identifies and develops appropriate responses that build upon the strengths of diverse students and addresses diverse needs and differences.
(3) The teacher applies current research findings about social and cultural environments, individual differences, linguistically diverse populations, students of different ages, students with exceptionalities, and gender differences.
(4) The teacher understands how students differ in their approaches to learning and creates instructional approaches that are adaptive to diverse learners.
(5) The teacher organizes and manages varied group learning strategies, as appropriate, to diverse strengths, needs, and/or interests of students and to the goals of the lesson.
(6) The teacher identifies stereotypes in curriculum materials and adapts instruction appropriately.
(7) The teacher helps students develop critical perspectives on biased materials.
(8) The teacher demonstrates sensitivity to New Mexico's unique linguistic and cultural diversity.

G. Family and Community
(1) The teacher demonstrates an awareness of the diverse cultures, histories, and values of the community.
(2) The teacher demonstrates understanding, respects, and values for the central role that community and family play in the learning process of a child and is able to utilize these experiences to enhance learning.
(3) The teacher values and utilizes the knowledge that all community members have something to contribute to the classroom to assist in the educational process.
(4) The teacher recognizes that families and community can be used as teaching resources to enhance learning and children's self value.
(5) The teacher effectively communicates to student's parents progress involving academic, behavioral, and social issues that influence learning.
(6) The teacher communicates to community members about important events and school activities.
(7) The teacher understands the importance of including parents and community members in classroom and school curriculum development and the decision making process.
(8) The teacher conveys good citizenship and demonstrates to students the importance of being an active part of the community.
(9) The teacher participates and attends various after school functions.

H. Inclusion
(1) The teacher understands special education regulations.
(2) The teacher understands the different levels of disabilities.
(3) The teacher understands the development and use of individualized education plans (IEPs) and individualizes transition plans/504 plans.

(4) The teacher understands the responsibilities in implementing objectives set in an IEP, an individualized transition plan/504 plan and utilizes modifications.

(5) The teacher develops lessons according to IEPs, an individualized transition plan/504 plan and utilizes modifications.

(6) The teacher monitors achievement and growth as set by an IEP, an individualized transition plan/504 plan and uses appropriate procedures to recommend changes when necessary.

(7) The teacher partners with special education teachers and others as necessary for implementation of the IEP.

(8) The teacher adjusts lessons and strategies as specified by the modifications for students with exceptionalities with regard to academic levels, physical environment, emotional, and transition needs.

(9) The teacher understands the social, emotional, physical, academic, and transition needs of students with exceptionalities.

(10) The teacher assists students with exceptionalities to understand social responsibilities to the environments in which they are engaged such as the school, community, and workplace.

(11) The teacher assists students with exceptionalities to have positive experiences in the regular classroom.

I. Development of Student

(1) The teacher understands various theories of cognitive, social, aesthetic, emotional and physical development as it relates to the student's needs and strengths.

(2) The teacher understands how the student learns and develops, and provides learning opportunities to support their cognitive, social, aesthetic, emotional, and physical development as it relates to the student's needs and strengths.

(3) The teacher develops curriculum and implements instructional strategies appropriate to the developmental level of each student, leading to effective management of transitional time.

(4) The teacher creates learning experiences in his/her discipline that demonstrates knowledge of student learning styles, diversity, and cognitive development.

J. Communication

(1) The teacher uses knowledge of effective verbal, nonverbal, technological, and media communication techniques to foster active inquiry, collaboration, problem solving, and supportive interaction in the learning community.

(2) The teacher effectively communicates orally and in writing using appropriate standard written and spoken English and encourages this in students.

(3) The teacher understands communications theory, language development, and the role of language appropriate to student learning styles.

(4) The teacher understands how to use a variety of strategies to facilitate language acquisition and development.

(5) The teacher recognizes that the conventions and skills of language need to be taught in meaningful and authentic contexts rather than in isolation.

(6) The teacher recognizes that writing is critical to other areas of language acquisition, cognitive growth, and expression and is an empowering personal internalization process.

(7) The teacher recognizes that the focus of reading is communication of meaning through interaction between the reader and the text.

(8) The teacher recognizes that humans communicate through a variety of verbal and non-verbal sign systems and can provide exposure to and experiences in multiple expressive modes across the curriculum.

(9) The teacher recognizes that all modes of communication are enhanced by social interaction and that speaking and writing help process and refine thinking and learning.

(10) The teacher understands how cultural, dialectic, and gender differences affect communication and encourage expression that is context appropriate.

(11) The teacher encourages culturally sensitive communication by and among all students in the class.

(12) The teacher is a thoughtful and responsive listener and encourages this quality in students.

(13) The teacher understands the role of multiple questioning strategies and student inquiry as communication tools.

(14) The teacher recognizes the importance of technology as a tool for learning and communication.

(15) The teacher uses appropriate public relations skills, particularly in relation to parent and community members.

K. Motivation

(1) The teacher uses verbal, nonverbal, and other communication techniques that enhance the motivation of students.

(2) The teacher varies teaching strategies and modifies learning activities to facilitate student motivation.

(3) The teacher establishes a classroom environment and utilizes feedback in a manner that encourages motivation.

(4) The teacher demonstrates an enthusiasm for teaching.

(5) The teacher maintains high expectations for the success of all students while establishing a classroom environment where students believe they can be successful.

(6) The teacher projects a positive attitude toward the subject and students.

(7) The teacher uses a variety of student assessment techniques to encourage student learning.

(8) The teacher uses assessment strategies to involve learners in self-assessment activities, to help them become aware of their strengths and needs, and to encourage them to set personal goals for learning.

[11-14-98; 6.61.4.10 NMAC – Rn, 6 NMAC 4.2.3.4.10 & A, 10-31-00]

HISTORY OF 6.61.4 NMAC:
PRE-NMAC HISTORY: The material in this Part was derived from that previously filed with the State Records Center and Archives under: SBE Regulation No. 71-26 Continuing Five Year Secondary Certificate, filed August 28, 1978;
SBE Regulation No. 72-3 Four Year Provisional Secondary Certificate, filed February 17, 1972;
SBE Regulation No. 72-4 Five Year Secondary Certificate, filed February 17, 1972;
SBE Regulation No. 76-4 Four Year Standard Secondary Certificate, filed March 26, 1976;
SBE Regulation No. 78-20 Four Year Standard Secondary Certificate, filed November 28, 1978;
SBE Regulation No. 78-24 Ten Year Professional Secondary Licensure, filed November 28, 1978;
SBE Regulation No. 86-9 Licensure in Secondary Education, Grades 7-12, filed January 19, 1987;
SBE Regulation No. 86-10 Licensure in Secondary Education, filed February 20, 1987;
SBE Regulation No. 87-4 Licensure in Secondary Education, Grades 7-12, filed June 18, 1987;
SBE Regulation No. 87-4 Amendment No. 1 Licensure in Secondary Education, Grades 7-12, filed December 4, 1990;
SBE Regulation No. 87-4 Amendment No. 2 Licensure in Secondary Education, Grades 7-12, filed April 3, 1995.

6.60.3 Alternative Licensure

TITLE 6 PRIMARY AND SECONDARY EDUCATION
CHAPTER 60 SCHOOL PERSONNEL - GENERAL PROVISIONS
PART 3 ALTERNATIVE LICENSURE

6.60.3.1 ISSUING AGENCY: Public Education Department
[07-01-00; 6.60.3.1 NMAC - Rn, 6 NMAC 4.2.2.1.1, 06-14-01; A, 08-31-04]

6.60.3.2 SCOPE: All persons who have earned at least a baccalaureate degree but have not completed educator preparation programs and seek alternative routes to licensure in early childhood education, elementary education, middle level education, K-12 specialty area education, secondary education, or special education.
[07-01-00; 6.60.3.2 NMAC - Rn, 6 NMAC 4.2.2.1.2 & A, 06-14-01; A, 04-29-05]

6.60.3.3 STATUTORY AUTHORITY: 22-2-1, 22-2-2, 22-10A-6, and 22-10A-8, NMSA 1978.
[07-01-00; 6.60.3.3 NMAC - Rn, 6 NMAC 4.2.2.1.3, 06-14-01; A, 06-30-03]

6.60.3.4 DURATION: Permanent
[07-01-00; 6.60.3.4 NMAC - Rn, 6 NMAC 4.2.2.1.4, 06-14-01]

6.60.3.5 EFFECTIVE DATE: July 1, 2000, unless a later date is cited in the history note at the end of a section.
[07-01-00; 6.60.3.5 NMAC - Rn, 6 NMAC 4.2.2.1.5 & A, 06-14-01; A, 06-01-02]

6.60.3.6 OBJECTIVE: Through this regulation the New Mexico public education department (hereinafter the "department") implements a state law that provides alternative routes to New Mexico teacher licensure for persons who hold at least a baccalaureate degree but have not completed a traditional educator preparation program.
[07-01-00; 6.60.3.6 NMAC - Rn, 6 NMAC 4.2.2.1.6, 06-14-01; A, 08-31-04]

6.60.3.7 DEFINITIONS:

A. "Particular field" means the license and/or endorsement area being sought.

B. "Appertains and corresponds to the subject area of instruction and level of instruction" means:

(1) that for early childhood licensure, the degree, including the credit hours, shall be related to early childhood education, birth through grade 3;

(2) that for elementary licensure, the degree, including the credit hours, shall include completed course work in any combination of the subject areas of language arts, mathematics, science, social studies, history, fine or performing arts and foreign language;

(3) that for middle level, secondary, and K-12 specialty area licensure the degree, including the credit hours, shall be in the license and/or endorsement area being sought; and,

(4) that for special education licensure, the degree, including the credit hours, shall include completed course work in any combination of the subject areas of language arts, mathematics, science, social studies, history, fine or performing arts and foreign language, or shall be related to special education (such as general elementary or secondary education, special education, psychology, child development, reading education).

C. "A program approved by the department" means that the same program approval standards and procedures used by the department for approving university preparatory programs shall be applied to alternative programs.

D. "Core academic subjects" means English, language arts, reading, mathematics, science, the arts, including music and visual arts, and social studies, which includes civics, government, economics, history, and geography, and modern and classical languages, except for the modern and classical Native American languages and cultures of New Mexico tribes or pueblos.

E. "A highly qualified, beginning early childhood, elementary, middle level, secondary, K-12-specialty area" teacher, under this rule, means a teacher who is fully qualified to teach the core academic subjects, who is new to the profession, who has pursued an alternative route to licensure and who:

(1) meets the requirements for alternative licensure in 6.60.3.8 NMAC, and

(2) has no licensure requirements waived on an emergency or temporary basis, or for any other reason, and

(3) has passed all applicable teacher testing requirements for the level of licensure under 6.60.5.8 NMAC.

F. "A highly qualified beginning middle or junior high school teacher holding alternative elementary K-8 licensure", under this rule, means a teacher who is fully qualified to teach the core academic subjects in a public middle or junior high school, and who is new to the profession and has pursued an alternative route to licensure, and who:

(1) meets the requirements for alternative elementary K-8 licensure in 6.60.3.8 NMAC, and

(2) has no licensure requirements waived on an emergency or temporary basis, or for any other reason, and

(3) has passed all applicable teacher testing requirements for elementary K-8 licensure in 6.60.5.8 NMAC, and

(4) if the teacher is new to the profession after June 30, 2006, or if the teacher was hired after the first day of school of the 2002-2003 school year and assigned to work in a title I targeted assistance program or a title I school-wide program:

(a) has passed the content knowledge test(s) of the New Mexico teacher assessments or comparable licensure tests from another state in each subject area the teacher teaches, or

(b) has successfully completed an undergraduate academic major or coursework equivalent to an undergraduate major, or a graduate degree, in each core academic subject the teacher teaches.

