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ABSTRACT

The Nevada Department of Education has joined with the Council of Chief State School Officers' cooperative effort to develop and report a system of indicators to track progress toward the state and national goals of improving mathematics and science education. This report combines the data resulting from this cooperative effort with other information and with norm-referenced measures of student achievement in order to provide an initial glimpse of the condition of science and mathematics education in Nevada's public schools. Four broad categories of indicators derived from various sources are reviewed: (1) student achievement indicators; (2) proportion of students taking advanced placement examinations and the proportion receiving a passing score; (3) instructional time and student participation in science and mathematics courses; and (4) teacher preparation in mathematics and science subject areas. The indicators of the status of math and science education used in the present study suggest that Nevada has made progress over the last 4 years, but still has areas needing improvement. (JRH)

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INDICATORS OF SCIENCE AND MATHEMATICS EDUCATION IN NEVADA

SCHOOL YEAR 1993-94

David Lawson Smith

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INDICATORS OF SCIENCE AND MATHEMATICS EDUCATION IN NEVADA

SCHOOL YEAR 1993-94

David Lawson Smith

August, 1996

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Executive Summary

The present study is the third in a series of reports on the findings of a cooperative effort between the Nevada Department of Education and the Council of Chief State School Officers to implement a system of indicators of progress in math and science education. Also, the present study includes achievement information from the Nevada Proficiency Examination Program and teacher information from the National Center for Education Statistics. Findings for School Year 1993-94 are reported here.

At the elementary school level, the results indicate that the State's public elementary schools, as a whole, do a good job in providing quality math and science education to Nevada's students. Among the major findings in this regard are:

- On the average, Nevada school children in grade four scored higher than national norms in mathematics competency tests.
- Statewide, there were slightly fewer Nevada fourth graders than would be expected in lower achievement groups on mathematics competency tests and more than expected in the higher achievement groups. There was considerable variability between districts in this regard.
- The amount of time spent on mathematics in Nevada's elementary schools compared well with other states, as did the amount of time spent on science education in grades 4-6.
- The amount of time spent on science education in grades 1-3 was relatively low.

At the middle school level, the findings include:

- Nevada's eighth graders scored higher than national norms in mathematics competency tests with fewer students than expected in lower achievement groups and more students than expected in higher achievement groups.
- Ninety-two percent of seventh graders and 89 percent of eighth graders in Nevada were enrolled in mathematics classes compared to national seventh and eighth grade percentages of 91 and 94, respectively. However, 37 percent of Nevada's eighth graders were enrolled in enriched math classes or algebra 1 (national = 31 percent), and 23 percent of seventh graders were enrolled in accelerated math classes

(national = 15 percent).

- Only 64 percent of seventh and eighth graders were enrolled in science courses in Nevada, compared to 79 percent nationally.

At the high school level (grades 9-12), there were a number of improvements over