G. "A highly qualified beginning K-12 special education teacher," under this rule, means a teacher who is new to the profession and who has pursued an alternative route to licensure and who is fully qualified to teach special education students by either providing access for those students to a regular education classroom where instruction in the core academic subjects is delivered by a highly qualified regular education teacher, by being fully qualified to teach each core academic subject the special education teacher teaches, or by being fully qualified to teach either language arts or mathematics or science and becoming fully qualified to teach any other core academic subjects which the teacher teaches within two years after the date of initial employment and who:

(1) meets the requirements for K-12 special education licensure in Subsections A or B in 6.61.6.8 NMAC, and

(2 has no licensure requirements waived on an emergency or temporary basis, or for any other reason, and

(3) has passed all applicable teacher testing requirements for licensure in 6.60.5.8 NMAC.

H. "A highly qualified teacher candidate for level I alternative licensure" means a person participating in an alternative route to licensure, who meets all of the following requirements:

(1) has fulfilled the degree requirements set forth in Subsection A of 6.60.3.8 NMAC; and

(2) receives high-quality professional development that is sustained, intensive, and classroom-focused, and includes classroom management and lesson planning for teaching New Mexico's diverse student population, both before and while teaching; and

(3) participates in a program of intensive supervision that consists of structured guidance and regular ongoing support for teachers or a teacher mentoring program; and

(4) assumes duties as a teacher only for a period of time not to exceed three years; and

(5) demonstrates satisfactory progress toward full alternative licensure by completing at least nine semester hours per year in his/her alternative licensure program or successfully demonstrates competency by way of portfolio assessment or by way of local evaluations for two full school years.

I. "Internship license" means a three-year non-renewable certificate or license issued by the department authorizing a candidate to teach where he/she does not yet meet the requirements for a level one alternative license but is satisfactorily participating in an alternative route to licensure under 6.60.3 NMAC.

J. "Undergraduate academic major", under this rule, means thirty (30) semester hours in a subject area.

K. "Full school year", for purposes of this rule, means a minimum of 160 instructional days in a school year or 320 instructional days over multiple school years of full-time or part-time teaching during which the teacher is the teacher of record in at least one class each school year while holding an internship teaching license. Instructional days may include teaching in summer school or similar educational setting.

[07-01-00; 6.60.3.7 NMAC - Rn, 6 NMAC 4.2.2.1.7, 06-14-01; A, 06-30-03; A, 04-29-05]

6.60.3.8 REQUIREMENTS FOR ALTERNATIVE LICENSURE: To receive a level 1, three-year alternative license, an applicant must meet the following requirements:

A. Degree requirements - An applicant for alternative licensure must meet the provisions of Subsection A, Paragraphs (1), (2) or (3).

(1) must possess a bachelor of arts or science degree from a regionally accredited college or university including completion of a minimum of thirty semester hours of graduate or undergraduate credit in a particular field that pertains and corresponds to the subject area of instruction and level of instruction that will enable the applicant to teach in a competent manner as determined by the department; or

(2) must possess a master of arts or science degree from a regionally accredited college or university including completion of a minimum of twelve graduate credit hours in a particular field that appertains and corresponds to the subject area of instruction and level of instruction that will enable the applicant to teach in a competent manner as determined by the department; or

(3) must possess a doctor's degree from a regionally accredited college or university; the degree shall correspond to the subject area of instruction and particular grade level that will enable the applicant to teach in a competent manner as determined by the department.

B. Professional teacher education requirements - An applicant for alternative licensure must meet the provisions of Paragraphs (1), (2), or (3) or (4) of this Subsection.

(1) Persons seeking either early childhood B-3, elementary K-8, or special education K-12 licensure, must complete various semester hours of credit earned through a regionally accredited college or university that has a department-approved alternative licensure program containing no less than twelve (12) nor more than twenty-one (21) semester hours of credit and meeting the following criteria:

(a) the credits must include six (6) semester hours of coursework in the teaching of reading; and

(b) the credits must include the department's competencies for entry level teachers that correspond to the license being sought; and

(c) the credits must be in a program approved by the department; and

(d) the program must include a student teaching or field-based component.

(2) Persons seeking either middle level 5-9, or secondary 7-12 licensure, must complete various semester hours of credit earned through a regionally accredited college or university that has department-approved alternative licensure program containing no less than twelve (12) nor more than eighteen (18) semester hours of credit and meeting the following criteria:

(a) the credits must include three (3) semester hours of coursework in the teaching of reading; and

(b) the credits must include the state board's competencies for entry level teachers that correspond to the license being sought; and

(c) the credits must be in a program approved by the department; and

(d) the program must include a student teaching or field-based component.

(3) Must successfully demonstrate the department's approved competencies for entry level teachers that correspond to the license being sought by way of a portfolio assessment pursuant to 6.2.4 NMAC. Such applicants shall also complete the reading courses set forth at Paragraphs (1) or (2) of this Subsection prior to being granted a portfolio review. Pursuant to 6.2.4 NMAC, under no circumstance shall an individual be granted a portfolio review unless that person has passed all sections of the current department-required New Mexico teacher test.

(4) Must successfully demonstrate the department's approved competencies for entry level teachers that correspond to the license being sought by way of evaluations conducted by a local school district over a period of at least two full school years as part of a PED-approved school-based or statewide teacher preparation program that provides the professional development that is required to support a highly qualified teacher candidate for level I alternative licensure as defined in this rule. The professional development program shall be developed in collaboration with a college, university, or other professional development providers. Such applicants shall also complete the reading courses set forth at Paragraphs (1) or (2) of this Subsection prior to being recommended for licensure by a local school district. Under no circumstance shall an individual be recommended for licensure by a local school district unless that person has passed all sections of the current department-required New Mexico teacher test.

C. Testing requirements: An applicant for alternative licensure must pass all of the New Mexico teacher assessments, including any applicable content knowledge assessment required by 6.60.5 NMAC, prior to receiving level one alternative licensure, and

D. An applicant for alternative licensure must be a highly qualified, beginning early childhood, elementary, middle level, secondary, K-12, or special education teacher, or be a highly qualified beginning middle or junior high school teacher holding alternative elementary K-8 licensure.

[07-01-00; 6.60.3.8 NMAC - Rn, 6 NMAC 4.2.2.1.8, 06-14-01; A, 06-01-02; A, 06-30-03; A, 08-31-04; A, 04-29-05]

6.60.3.9 REQUIREMENTS FOR INTERNSHIP LICENSURE

A. A candidate for alternative licensure may be permitted to assume the functions of a teacher prior to completion of licensure requirements and be issued a three-year non-renewable internship license, if he/she is a highly qualified teacher candidate for level I alternative licensure, as defined in this rule.

(1) Such a candidate may be issued a three-year non-renewable internship license to allow time to complete the teacher competency testing requirements of 6.60.5.8 NMAC, and the reading coursework requirement set forth in Paragraphs (1) or (2) of Subsection B of 6.60.3.8 NMAC, and to present a portfolio or be evaluated for competency by a local school district.

(2) At the time of internship licensure application, the candidate must:

(a) present proof of registration for the New Mexico teacher assessments at the next available testing date, and

(b) present proof of enrollment in the required coursework for the teaching of reading.

(3) If a candidate for this licensure is not successful in demonstrating competency by way of portfolio assessment or by way of local public school district evaluations, he/she may still proceed by way of the alternative route set forth in this

Subsection although the three-year non-renewable license issued under Paragraph (1) of Subsection B of 6.60.3.9 NMAC shall not be extended or renewed in order to provide additional time to complete an alternative licensure program.

B. A candidate enrolled in a department approved post-baccalaureate teacher preparation program or advanced degree program with a teacher preparation component may be considered to be participating in an alternative route to licensure and be issued internship licenses under Subsection A of 6.60.3.9 NMAC. Upon the completion of approved teacher preparation program requirements, the candidate may be issued a standard level I license if, in addition, the candidate meets the requirements for standard licensure within the three-year period allowed to complete an alternative route to licensure.

C. After June 30, 2003, the time that a person provides services under an internship license shall not be counted toward or considered for advancement to level two or level three licensure.

[07-01-00; 6.60.3.9 NMAC - Rn, 6 NMAC 4.2.2.1.9, 06-14-01; 6.60.3.9 NMAC - N, 06-30-03; A, 08-31-04; A, 04-29-05]

6.60.3.10 REQUIREMENTS FOR STANDARD LICENSURE: To receive a standard level two license, an applicant must meet all of the requirements for licensure advancement to level two set forth in Subsection A of 6.60.6.9 NMAC.

[07-01-00; 6.60.3.10 NMAC - Rn, 6 NMAC 4.2.2.1.10, 06-14-01; 6.60.3.10 NMAC - Rn, 6.60.3.9 NMAC, 06-30-03; A, 08-31-04; A, 04-29-05]

6.60.3.11 SAVINGS CLAUSE:

A. All persons already holding alternative licensure who by June 30, 2000 have satisfactorily completed all requirements for that licensure shall be entitled to a standard license at level 2.

B. All persons for whom an alternative licensure program has already been approved by the department on or prior to June 30, 2000 but have not yet completed all requirements of that program will be permitted to continue toward licensure in accordance with their approved program.

C. All persons holding valid distinguished scholar licensure who by June 30, 2000 have passed all portions of either the core battery of the national teachers examination or the New Mexico teacher assessments shall be entitled to a three-year alternative license. During the three-year alternative licensure period, the alternative licensee shall complete all provisions set forth in Subsections B and C of 6.60.3.9 NMAC for standard licensure.

[6.60.3.11 NMAC - Rn, 6.60.3.10 NMAC, 06-30-03; A, 08-31-04]

HISTORY OF 6.60.3 NMAC:

PRE-NMAC HISTORY: The material in this part was derived from that previously filed with State Records Center and Archives under SBE Regulation No. 86-6, Alternative Licensure, filed July 14, 1986; and
SBE Regulation No. 86-6, Amendment No, 1, Alternative Licensure filed December 4, 1990.

HISTORY OF REPEALED MATERIAL:

6 NMAC 4.2.2.1, Alternative Licensure, was repealed by the State Board of Education effective July 1, 2000 and repromulgated effective July 1, 2000.

6.60.5 Competency Testing for Licensure

TITLE 6 PRIMARY AND SECONDARY EDUCATION
CHAPTER 60 SCHOOL PERSONNEL - GENERAL PROVISIONS
PART 5 COMPETENCY TESTING FOR LICENSURE

6.60.5.1 ISSUING AGENCY: Public Education Department

[12-31-98, 07-30-99; 6.60.5.1 NMAC - Rn, 6 NMAC 4.2.2.2.1, 10-13-00; A, 04-29-05]

6.60.5.2 SCOPE: All persons seeking teaching licensure, certain licensure endorsements, and bilingual education endorsement on or after July 30, 1999; and all persons who have registered to take or have taken any portion of the New Mexico teacher assessments.

[12-31-98, 07-30-99; 6.60.5.2 NMAC - Rn, 6 NMAC 4.2.2.2.2 & A, 10-13-00; A, 07-01-01; A, 07-15-02; A, 04-29-05]

6.60.5.3 STATUTORY AUTHORITY: Sections 22-2-1 and 22-2-2, NMSA 1978.

[12-31-98; 6.60.5.3 NMAC - Rn, 6 NMAC 4.2.2.2.3, 10-13-00; A, 07-01-01; A, 04-29-05]

6.60.5.4 DURATION: Permanent

[12-31-98; 6.60.5.4 NMAC - Rn, 6 NMAC 4.2.2.2.4, 10-13-00]

6.60.5.5 EFFECTIVE DATE: July 30, 1999, unless a later date is cited in the history at the end of a section.

[12-31-98, 07-30-99; 6.60.5.5 NMAC - Rn, 6 NMAC 4.2.2.2.5 & A, 10-13-00]

6.60.5.6 OBJECTIVE: This regulation is adopted by the public education department (hereinafter department") for the purpose of establishing the New Mexico teacher assessments ("NMTA") as the primary acceptable examination for educator

licensure in New Mexico. Although the department adopts the New Mexico teacher assessments as the successor examination to the core battery of the national teachers examination, this regulation also provides for acceptance of passing test scores from those applicants who took the core battery of the national teachers examination and have applied for licensure on or after July 30, 1999. This regulation also establishes the New Mexico content knowledge assessments ("NMCKA"), which is part of the NMTA, as the content tests required to be taken to hold certain endorsements on teaching licenses or to receive an initial elementary K-8 license. This regulation also establishes Prueba de Español para la Certificación Bilingüe as the department's required Spanish language proficiency examination for persons seeking an endorsement to a teaching license in Spanish/English bilingual education and allows that test to be used as the content knowledge test to be taken for an endorsement in modern and classical languages for Spanish. This regulation also allows the national family and consumer sciences test to be used as the content knowledge test to be taken for an endorsement in family and consumer sciences. Lastly, this regulation establishes procedures for investigating NMTA testing irregularities and taking corrective action.
[12-31-98, 07-30-99; 6.60.5.6 NMAC - Rn, 6 NMAC 4.2.2.2.6 & A, 10-13-00; A, 07-01-01; A, 07-15-02; A, 02-14-03; A, 04-29-05]

6.60.5.7 DEFINITIONS:

A. "NMCKA" means the New Mexico content knowledge assessments, which are the teacher-tests approved by the department, portions of which individuals must take and pass in order to receive endorsements on an initial license or as an option to add endorsements to an existing license in language arts, reading, mathematics, science, social studies, the arts (music or visual arts), modern and classical languages, health, physical education, library/media, teaching English to speakers of other languages (TESOL), and family and consumer sciences, or to receive initial licensure in elementary education from grades K-8.

B. "NMTA" means the New Mexico teacher assessments, which are the teacher-tests approved by the department that all individuals must take and pass in order to receive initial educator licensure; the NMTA consists of the New Mexico assessment of teacher basic skills the New Mexico assessment of teacher competency (both at the elementary and secondary levels), and the New Mexico content knowledge assessments ("NMCKA"); it shall include any test materials related to a testing applicant's taking of or registration for the NMTA.

C. "Test administrator" means the business entity, namely, the national evaluation systems, inc. or NES that developed the NMTA, administers the NMTA at testing centers throughout New Mexico, scores the NMTA, and reports NMTA testing results to the department.

D. "Testing applicant" means a person who has filed an NMTA registration form with the test administrator, or has yet taken a portion of the NMTA.

E. "Testing irregularity" means any circumstance within or beyond the control of a testing applicant that, in the sole opinion of the department or NES raises doubts about the propriety of a testing applicant's NMTA registration, NMTA score, or conduct during an NMTA test.

F. "Withheld NMTA score(s)" means the suspension of use by and disclosure to a testing applicant of his NMTA score(s) for up to 120 days upon a determination made by the department professional licensure bureau director that testing irregularity is likely to have occurred.

G. "Voided NMTA score(s)" means the cancellation, invalidation and non-disclosure of a testing applicant of his NMTA score(s) after a final determination of testing irregularity by the department's professional licensure bureau director or by a hearing officer of the secretary of education.

H. "Rules of test participation" means any written rules in the applicable NMTA registration bulletin that a testing applicant has expressly agreed to comply with as a condition of registering for or taking the NMTA.

I. "Educator licensure application" means an application for any professional teaching or administrative license, excluding licensure for an athletic coach, educational assistant, substitute teacher, or instructional support providers.

J. "Core academic subjects" English, language arts, reading, mathematics, science, modern and classical languages, except the modern and classical Native American languages and cultures of New Mexico tribes or pueblos, the arts, including music and visual arts, and social studies, which includes civics, government, economics, history, and geography.

K. "Highly qualified", under this rule, means a teacher of the core academic subjects who has no certification or licensure requirements waived on a temporary basis.
[6.60.5.7 NMAC - N, 07-01-01; A, 07-15-02; A, 02-14-03; A, 06-30-03; A, 04-29-05]

6.60.5.8 REQUIREMENTS: The NMTA consists of two generic categories of assessments. The first category is the basic knowledge, skills and competency assessments identified at Subsection A of **6.60.5.8** NMAC below. The second category is the content knowledge assessments, sometimes called content tests, identified at Subsection B of **6.60.5.8** NMAC below.

A. Beginning July 30, 1999 except for those individuals covered by Subsection C of **6.60.5.8** NMAC, below all applicants for initial licensure in addition to meeting all other licensure and background check requirements of the department, are required to take the basic knowledge, skills and competency assessments of the New Mexico teacher assessments, which consist of the following tests and obtaining the following passing scores:

(1) assessment of teacher basic skills: passing score = 240; and

(2) either:

(a) assessment of teacher competency, elementary level (for those seeking early childhood B-3 through the testing date in July, 2004, or elementary K-8 licensure including special education K-12, middle level 5-9 and grade K-12 licensure): passing score = 240; or

(b) assessment of teacher competency, secondary level (for those seeking secondary 7-12 licensure including special education K-12, middle level 5-9 and grade K-12 licensure): passing score = 240; or

(c) assessment of teacher competency, early childhood level (for those seeking early childhood B-3 licensure beginning with the testing date in September, 2004): passing score = 240.

B. In addition to the testing requirement above, all applicants for initial teacher licensure must take and pass a test in their content area subject according to the following schedule:

(1) Beginning with the September, 2002, administration of the department's content testing, if they are seeking licensure in elementary K-8, they shall take and pass the department's content knowledge assessment in elementary education prior to issuance of that license except as provided in Paragraph (6) of Subsection B of **6.60.5.8** NMAC.

(2) Beginning with the September, 2002, administration of the department's content testing, if they are applying for licensure in early childhood birth - grade 3 or elementary K-8 and are also seeking an endorsement in reading, they shall take and pass the department's content knowledge assessment in that content area prior to issuance of that license.

(3) Beginning with the September, 2004, administration of the department's content testing, if they are applying for licensure in early childhood B-3, elementary K-8, secondary 7-12, middle level 5-9 and/or grade K-12, and are also seeking an endorsement in the arts (music or visual arts) or modern and classical languages (Spanish, French, or German) they must take and pass the department's content knowledge assessment(s) in the respective content area prior to issuance of the endorsement(s).

(4) Beginning with the September, 2002, administration of the department's content testing, if they are applying for licensure in secondary 7-12, middle level 5-9 and/or grade K-12 and are also seeking endorsement in language arts, reading, mathematics, science or social studies, or any combination thereof, they shall take and pass the department's content knowledge assessment in that content area prior to issuance of that license.

(5) Beginning with the September, 2006, administration of the department's content testing if they are applying for licensure in early childhood B-3, elementary K-8, secondary 7-12, middle level 5-9 and/or grade K-12, and are also seeking an endorsement in the health, physical education, library/media, teaching English to speakers of other languages (TESOL), or family and consumer sciences, they must take and pass the department's content knowledge assessment(s) in the respective content area prior to issuance of the endorsement(s).

(6) An elementary K-8 licensed teacher who is new to the profession and who teaches language arts, social studies, mathematics, or science in a middle school or junior high school must either:

(a) take and pass the department's middle level content knowledge assessment(s) in each core subject area the teacher teaches; or

(b) complete twenty-four semester hours of coursework, upper or lower division, in each core academic subject the teacher teaches and take and pass the content knowledge assessment in elementary education.

(7) If they currently hold a license and seek to add an endorsement in language arts, reading, mathematics, science, social studies, the arts (music or visual arts), modern and classical languages (Spanish, French, or German), health, physical education, library/media, teaching English to speakers of other languages (TESOL), or family and consumer sciences, they may be issued an endorsement in the content area upon passage of the department's content knowledge assessment(s) in the respective content area except that a candidate who has passed the Prueba de Español para la Certificación Bilingüe must also complete required coursework in order to add an endorsement in modern and classical languages (Spanish).

C. Applicants for an initial Spanish/English bilingual endorsement to a teaching license must, in addition to meeting all other department requirements for the endorsement, pass Prueba de Español para la Certificación Bilingüe by obtaining a score of 2 or higher on any 12 of the 15 subsections. Applicants seeking this endorsement through licensure reciprocity should consult 6.60.4 NMAC for guidance.

D. A person who has failed any portion of the NMTA, excluding any New Mexico content knowledge assessment, may nevertheless qualify for issuance of a level I license provided that he or she:

(1) must at the time of issuance of such a license, have attempted but failed at least twice any portion of the NMTA, excluding any New Mexico content knowledge assessment;

(2) must at the time of issuance of such a license, have attained a score of at least 170 on each of the basic skills, general knowledge and teacher competency tests;

(3) must at the time of issuance of such a license, have been employed and observed teaching in the same school district on either a substandard, temporary or combination of such licenses for at least two full school years;

(4) must at least once annually retake any failed test; and,

(5) must, pursuant to 6.60.10 NMAC ("Mentorship Programs for Beginning Teachers"), be assigned a mentor by a school district and must successfully complete at least one year of an approved mentorship program.

E. No such level I license authorized by Subsection D of **6.60.5.8** NMAC, shall be issued unless:

(1) the superintendent of the employing school district certifies in writing to the department through the professional licensure bureau of the PED, that the individual failing a portion of the NMTA as described above, should be relieved from passing one or more portions of the NMTA because he/she has successfully performed at a high degree in the same school district during at least two consecutive school years;

(2) the required high degree of performance in the case of an elementary K-8 teacher, must be documented on at least two annual evaluations and address the individual's subject knowledge and teaching skills in reading, mathematics, and other areas of the basic elementary school curriculum;

(3) the required high degree of performance in the case of a secondary 7-12 teacher, must be documented on at least two annual evaluations and address the individual's subject knowledge and teaching skills in the endorsement area in which licensure is sought.

F. Limitations on level I licenses issued pursuant to Subsections D and E of **6.60.5.8** NMAC:

(1) there shall be no exception to the requirement that a person must take and pass a state content knowledge assessment required under this rule;

(2) although a person issued such a license may receive an unrestricted level II license once he/she receives a certification of competencies at the time of licensure renewal, until this occurs he/she must, as a condition of holding this licensure, remain employed in the school district that certified that he/she should be relieved from passing one or more portions of the NMTA;

(3) during the time that a person holds such a license, if he/she was hired by a district after the first day of school of the 2002-2003 school year, he/she may not be assigned by the district to work in a targeted assistance program or school-wide program that is funded by Title I of the Elementary and Secondary Education Act;

(4) under no circumstances shall any level I license be issued under these subsections after June 30, 2005;

(5) A person issued a level I license who has not passed one or more portions of the NMTA, shall not acquire a property interest in that license. Nor shall a person issued such a license acquire professional status by reason of being issued that license and holding it from year to year. Accordingly, such a license may be suspended, revoked, or its issuance denied for any reason without a hearing at any time by a vote of the department upon a written recommendation by the secretary of education ("the secretary") or his designee that states the reason for the recommendation. The individual whose license is considered for suspension, revocation, or denial of issuance, shall be given notice from the secretary of the reason for the proposed suspension, revocation or denial of issuance of his license, the date and time when the secretary will consider taking final action against his license, and an opportunity to address the secretary. Besides acts of immorality, incompetence or misconduct, such a license may be suspended, revoked or its issuance denied, for any condition not satisfied in Subsection D or E of 6.60.5.8 NMAC.

[12-31-98, 07-30-99, 02-14-00; **6.60.5.8** NMAC - Rn, 6 NMAC 4.2.2.2.8 & A, 10-13-00; A, 07-15-02; A, 02-14-03; A, 06-30-03; A, 04-29-05]

6.60.5.9 IMPLEMENTATION: Except as provided in Subsection B of this section, applicants described in Section **6.60.5.8** NMAC who have not completed all testing requirements but have met all other licensure and background check requirements of the department will be granted a nonrenewable one-year license, effective on July 1 of the year of application and expiring on June 30 of the following year.

A. Consistent with Title I, Section 1119 (a) (1) and Title IX, Section 9101 (23) (A) (ii) of the No Child Left Behind Act, if a teacher is not highly qualified and has been issued a one-year license by the department in the core academic subjects under this section, local education agencies receiving funds under title I of the act shall not assign that teacher to teach the core academic subjects in a title I targeted assistance program or schoolwide program, if he/she was initially employed after the first day of school of the 2002-2003 school year.

B. Consistent with Title I, Section 1119 (a) (2) and Title IX, Section 9101 (23) (A) (ii) of the No Child Left Behind Act, which requires that all teachers of the core academic subjects be highly qualified by the end of the 2005-2006 school year, the department will not issue one year licenses in the core academic subjects under this section after June 30, 2006.

[07-30-99; 6.60.5.9 NMAC - Rn, 6 NMAC 4.2.2.2.9, 10-13-00; A, 06-30-03; A, 04-29-05]

6.60.5.10 SAVINGS CLAUSE: Applicants described in Section 6.60.5.8 NMAC applying for licensure after July 30, 1999, who have taken the professional knowledge portion of the core battery of the national teachers examination within ten years of application for licensure or who have ever taken the communications skills and general knowledge portions of the core battery of the national teachers examination that correspond with portions of the NMTA as indicated below, will be exempt from taking the same portions of the NMTA provided they have obtained the following minimum scaled score that correspond with each test of the core battery of the national teachers examination:

A.	professional knowledge	630	corresponds with NMTA-teacher proficiency		240
B.	communication skills	644	corresponds with NMTA-basics skills		240

[07-30-99; 6.60.5.10 NMAC - Rn, 6 NMAC 4.2.2.2.10 & A, 10-13-00; A, 07-15-02; A, 02-14-03; A, 04-29-05]

6.60.5.11 TESTING IRREGULARITIES: Where a potential testing irregularity is reported to the department, the department shall make a preliminary inquiry to determine if further investigation is warranted.

A. If after a preliminary inquiry the department determines that a potential testing irregularity warrants further investigation, the department may cause that testing applicant's NMTA score to be withheld pending the completion of an investigation. The department shall notify a testing applicant that any NMTA score suspected of being obtained by means of or following a testing irregularity may be withheld for up to 120 days pending an investigation. At the conclusion of its investigation, the department shall notify the test administrator and the testing applicant of its findings and conclusions, whether or not a testing irregularity has been substantiated.

B. If after an investigation the department finds and concludes that a testing irregularity is substantiated by the evidence, it may, after notifying the test administrator and the testing applicant of its findings, conclusions and intended action:

(1) void the applicant's test score(s);

(2) bar the applicant from retaking the NMTA for up to five (5) years;
(3) direct that the applicant's registration fee be forfeited;
(4) direct that the applicant's registration fee be refunded;
(5) permit the applicant to retake all or portions of the NMTA under controlled conditions; or
(6) impose any combination of the foregoing options.

C. If after an investigation the department finds and concludes that no testing irregularity is substantiated by the evidence, it shall promptly notify the test administrator and the testing applicant and direct that any withheld NMTA be released and available for use in the educator licensure process.

[6.60.5.11 NMAC - N, 07-01-01; A, 04-29-05]

6.60.5.12 RIGHTS OF A TESTING APPLICANT: The department shall advise the testing applicant at the time he is notified that his NMTA score will be withheld or voided, that he can at any time provide the department with a statement or documentary evidence rebutting the likely or substantiated existence of a testing irregularity. However, the testing applicant shall be cautioned that any statement or document he provides may later be used against him at a department administrative proceeding, a civil proceeding or a criminal proceeding.

A. Where a testing applicant has an initial educator licensure application on file with the department at the time he is notified that a testing irregularity has been substantiated, he shall have a right to request a hearing within 30 days of the notification and shall be afforded all the procedural and substantive due process rights contained in 6.68.2 NMAC ("Denial of Applications for Licenses for School Personnel"), which regulation shall govern the proceedings. The department may combine this hearing with a licensure denial hearing. The right to discovery shall be limited as set forth in section 13 of 6.60.5 NMAC below.

B. Where a testing applicant does not have an initial educator licensure application on file with the department at the time he is notified that a testing irregularity has been substantiated, he shall have 20 days to notify the department professional licensure director of his desire to schedule a telephonic conference-call or in-person meeting with the director. Such request must be in writing. Any relevant documents may be introduced and either side may be represented by an attorney and up to three witnesses may be called. The formal rules of evidence shall not apply and either side may at their own expense request that any witness statements be sworn and that a record be made of the meeting. The director shall issue a written decision consisting of written findings, conclusions and action to be taken. The decision will be issued to the testing applicant within 14 days of the meeting. The decision of the director, which must be based on a preponderance of the evidence, shall be final and not subject to review, appeal, or reconsideration by the agency.

C. A testing applicant with an initial educator licensure application on file with the department at the time he is notified that a testing irregularity has been substantiated, may waive his right to a hearing and proceed by way of a meeting with the director as set forth in the immediately preceding paragraph.

[6.60.5.12 NMAC - N, 07-01-01; A, 04-29-05]

6.60.5.13 LIMITED DISCOVERY RIGHTS: The NMTA is the primary department-approved teacher test for the state of New Mexico. It was developed by the test administrator under contract with the department to help identify candidates for educator licensure who have demonstrated the level of knowledge and skills necessary for performing the duties of a teacher in New Mexico's public schools. The department holds the exclusive copyright on the NMTA. As such, the department must safeguard not only the copyright but also the confidentiality of the NMTA. Any testing applicant who timely requests a meeting or a hearing as permitted by this regulation, shall have only limited access to the questions and answers of his NMTA and/or related materials.

A. Given the proprietary nature of the NMTA and/or related materials, under no circumstance shall a testing applicant's disputed or undisputed NMTA be released to a testing applicant, his attorney, his representative, or the general public.

B. Upon request made to the director, a testing applicant, his attorney, or representative shall be given as much access to the applicant's disputed or undisputed NMTA and/or related materials as is deemed reasonably necessary by the director, or hearing officer as the case may be, to prepare for his pending meeting or hearing.

C. Anyone given permission to view a testing applicant's disputed or undisputed NMTA and/or related materials, must sign a confidentiality agreement offered by the department. An NMTA and/or related materials may only be viewed during routine office hours of the department under supervision of an department employee and on the department premises. No NMTA and/or related materials may be written on, marked, electronically copied, hand-duplicated, or otherwise removed from the premises of the department. The form, subject matter, substance and wording of any NMTA test question or answer may also not be removed from the premises of the department nor may they be further disclosed in any other way. A person granted permission to review the materials covered by this section may not bring any manual or electronic copying devices to the location where the materials are offered. Such copying devices referred to in the preceding sentence shall include but not be limited to cameras, camcorders, tape recorders, writing utensils, hand-held computers, paper, briefcases, etc. The said confidentiality agreement shall accomplish this as well as other test-security goals. Anyone who enters the department premises to review the materials covered by this section and who violates or attempts to violate any protected security measure may be, at the discretion of the department, removed from the premises and be considered to have forfeited any additional access to an applicant's disputed or undisputed NMTA and/or related materials.

D. The original or copy of any NMTA and/or related materials used as evidence at any meeting or hearing shall also be subject to confidentiality by all attendees and participants. Accordingly, all such meetings or hearings shall be closed to the public.
[6.60.5.13 NMAC - N, 07-01-01; A, 04-29-05]

6.60.5.14 LICENSURE DENIAL OR REVOCATION: Engaging in a testing irregularity shall constitute a good and just ground to deny a testing applicant's licensure application or to revoke or suspend any license held by a testing applicant that was issued by the department. In the case of licensure revocation or suspension, the department shall proceed under authority and procedure of 6.68.3 NMAC ("Suspension or Revocation of a License Held by a Licensed School Individual") and the Uniform Licensing Act [Sections 61-1-1 through 61-1-31 NMSA 1978].
[6.60.5.14 NMAC - N, 07-01-01; A, 04-29-05]

HISTORY OF 6.60.5 NMAC:
Pre-NMAC History:
The material in this Part was derived from that previously filed with State Records Center and Archives under SBE Regulation No. 84-8, Relating to Competency Testing for Certification and Performance Evaluation Requirement, filed August 27, 1984;
SBE Regulation No. 84-8 Amendment No. 1, Relating to Competency Testing for Certification and Performance Evaluation Requirement, filed May 18, 1987; and
SBE Regulation No. 89-5, Competency Testing for Licensure, filed August 17, 1989.
History of Repealed Material:
6 NMAC 4.2.2.2.8.2 - Repealed 02-14-00.

6.60.10. Mentorship Programs for Beginning Teachers

TITLE 6 PRIMARY & SECONDARY EDUCATION
CHAPTER 60 SCHOOL PERSONNEL - GENERAL PROVISIONS
PART 10 MENTORSHIP PROGRAMS FOR BEGINNING TEACHERS

6.60.10.1 ISSUING AGENCY: State Board of Education
[6.60.10.1 NMAC - N, 07-01-02]

6.60.10.2 SCOPE: All beginning teachers holding a level 1 New Mexico teaching license and employed in a New Mexico public school district, charter school, or state agency shall successfully complete a one to three year beginning teacher mentorship program provided by the public school district, charter school or state agency.
[6.60.10.2 NMAC - N, 07-01-02]

6.60.10.3 STATUTORY AUTHORITY: Section 22-2-8.10, NMSA 1978.
[6.60.10.3 NMAC - N, 07-01-02]

6.60.10.4 DURATION: Permanent
[6.60.10.4 NMAC - N, 07-01-02]

6.60.10.5 EFFECTIVE DATE: July 1, 2002, unless a later date is cited in the history note at the end of a section.
[6.60.10.5 NMAC - N, 07-01-02]

6.60.10.6 OBJECTIVE: To establish requirements for statewide mentorship programs to provide beginning teachers an effective transition into the teaching profession, retain capable teachers, improve the achievement of students, and improve the overall success of the school.
[6.60.10.6 NMAC - N, 07-01-02]

6.60.10.7 DEFINITIONS:
A. "beginning teacher" means a teacher holding a New Mexico level 1 teaching license who has less than three complete years, full-or part-time, of classroom teaching experience. For the purpose of this rule, teachers with more than three complete years, full-or part-time, of classroom teaching experience but who hold level 1 licensure are not beginning teachers.
B. **"teaching license"** means a state board of education license issued in Early Childhood, Birth-Grade 3; Elementary Education, Grades K-8; Middle Level, Grades 5-9; Secondary Education, Grades 7-12; Special Education, Grades K-12; Licensure for K-12; and Secondary Vocational-Technical Education.
[6.60.10.7 NMAC - N, 07-01-02]

6.60.10.8 REQUIREMENTS FOR MENTORSHIP PROGRAMS: All mentorship programs must receive initial approval from the director of professional licensure for the state department of public education (hereinafter the "director"). To receive approval, public school districts, charter schools, or state agencies must submit a proposed mentorship program that aligns with and supports the public school district's, charter school's, or state agency's long range plan for student success and aligns with the state board's Nine Essential Teacher Competencies and Indicators contained in 6.69.3 NMAC, or any successor competencies adopted by the state board for level 1 teachers. The proposal must describe how the mentorship program addresses the following:

A. Provides individual support for beginning teachers from designated mentors or support providers. The support activities must include collaborative curriculum alignment, design, and planning; they must also include classroom observations, student assessment, individual instructional conferences, and instructional resource development.

B. Is mandatory for all beginning teachers holding level 1 licensure whether standard, alternative, or substandard.

C. Includes structured and research-based training activities for mentors. The training must include the development and needs of beginning teachers, the process of developing mentorship relationships, the process of documenting teacher growth, and best practices in working with novice teachers.

D. Uses a structured process for selection of mentors that includes selection and evaluation criteria and details the person or persons responsible for implementing the selection and evaluation process.

E. Provides compensation for mentors.

F. Uses an ongoing, formative evaluation of beginning teachers for the improvement of teaching practice.

G. Uses an ongoing summative evaluation of beginning teacher performance during the first 1 to 3 years of teaching, including an annual assessment of competence for continuing licensure and a final assessment of competence for teachers seeking level 2 licensure. Evaluation of beginning teacher performance shall include annual review and progress reports during the mentorship program, collection of documented evidence of teacher growth and development, and summative assessment of Level I teacher competencies.

H. Has a process for addressing disputes or grievances between mentors and beginning teachers and for replacing mentors for good cause shown.

I. Establishes a program that is at least one year in length but includes provisions whereby support for an additional 2 or 3 years can be provided to teachers who do not successfully complete the first year and continue to be employed in the public school district, charter school, or state agency. and,

J. Has documentation that describes how support was sought and obtained from the local school board, administrators, and other district and school personnel.

[6.60.10.8 NMAC - N, 07-01-02]

6.60.10.9 COMPLETION OF MENTORSHIP PROGRAM: All beginning teacher must successfully complete a minimum of a one-year mentor program to be eligible for a level 2 license. Successful completion of the program shall be documented on a form available from the professional licensure unit and shall be maintained in each teacher's licensure file in the professional licensure unit. Under no circumstance shall a beginning teacher who is otherwise eligible to receive a level 2 license unless he or she has been certified as having successfully completed a mentorship program.

[6.60.10.9 NMAC - N, 07-01-02]

6.60.10.10 PROGRAM EVALUATION AND APPROVAL: All mentorship programs shall be evaluated annually to determine the effectiveness of the program. Mentorship programs must be renewed every 12 months. To accomplish this, public school districts, charter schools, or state agencies shall, within 60 days of the anniversary of the date of the approval of their current mentorship program, submit an annual self-evaluation to the director with evaluation criteria and procedures indicating how teacher retention has improved and student performance has increased.

[6.60.10.10 NMAC - N, 07-01-02]

6.60.10.11 SAVINGS CLAUSE: All mentorship programs submitted by a public school district, charter school, or state agency to comply with state board Rule 6 NMAC 4.2.2.1, Alternative Licensure, and approved by the state board shall be deemed to be in compliance with Sections 1 through 9 of this rule. The director reserves the right to impose additional requirements to comply with Section 10 of 6.60.10 NMAC.

[6.60.10.11 NMAC - N, 07-01-02]

Appendix 3

Present and Past Mathematics and Science Projects

Present Projects

New Mexico Math, Science and Engineering Achievement (NM MESA) Inc. was founded in 1982 based on a model developed at UC-Berkeley in 1970. It is

> "a non-profit organization, promotes educational enrichment for middle and high school students from historically under-represented ethnic groups. NM MESA, in partnership with schools and universities, prepares these pre-college students for college and careers in mathematics, engineering, science and related fields."

In the 2003-2004 school year NM MESA worked with almost 5000 students in over 100 schools. Among the tools that NM MESA uses to accomplish it mission are

- Tutoring/study skills
- Advanced studies
- College and career counseling
- Field trips and academic competitions
- Leadership development
- Summer programs
- Scholarship incentives
- Elementary school outreach
- Teacher professional development
- Parental support
- Community service
- Business collaboration/outreach

It has a Board of Directors, an Executive Director, six regional offices, and hires teachers to be Advisors in the schools. It receives funding from the State of New Mexico, and several private foundations, federal agencies and individual donors. <www.nmmesa.org/>

Gadsden Mathematics Initiative (NSF Award #0096674, 2001-2006, $2,024,850) Lessons learned: This project involves a district-wide effort in mathematics professional development utilizing NSF-funded curricula (*Investigations* in grade K to 6 and *Connected Math* in grades 7 and 8). (For more details on the NSF-funded curricula see Chapter 5.) All district teachers, as well as all principals, are receiving on-going professional development in mathematics content and instructional strategies that are resulting in success in this low-income district with large numbers of non-English speaking students. Keys to success are that this is a district-supported initiative that aligns K-12 mathematics instruction, encourages teacher reflective study, and gradually introduced the new reform curricula. Challenges include lack of teacher content knowledge and sound pedagogical practice related to that content. With district funds 22 teachers are now enrolled in a Masters of Arts in Teaching (MAT) in Mathematics. Data from the GMI are presented in Chapter 1 in the section entitled "One Bright Spot". <www.gisd.k12.nm.us/GMIWebsite/GMIHomepage.htm>

The Northern New Mexico Math and Science Academy (MSA) program was started in 2000 by the Northern New Mexico Council for Excellence in Education (NNMCEE) in partnership with the Los Alamos National Laboratory. In 2004-2005 the four MSA staff members are

working with over 70 teachers in 14 middle and elementary schools in five districts. It is "oriented towards coaching, mentoring, and problem solving; the cognitive coaching model, with multiple opportunities for reflection continues as centerpiece of MSA" (Osmundson & Herman, 2005, p. 38). <www.lanl.gov/education/teachers/mathsci.shtml>

MathStar New Mexico is part of a five year federal project funded through the Star Schools Program at the USDOEd (and is now in an extension/dissemination phase). Teachers in three states, California, Colorado, and New Mexico were provided with real life examples of excellent instructional practices through video streaming (i.e. broadcasting over the Internet), digital video disks, and other media to improve mathematics education in middle schools though the distribution of an innovative mathematics curriculum. The project was designed to improve middle school mathematics instruction by:

- helping teachers integrate technology to support content learning,
- implementing standards-based mathematics instruction,
- providing teachers with professional development opportunities, and
- establishing a community of learners who understand how to engage students in significant learning through the high quality use of educational technologies.

MathStar served as the basis of the developed of the Mathematically Connected Communities (MC^2) project and is perhaps best known for introducing the Lesson Study process into many school in New Mexico. <mathstar.nmsu.edu>

Improved Mentoring, Professional Development, and Recruitment of Educators for Secondary Science and Math (NSF Award #0433818, 2004-2008, $500,000) is the Robert Noyce Scholarship program at the University of New Mexico (UNM) which is recruiting and preparing 22 to 34 new science and mathematics teachers for Albuquerque Public Schools and the Bernalillo Public Schools. The program is administered through the College of Arts and Sciences and the Albuquerque Teachers Institute, a program in the College of Arts and Sciences that supports K-12 outreach activities. Recruitment efforts target departments with large numbers of STEM majors and the School of Engineering. A new interdisciplinary course, Teaching Environmental Science, provides early field experiences for undergraduate students to encourage science teaching as a career. Special efforts to mentor Noyce Scholars include Master Teacher Mentors and summer professional development programs offered through the Albuquerque Teachers Institute. The mentoring efforts are designed to help teachers through the difficult first years. The project's objectives include: 1) a 30 to 50% increase in the number of STEM teachers graduating from UNM; 2) an increase in the number of highly trained teachers in high need school districts; 3) greater visibility of teacher training programs to all STEM majors; 4) increased numbers of STEM students that consider teaching careers due to advertising and early field experiences through the Noyce program; 5) better retention of new teachers through improved mentoring activities; and 6) effective assessment of Noyce scholars and a comparison group of new teachers.

New Mexico Alliance for Minority Participation (NM AMP) (NSF Award #980223, 1998-2005; NSF Award #9353215, 1993-1998, $5,022,081) is designed to increase the enrollment and graduation rate of underrepresented ethnic minorities in science, technology, engineering and mathematics (STEM). Since its inception in 1993 the number of STEM degrees awarded has

more than doubled from 252 to 510, and the percent of degrees of STEM degree earned by underrepresented students has increased from 24% to 44%. <www.nmsu.edu/~nmamp>

Regional Alliance for Science, Engineering and Mathematics (RASEM^2) for Students with Disabilities (NSF Award # 0124198, 2001-2006, $3,197,433; NSF Award #98000298, 1998-2001, $903,980) has as its mission leveling the playing field for students with disabilities. RASEM^2 is providing the means, support and encouragement for students with disabilities to overcome the educational barriers they face in considering science, engineering, math and technology careers. RASEM^{2}recruits college students for the Mentor/Mentee program, conducts workshops for Teacher Outreach Program (TOP) and provides funding on a competitive basis for TOP and University partner projects. One of the goals of RASEM^2 recruiting efforts is to ensure that students who are recruited for STEM majors at the University level receive all of the necessary support to remain in the program of their choice. <rasem.nmsu.edu>

The NMSU Computer Science, Engineering, and Mathematics Scholarships (CSEMS) Program (NSF Award #0422518, 2004-2008, $395,992) is designed to support degree completion, the CSEMS program at New Mexico State University provides financial support to academically talented, financially needy students, improving their educational experience through activities that promote academic and professional excellence and workforce preparedness. Building on the state-wide partnership established in 1993 by the New Mexico Alliance for Minority Participation (New Mexico AMP) Program, CSEMS will offer scholarships to thirty transfer students and incoming freshmen. Additionally, the program offers the CSEMS Academic and Professional Experience (CAPE) that includes four important components: 1) academic tutoring, 2) academic and professional workshops, 3) discipline-specific faculty mentorships, and 4) research opportunities. CAPE complements a wide array of existing student support programs and services. Students are recruited for the program in collaboration with 1) existing mechanisms of New Mexico AMP, 2) the College of Engineering, 3) the College of Arts and Sciences Advising Center, and 5) the Financial Aid Office. Program selection will be based on financial need and academic merit, with first priority given to underrepresented students transferring from a New Mexico community college, second priority given to graduated high school seniors entering as freshmen in the targeted disciplines, and third priority given to currently enrolled NMSU students.

New Mexico Tribal Coalition – Rural Systemic Initiative (NMTC) (NSF Award #0100324, 2001-2005, $2,615,595), a program of the Santa Fe Indian School (SFIS), has partnerships and relationships with all 12 schools that it serves to assure a standards-based, inquiry-centered, K-12 mathematics and science education system that supports all learners in attaining success in vigorous, high-quality mathematics and science. In 1997, the Coalition of Educators for Native American Children (CENAC) was created to include all 12 schools that receive BIA funding and serve Pueblo Indian students. Through this coalition, CENAC maximizes its resources and addresses common problems. Teachers concerned about mathematics and science achievement in the CENAC schools created the proposal for NMTC. This approach assured that partnerships and buy-in were strongly in place before the grant began. After 400 years of active resistance, encouraging children to learn dominant culture academics will take time and concentrated effort. Community-based education (CBE) is an approach that answers these challenges and NMTC strives to move toward this method. The strands for successful CBE are three-fold: 1) tribal

leadership sets the focus for education each school year; 2) students have concrete experiences in Pueblo communities addressing this focus; and 3) students return useful information about the focus to the communities. In this way, it is the tribe, not an institution of the dominant culture, that sets the priorities, and students' cultural knowledge and learning styles are enhanced and validated. <www.tribalcoalition.org>

Reforming Math, Science and Technology Education in Northern NM (Northern Network RSI) (NSF Award #0100584, 2001-2006, $4.85 million) Lessons learned: This new project has already found that continual on-site mentoring and assistance to schools is a critical component of professional development and must be provided by top-quality teachers with strong content knowledge who must be prepared to function as mentors and coaches. Needs assessment to drive project implementation decisions must be on-going and projects must be flexible to adjust for changing conditions. Participant schools must be very aware of necessary commitments to be involved or change will be limited by staff turnover, particularly at the administrative level. Solutions which have the best chance of working usually emanate from those in the trenches, in collaboration with service providers. <northernnetwork.unm.edu/>

New Mexico Experimental Program to Stimulate Competitive Research (NM EPSCoR) (NSF Award #0132632, 2002-2005, $6,259,280; #0447691, 2005-2006, $2,250,000) fulfills this title by gathering resources and expertise from academic institutions, our national labs, private industry, and state and federal sources to benefit education, the environment, and the New Mexico economy. NM ESPCoR's education program focuses on multi-disciplinary place-based teaching and learning in the hydrologic and nanoscale sciences, engaging, challenging, and mentoring New Mexico students and teachers. <www.nmepscor.org>

APS Math Science Technology Partnership is a partnership with business and education to create a math science and technology system within Albuquerque Public Schools. One of its goals is to create a mathematics, science and technology high school and feeder middle and elementary school system using quality principles in education. The system will serve as a model for the district and the state. <www.mstp.org>

Math and Science Partnerships (MSPs) are funded by the NM Public Education Department with flow through dollars from the USDOEd. In 2004 two MSPs were funded in New Mexico: Mathematically Connected Communities (MC^2) at NMSU <mc2.nmsu.edu>, and La Meta at UNM <http://www.math.unm.edu/~umland/LaMeta/LaMeta.htm>. Those programs received continuation grants for 2005 and two new MSPs (at Western New Mexico University and San Juan College) were funded in collaboration with MC^2. All four MSPs offer summer academies for middle school mathematics teachers and follow-up support during the academic year. It is expected that there will be additional MSP funding for 2006.

The Center for Mathematics Education of Latinos/as (CEMELA) is an interdisciplinary, multi-university consortium focused on the research and practice of the teaching of mathematics to Latino/a students in the United States. CEMELA brings together experts in mathematics education, mathematics, language, and culture to collaboratively work on improving the mathematics education of low-income Latino/a students. CEMELA aims to understand the interplay of mathematics education and the unique language, social and political issues that

affect Latino/a communities. Partner universities in CEMELA are: The University of New Mexico; The University of Arizona; The University of California at Santa Cruz; and The University of Illinois at Chicago. <cemela.math.arizona.edu>

The Regional Educational Technology Assistance Program (RETA) is a statewide partnership that helps teachers and administrators integrate technology in the classroom. RETA also develops technology-based curricula and helps support teachers in preparing Professional Dossiers for the Three-Tier Licensure system. Having received over $8,000,000 in Technology Challenge Grant funds from the USDOEd, RETA now receives most of its funding from the state. <reta.nmsu.edu>

Strengthening Quality in Schools (SQS) is an initiative established by the Governor's Business Executives for Education (GBEE) to provide the expertise needed to develop a world class quality education system for New Mexico schools. SQS assists in improving a variety of aspects of education using Total Quality Management principles. The project provides the training, tools and support necessary for improvement of student performance. From 1992, SQS has completed Phases I,II, III, IV, and V involving over 1/3 of the state's school districts including partners from local community colleges, universities, businesses, and the Public Education Department. Currently in Phase VI, approximately 115 sites are participating in SQS during 2003-2004. <www.sandia.gov/sqs/>

Re:Learning New Mexico is committed to serve as a catalyst for change in order to develop self-renewing school communities by providing resources and processes for positive growth and modeling a culture for learning. Re:Learning New Mexico works with schools at three levels of commitment. Fully committed schools are provided access to a year-long institute for leadership development for principals, on-site collegial coaching and mentoring, training in research-based instructional strategies and curriculum design. Re:Learning also facilitates a strategic planning process based on its model for Building Exemplar Schools together (BEST). It includes gathering and analysis of student and community data, assessment of the current state of the school, planning and prioritizing strategies for ongoing improvement of program as well as student achievement. Schools at the middle range of commitment have access to some Re:Learning support in the above strategies as they are compatible with the schools' own strategic plans. At the lowest level of commitment, schools are given the opportunity for regional workshops and seminars on topics such as literacy, facets of understanding and other current topics of interest. Schools at all levels are invited to these regional trainings. Re:Learning New Mexico is a National Affiliate Center of the Coalition for Essential Schools. <www.relnm.org>

Past Projects

New Mexico Collaborative for Excellence in Teacher Preparation (NM-CETP) (NSF Award #9653973, 1997-2002, $5,515.021; NSF Award #0211314, 2002-2005, $600,000) - Lessons learned: At the universities in New Mexico, in general, change related to mathematics education appeared to be easier to achieve than change in science education indicating that, while mathematics may be the area in which to focus initially, more effort needs to be directed to science education. Although strong deans can sometimes "force" changes, they will be more sustainable if they come from the faculty and are supported by the dean. If you cultivate relationships with policy makers you can indeed be in a position to have an impact on policy

decisions. External funding can bring energetic personnel on board who help to sustain efforts once that external funding is gone. In a state-wide project, dispersing external funds to all major partners does indeed create greater commitment.

Navajo Nation Rural Systemic Initiative (NN-RSI) (NSF Award # 9813616, 1998-2005, $10,134,444) spun off from the earlier UCAN-RSI. The mission of the NN-RSI was to create a standards-based student centered teaching and learning environment in science, mathematics, technology (SMT) for approximately 70,000 K-12 students on or near the Navajo Reservation, most of whom come from families living below the Federal poverty level. The NN-RSI assisted schools in implementing a standards-based science and mathematics program by promoting a variety of instructional strategies and by assisting teachers to teach within the context of the cultural environment of Navajo students toward identified goals and objectives.

Fellows for the Advancement of Mathematics Education (New Mexico FAME) (Award #9250024, 1991-1995, $520,127) Professional development has lasting impact on individuals and a district when it is intensive and sustained. It was intensive in that elementary teachers took mathematics courses over 3 years which included two-week summer institutes and weekly evening meetings over a three year period with the focus of the classes was to increase teachers' content knowledge, pedagogical skills and understanding of students and to develop leadership skills. Many of the FAME teachers have become state and national leaders in math education. However, it only served a few teachers in three districts. Future grants should plan for participating districts to support the continuing work of the teacher leaders after the granting period.

Systemic Initiative in Math and Science Education (SIMSE) (Award #9250024, 1992-1997, $10 million) Lessons Learned: Through regional offices, SIMSE was able to draw upon local resources (local community colleges/universities, national labs, businesses and community outreach programs) to build the capacity of schools to provide more meaningful mathematics and science learning opportunities for students. By working with teachers and principals to analyze and assess the effectiveness of their school mathematics and science programs Math/Science Action Plans could be developed and implemented. School adoption of standards based curriculum is critical or many teachers will continue to rely primarily on traditional textbooks and the teaching of procedures. SIMSE enjoyed success in some schools and its efforts were supported by some districts. However, its summer institutes were not aligned in terms of content and standards statewide, and therefore there was not the widespread, long-term sustainability desired.

Utah, Colorado, Arizona, New Mexico Rural Systemic Initiative (UCAN-RSI) (Award #9554468, 1995-2001, $9.5 million) Lessons Learned: To implement sustainable institutional changes the following were necessary: finding a common vision in all the communities involved; developing informed, skilled leadership, both within the educational system and, more importantly, within the community; continuing to include even the less aggressive communities; moving changes into the classroom early on; understanding and working with the intricacies of the political processes in each independent community and working within these to accomplish our goals; and a dedication to respecting local culture, having a goal of inclusivity, and a mission of forming community-based partnerships. Consortia were created that still exist and help sustain new practices, but the problems that are rooted in long-term poverty are so serious that continued outside support is still necessary.

Appendix 4

Math and Science Professional Organizations

New Mexico has many professional organizations that dedicated to improving mathematics and science education in the state. Below are descriptions of some of them.

The New Mexico Partnership for Math and Science Education (NMPMSE)

NMPMSE is one of the main sponsor's for the New Mexico Math and Science Education Town Hall/Summit. The NMPMSE is an organization of individuals and institutions that are committed to improving the quality and the quantity of education in Science, Mathematics, Engineering, and other related fields in the state of New Mexico. It is affiliated with the National Association of State Science and Mathematics Coalitions (NASSMC). It was created in the early 1990s. It usually meets five times a year at open meetings. Meeting times and locations can be found at its website: web.nmsu.edu/~pscott/partner.htm.

The New Mexico Council of Teachers of Mathematics (NMCTM)

NMCTM is a state-level affiliate of the National Council of Teachers of Mathematics (NCTM). It was apparently created in the 1970w. It publishes a newsletter or small journal twice a year, and collaborates with the NMSTA and EEANM to sponsor the annual New Mexico Math and Science Conference. NMCTM maintains a website at education.nmsu.edu/nmctm/.

The New Mexico Science Teachers Association (NMSTA)

NMSTA's mission is to provide a network for educators throughout the state to work collaboratively towards improving science education from pre-kindergarten through college. The NMSTA assists classroom teachers by providing guidance and strategies through professional development opportunities the enhance science education". It is an affiliate of the National Science Teachers Association (NSTA). Resources for sciences teachers and information about the NMSTA listserv are available at its website: www.nmsta.org.

The Coalition for Excellence in Science and Math Education (CESE)

CESE "is composed of interested citizens throughout New Mexico and the nation, including scientists, engineers, educators, university faculty, members of the clergy, and parents. CESE is non-partisan and non-sectarian, and welcomes members of all religions and political philosophies. This coalition works to improve science education and science literacy for all citizens." CESE's first annual meeting was held in 1997 in the context of concerns over non-scientific influences on the state Science Standards. CESE serves as the Advisory Board for the NMPMSE. The CESE website is www.cesame-nm.org/.

The Environmental Education Association of New Mexico (EEANM)

EEANM is a nonprofit organization which provides, promotes, and enhances quality environmental education by offering New Mexicans opportunities for professional development, communication, and partnership. Its quarterly newsletter, *EE Connections*, is available at their website: www.eeanm.org/.

The New Mexico Academy of Sciences (NMAS)

NMAS "has been in continuous existence since 1915. The Academy is a member of the National Association of Academies of Science and an affiliate of the American Association for the Advancement of Science". It works with teachers, state agencies, and the legislature to establish appropriate standards for the teaching of the sciences. The Academy can also act as a resource center, providing scientific advice and expertise to these groups and others. More information is available at its website: www.nmas.org.

The Central New Mexico Local Section of the American Chemical Society

This New Mexico affiliate of the ACS has a membership of over 800 and serves members in the central and north region of the state. The Section sponsors awards at a number of Science and Engineering Fairs within the state and also collaborates with the New Mexico Academy of Science in recognizing two Outstanding Science Teachers each year. Its website is www.acs.nm.org/.

Appendix 5

Supplemental Educational Services

Table 1 – Schools Eligible for Supplemental Services (SES) in 2004-2005

District	School	Level	04-05 rating
Albuquerque	Atrisco	Elem	CA
Albuquerque	ErniePyle	Middle	R1
Albuquerque	Eugene Field	Elem	R1
Albuquerque	Lavaland	Elem	R1
Albuquerque	Mary Ann Binford	Elem	CA
Albuquerque	Valle Vista	Elem	R1
Albuquerque	Jimmy Carter	Middle	SI2
Albuquerque	Truman	Middle	R1
Albuquerque	Washington	Middle	R2
Belen	Belen	Middle	SI2
Bernalillo	Santo Domingo	Middle	R1
Central	Mesa	Elem	R2
Central	Nataani Nez	Elem	R1
Central	Newcomb	High School	CA
Central	Tse Bit Ai	Middle	R2
Cuba	Cuba	Elem	SI2
Cuba	Cuba	High School	R2
Dulce	Dulce	Elem	R1
Dulce	Dulce	High School	CA
Dulce	Dulce	Middle	CA
Espanola	Dixon	Elem	SI2
Espanola	James H. Rodriguez	Elem	CA
Espanola	Tony Quintana	Elem	R1
Espanola	Espanola Valley	High School	CA
Espanola	Carlos Vigil	Mid-High	CA
Espanola	Espanola	Middle	R1
Gadsden	Anthony	Elem	CA
Gadsden	Chaparrel	Middle	CA
Gadsden	Gadsden	Middle	CA
Gadsden	Santa Teresa	Middle	CA
Gallup-McKinley	Chee Dodge	Elem	R1
Gallup-McKinley	Church Rock	Elem	R2
Gallup-McKinley	David Skeet	Elem	R2
Gallup-McKinley	Navajo	Elem	R1
Gallup-McKinley	Ramah	Elem	CA
Gallup-McKinley	Rocky View	Elem	R1
Gallup-McKinley	Stagecoach	Elem	R1
Gallup-McKinley	Tobe Turpin	Elem	R1
Gallup-McKinley	Thoreau	High School	CA
Gallup-McKinley	Tohatchi	High School	R1
Gallup-McKinley	Gallup Jr. High	Middle	CA
Gallup-McKinley	JFKennedy	Middle	R2

Gallup-McKinley	Thoreau	Middle	R2
Grants-Cibola	Cubero	Elem	SI2
Grants-Cibola	Laguna-Acoma	Middle	R2
Los Lunas	Desert View Interm.	Middle	R1
Magdalena	Magdalena	Elem	CA
Mesa Vista	Ojo Caliente	Elem	SI2
Mesa Vista	Mesa Vista	Middle	SI2
Santa Fe	Edward Ortiz	Middle	R1
Zuni	Dowa Yalanne	Elem	CA
Zuni	Twin Buttes	High School	SI2
Zuni	Zuni	Middle	R2

Table 2 provides an overview of the services available to students, as described by the providers <sde.state.nm.us/fedpro/sess.html>.

Table 2: Approved SES Providers in New Mexico

Provider	Grade Levels & Geographic Area Served	Content Areas	Curriculum/Program Description
Acadamia.net	K-12 Statewide (Internet access needed)	Reading & Math	The curriculum is an individualized, interactive software program that allows children to work at their own pace. It is based on direct and individualized instruction through an immediate and ongoing criterion referenced assessment program. The initial assessment tests will pinpoint areas of weakness where we can then generate a customized curriculum for each child.
Advantage Tutoring Services	K-8 Statewide	Reading & Math	Individualized instruction follows the National Reading Panel and National Council of Teachers of Mathematics guidance, is informed by results from the pre-test, and is guided by on-going rubric assessments. Teachers, serving as tutors, employ best practices to help students increase achievement as measured against NM Content Standards.
African American Cultural Association-Community Academic Initiative Resources Center (C.A.I.R.)	3-9 Albuquerque Public Schools	Reading & Math	The C.A.I.R. Center uses a balanced literacy model for reading addressing phonemic awareness, vocabulary development, reading fluency and comprehension. Leveled text including African American Literature matched to the Student's reading level will be used along with an array of strategies to improve student performance. The Math curriculum uses methods of

			discussion and exploration of Math Concepts modeled after the TERC investigations model.
Club Z	K-12 Statewide	Reading & Math	Highly-interactive, personal instruction using the same tutor throughout the program to maximize the teacher/student relationship. Tutors use classroom curriculum with which the student is experiencing difficulty. For students below grade level, we use remedial approaches appropriate to the students' needs. In all cases, session-by-session activity/progress reviews with parents are conducted and require parent signature. Teacher interaction is sought whenever available. Course summaries are provided. Individual session reports are available.
Compass Learning	K-10 Statewide	Reading & Math	Proven, researched, and easy to use technology based program(s).
CompatibleLand	3-9 APS, Belen, Bernalillo, Cuba, Jemez Valley, Jemez Mountain, Los Lunas, Rio Rancho, and Santa Fe	Reading & Math	CompatibleLand uses A+LS CAI (computer assisted instruction) to deliver a curriculum of math, and English. This software system is approved by State of New Mexico and is aligned with State of New Mexico curriculum. Students work on self paced customized lesson plan. When a student has question, on-site tutors will work with the student to explain the lesson one-on-one.
E2020, Inc.	7-12 Statewide	Reading, Math, Science, Social Studies	The E2020 Virtual Classroom™ provides one-on-one core curriculum instruction emphasizing individual student progression and achievement.
Education Station, A Sylvan Partnership	K-12 Albuquerque Public Schools and Districts that can meet hardware requirements	Reading & Math	Reading and math programs focus on the unique needs of each student and give your child the skills they need to perform better on their tests. Education Station's instructional content and methods are aligned with state standards, as well as landmark educational research contained in The National Reading Panel. Our reading curriculum represents a balanced approach that includes the five essential elements of effective reading instruction: Phonemic Awareness, Phonics Instruction, Oral Language

			Development, Vocabulary Instruction and Comprehension. Furthermore, the Education Station math instructional content and methods include the six principles that are seen as high quality mathematics programs as defined by the National Council of Teachers of Mathematics. The eSylvan curriculum was modeled specifically after the curriculum used in the Sylvan Learning Centers for reading and mathematics remediation.
JRL Enterprises-ICanLearn.com	5-10 Statewide (specific hardware requirements)	Reading & Math	The ICanLearn Education Systyem Pre-Algebra to students is a self-paced learning environment that delivers 1:1 student to computer ratio. I CAN Learn utilizes a modified direct instruciton approach which includes a pre test, introduction to the lesson through real world problems, cintent presentation, individual and guided practices and a post test.
InSight Educational Services	K-12 Santa Fe	Reading, Math, Science, & Social Studies	InSight uses the Sequoia School curriculum, which has been administered to over 1,500 New Mexico K-12 students; it is hands-on, research-based and individualized. The average grade level increase is one year for every 40 hours of instruction. This curriculum was designed for students with learning disabilities or special needs and is also high interest to help students that are not motivated or have had poor educational experiences. It uses a variety of innovative materials to help students move quickly through skill mastery. An enrichment component for students that are gifted is also available. The curriculum complements the public schools' content standards.
International Chatroom, LLC	K-12 Dona Ana County, Luna County and Otero County	Reading, Math, & Language	Using the A+LS computer program, each student has a 1:7 student to computer ratio. The curriculum incorporates 822 lessons for grades 1-12. The program instructs students from beginning reading levels to more advanced reading skill utilizing a four step approach in each lesson: Study, Practice Test, mastery Test and Essay exercise. The Chatroom also offer

			individual and small group tutoring in math.
Lindamood-Bell Learning Processes	K-12 Statewide	Reading & Math	Uses four programs to stimulate and develop the brain functions necessary for literacy development: The Lindamood Phoneme Sequencing® (LiPS®) program and the Seeing Stars® (SI™) program to develop phonemic awareness, reading, fluency, and spelling, the Visualizing and Verbalizing® (V/V®) program to develop comprehension and critical thinking skills, and the On Cloud Nine® (OCN™) program to develop mathematical computation and reasoning.
Newton Learning, A Division of Edison Schools	K-8 Statewide	Reading & Math	Offers project-based, hands-on and always reflect research-based Best Practices. Newton Learning Curriculum Teams have crafted the curriculum to support the New Mexico Academic Standards. Lessons are designed to be interactive, to stimulate thinking, and to help improve overall student motivation and achievement. Focus Mini-lessons align with state standards and standardized tests to allow students the opportunity to practice necessary skills while teachers track students' monthly progress toward their individual goals. Newton Learning teachers receive quality materials to deliver consistent curriculum and benefit from ongoing Professional Development.
The One Room School House	K-8 Statewide	Reading & Math	The core of our program uses high quality reasearch based curriculum developed by certified teachers. Lessons are aligned with New Mexico's standards and benchmarks to help achieve maximum student success. Our program targets the five mandatory components of a sucessful reader. They are: phonemic awareness, vocabulary development, phonics, reading fluency, and reading comprehension strategies.
PLATO Learning, Inc. (formerly Lightspan)	K-8 Statewide	Reading/Math	Provides face-to-face tutorial services to designated students in small group settings using the standards-based reading, language arts, and mathematics CD-ROM PLATO Learning Achieve

			Now® curriculum as augmentation. The blueprint for the design of these tutoring services is the individual Student Tutorial Plan, which will facilitate two to four hours of direct services for two per week in an after-school setting.
Princeton Review	3-12 Statewide (districts must accommodate minimum number of students)	Reading & Math	A skill remediation course that is aligned to New Mexico state standards.
Rio Grande Educational Collaborative	K-9 APS, Belen, Bernalillo, Los Lunas, and Rio Rancho	Reading, Math, Language Arts, Science, Social Studies, and ELL	All programs are aligned with Balanced Literacy Model; speaking, listening, presenting, writing, reading and viewing. These components drive instruction for all academic disciplines within the child's regular school day Afterschool teachers and tutors utilize the math model in use in the regular classroom
Santa Fe Public Schools-After School Program	K-8 Santa Fe	Reading & Math	Using the Achieve Now cmputer program (No curriculum description provided)
TESCO	6-8 APS, Belen, Gadsden, Los Lunas, Las Cruces, Hatch, Alamorgordo	Reading & Math	Customized curriculum designed to achieve approved parent-student achievement objectives.
Tutor.com	7-12 Statewide (hardware and Internet requirements)	Reading & Math	Provide on-line and cmputer based enrichment and remediation in math and reading (No curriculum description provided)
Youth Development, Inc.	K-12 Statewide	Reading, Math, & Writing	Instructional delivery is based upon the National Reading Panels's Report of identified Best Practices in Phonemic Awareness, Phonics & Word Study, Fluency, Comprehension and Vocabulary. Oral Language Development and literacy are the focal points of individualized instruction. Proven best practices in mathematics are also implemented.
Zuni Public Schools	K-12 Zuni	Reading & Math	One -on-one tutoring where reading and math skills are remediated and enriched (No curriculum description provided)

Appendix 6

Report on Mathematics and Science Education Funders

(A special thank you to Jessica Venable at NASSMC for providing this information.)

Toshiba America Foundation <www.toshiba.com/taf/index.html>

The mission of Toshiba America Foundation is to contribute to the quality of science and mathematics education in U.S. communities by investing in projects designed by classroom teachers to improve science and mathematics education for students in grades K thru 12. Total giving: $506,490.

American Honda Foundation <corporate.honda.com/america/philanthropy.aspx?id=ahf>

Through a program of responsible investment (of contributions funds) in organizations meeting the needs of the American society in the areas of youth and scientific education, the American Honda Foundation strives to assist in deriving long term benefits for the communities in which it operated and the society as a whole. In 2004, the foundation awarded over $23,000 to NMSU. Total giving: $1,350,206.

AT&T Foundation <www.att.com/foundation/guidelines.html>

The AT&T Foundation supports K-12 and higher education. Accredited public and private elementary and secondary schools, accredited public and private two- and four-year institutions of higher education, and educational nonprofit organizations are eligible for consideration. The AT&T Foundation awards grants by invitation to education projects that focus on: (1) Improving the quality of teaching and learning through the effective use of technology; (2) Developing workforce skills for the IT industry; (3) Advancing diversity in education and the workplace, especially in the fields of science, math, engineering and technology. Total giving: $18,228,630.

Intel Foundation <www.intel.com/community/grant.htm>

Our primary giving focus is education; we have strong interest in supporting K-12/higher education and community programs that deliver the kind of educational opportunities that all students will need to prepare themselves to succeed in the 21st century. Intel vigorously supports education through grants for programs that advance science, math and technology education, particularly for women and underserved populations. Grants are made to NM-based organizations. Total giving: $34,301,543.

GE Foundation <www.gefoundation.com>

The foundation supports higher education initiatives that focus on increasing access to opportunities for success for people currently underrepresented in the areas of engineering, information technology, and business areas where minorities and women have been traditionally underserved. The foundation is particularly interested in efforts that: a) link with K-12 efforts to strengthen students' math skills and interest in these careers; and b) result in lasting impact through professional development, curricular change, and other means. Total giving: $50,847,173.

The Nicholas C. Metropolis Mathematics Foundation
54 Wildflower Way
Santa Fe, NM 87506

The foundation provides scholarships to students in the field of mathematics, sponsors and promotes workshops and seminars for high school teachers in the field of mathematics. It may also facilitate the use of visiting scholars to perform research and/or train at LANL or at various universities or other places of research or education.

Dreyfus Foundation Special Grant Program in Chemical Sciences <www.dreyfus.org/sg.shtml>

The Foundation encourages proposals that are likely to significantly advance the chemical sciences. Examples of areas of interest are (but are not limited to): the increase of public awareness, understanding and appreciation of the chemical sciences; environmental chemistry; innovative approaches to chemistry education; and programs to make chemistry careers more attractive. Total giving (foundation-wide): $4,995,035.

Bill and Melinda Gates Foundation <www.gatesfoundation.org/Education/>

Through its partnerships in communities across the nation, the foundation is committed to raising the high school graduation rate and helping all students - regardless of race of family income - graduate as strong citizens ready for college and work. Areas include: 1) Increasing U.S. Graduation and College-Readiness Rates: The foundation is committed to significantly increasing the high school graduation rate for all students and increasing the percentage of students who graduate prepared for college. 2) Scholarship Programs: The foundation is dedicated to reducing financial obstacles that prevent many students from fulfilling their potential. Scholarship programs include the Washington State Achievers Scholarship Program, Gates Millennium Scholars Program, and Gates Cambridge Scholars Program. 3) Research and Evaluation: Research and evaluation are essential components of the foundation's work in education. Total giving: $1,261,110,000.

GenCorp Foundation <www.gencorp.com/pages/gcf_philedu.html#>

The highest priority is to support of all levels and types of education, particularly: (1) Programs designed for K-12, including those that emphasize mathematics and science; and (2) Colleges and universities that support and encourage excellence in mathematics, science and engineering. Total giving (2003/Education): $346,359. Contact: Socorro, New Mexico; Lorraine Valencia; (505) 835-2070.

Hewlett-Packard Company Foundation <www.hp.com/go/grants>

HP's educational initiatives focus on three major areas: (1) Transforming the learning experience: Integrating technology into classrooms to revolutionize teaching and learning processes. (2) Leading students to high-tech careers: Increasing the number of students on paths toward high-tech careers, emphasizing groups that are underrepresented in the technology sector. (3) Student success in key subjects: Enhancing skills in math, science and engineering through national and district-wide school reform and teacher professional development. HP in the U.S. does not accept unsolicited requests for grants. Total giving: $1,160,000.

IBM International Foundation <www.ibm.com/ibm/ibmgives/grant/index.shtml>

Through major initiatives such as Reinventing Education, the IBM KidSmart Early Learning Program, and IBM MentorPlace, IBM is working to raise student achievement and enhance academic productivity to support thriving communities around the globe. Total giving: $10,209,092.

W. M. Keck Foundation <www.wmkeck.org/index.html>

The W.M. Keck Foundation established the Science and Engineering Program with the objective to support innovative undergraduate instruction in these fields as well as leading university research programs and interdisciplinary projects. Total giving: $52,211,210.

Richard Lounsbery Foundation <www.rlounsbery.org/default.asp>

The Richard Lounsbery Foundation aims to enhance national strengths in science and technology through support of programs in the following areas: science and technology components of key US policy issues; elementary and secondary science and math education; historical studies and contemporary assessments of key trends in the physical and biomedical sciences; and start-up assistance for establishing the infrastructure of research projects. Total giving: $2,617,145.

Motorola Foundation <www.motorola.com/content/0,,5120-8165,00.html>

Motorola supports systemic and continuous improvements in schools at all grade levels, concentrating on mathematics, science, and engineering, especially for under-represented groups. Total giving: $9,078,537.

SBC Foundation <www.sbc.com/gen/corporate-citizenship?pid=2560>

The foundation supports: 1) K-12 and higher education initiatives that improve and strengthen the education process; 2) programs that support strategic change in K-12 education that can be linked to improved student achievement; 3) programs that support at-risk students and parental involvement in student progress; and 4) prominent public or private colleges and universities in collaborations with K-12 organizations that improve teacher preparedness, expand education technologies, promote excellence in math, science, and engineering, support minority student success, and further education reform approaches. Total giving: $45,607,108.

Alfred P. Sloan Foundation <www.sloan.org/programs/index.shtml>

Programs to strengthen education in science and technology, to increase interest in these fields, and to understand and communicate to others the nature of careers in these fields have long been supported by the foundation. Increasingly important are opportunities presented by electronic technologies for learning outside the classroom. This program is divided into the following sections: 1) Education for Scientific and Technical Careers; 2) Increasing Ph.D.s For Underrepresented Minorities; 3) Promoting Women in Science and Engineering; 4) Other Programs for Women and Minorities; 5) Retention of Students in Higher Education; and 6) Public Understanding of Science and Technology. Total giving: $59,727,832.

Appendix 7

Acronym List

ARPA-E – Advanced Research Project Agency-Energy

AAAS – American Association for the Advancement of Science <www.aaas.org/>

AFT – American Federation of Teachers <www.aft.org/>

AISES – American Indian Science & Engineering Society <www.aises.org/>

AIR – American Institutes for Research <www.air.org>

AMS – American Mathematical Society <www.ams.org>

AP – Advanced Placement <www.collegeboard.com/student/testing/ap/about.html>

APS – Albuquerque (Alamogordo and Artesia) Public Schools <ww2.aps.edu/>

ARISE – American Renaissance in Science Education <www-ed.fnal.gov/arise/fnal_arise.shtml>

ATI – Albuquerque Teachers Institute <www.unm.edu/%7Eabqteach/>

BHEF – Business-Higher Education Forum <www.bhef.com>

BSCS – Biological Sciences Curriculum Study <www.seti-inst.edu/education/vtt-overview.html>

CBMS – Conference Board of Mathematical Sciences <www.cbmsweb.org>

CESE – Coalition for Excellence in Science and Math Education <www.cesame-nm.org/>

CLT – Centers for Teaching & Learning
<www.nsf.gov/funding/pgm_summ.jsp?pims_id=5465&org=NSF&from=fund>

CMP – Connected Mathematics Project <www.math.msu.edu/cmp/index.html>

DARPA – Defense Advanced Research Project Agency

DOE – Department of Energy

DOEd – Department of Education <www.ed.gov>

DMI – Developing Mathematical Ideas <www2.edc.org/CDT/dmi/dmicur.html>

EDC – Education Development Center <main.edc.org/>

ENMCMSE – Eastern NM Center for Math & Science Education

ENMERC – Eastern NM Educational Resource Consortium <www.edgate.com/>

ENMU – Eastern New Mexico University <www.enmu.edu/>

EPSCoR – Experimental Program to Stimulate Competitive Research <www.nsf.gov/div/index.jsp?div=EPSCOR>

EPSS – Educational Plan for Student Success

FACETS – Foundations & Challenges to Encourage Technology-based Science

FOSS – Full Option Science System <www.lawrencehallofscience.org/foss/>

GMI – Gadsden Math Initiative <www.gisd.k12.nm.us/board.htm>

HED – Higher Education Department (formerly Commission on Higher Education) <hed.state.nm.us/>

IMP – Interactive Mathematics Program <www.mathimp.org/>

ITP – Innovative Technology Partnerships <www.itpnm.com/index.htm>

LANL – Los Alamos National Laboratory <www.lanl.gov/>

LESC – Legislative Education Study Committee <legis.state.nm.us/lcs/lesc/lescdefault.asp>

LFC – Legislative Finance Committee <legis.state.nm.us/lcs/lfc/lfcdefault.asp>

LOL – Lenses on Learning

MAA – Mathematical Association of American <www.maa.org>

MESA – Math, Engineering & Science Achievement <www.nmmesa.org/>

MSP – Math and Science Partnerships <www.nsf.gov/funding/pgm_summ.jsp?pims_id=5756&org=NSF>

NASA – National Aeronautics and Space Administration <www.nasa.gov/externalflash/exp12_front/index.html>

NASSMC – National Alliance of State Science and Mathematics Coalitions <www.nassmc.org/>

NCTM – National Council of Teachers of Mathematics <www.nctm.org/>

NEA – National Education Association <www.nea.org/index.html>

NMAC – New Mexico Administrative Code <www.nmcpr.state.nm.us/nmac/>

NMACC – NM Association of Community Colleges <www.nmacc.org/>

NMCTM – NM Council of Teachers of Math <education.nmsu.edu/nmctm/>

NMHU – New Mexico Highlands University <www.nmhu.edu/>

NMMNHS – NM Museum of Natural History and Science <museums.state.nm.us/nmmnh>

NMPMSE – NM Partnership of Math Science Education <web.nmsu.edu/~pscott/partner.htm>

NMSTA – NM Science Teachers Association <www.nmsta.org/>

NMSU – New Mexico State University <www.nmsu.edu/>

NMTA – NM Teacher Assessments <www.nmta.nesinc.com/>

NNMC – Northern New Mexico College (formerly Northern New Mexico Community College) <www.nnmcc.edu/>

NNMCEE – Northern New Mexico Council for Excellence in Education <education.lanl.gov/NNMCEE/>

NNMNRE – Northern NM Network for Rural Education <northernnetwork.unm.edu>

NSF – National Science Foundation <www.nsf.gov/>

NSRC – National Science Resource Center <www.nsrconline.org/>

NSTA – National Science Teachers Association <www.nsta.org/>

PEC – Public Education Commission (formerly NM State Board of Education) <www.ped.state.nm.us/pec/index.html>

PED – Public Education Department (formerly State Department of Education (SDE)) <www.ped.state.nm.us>

PF – Physics First <www-ed.fnal.gov/arise/index.html>

REC – Regional Education Cooperative

RETA – Regional Educational Technology Assistance <reta.nmsu.edu/>

RSI – Rural Systemic Initiative

SLC – Science of Learning Center

SNM SEMAA – Southern NM Science, Engineering, Math, and Aerospace Academy <education.nmsu.edu/projects/semaa/>

SNMERC– Southeastern NM Educational Resource Center <www.snmerc.org/>

SSMA – School Science and Mathematics Association <www.ssma.org/>

STC/MS – Science and Technology Concepts for Middle Schools™ <www.stcms.si.edu/>

STEM – Science, Technology, Engineering and Mathematics

TIMS – Teaching Integrated Mathematics and Science Project <www.math.uic.edu/~imse/IMSE/TIMS/tims.html>

UCSMP – U of Chicago School Math Project <socialsciences.uchicago.edu/ucsmp/>

UNM – University of New Mexico <www.unm.edu/>

WNMU – Western New Mexico University <www.wnmu.edu/>

WSTF – White Sands Test Facility <www.wstf.nasa.gov/>

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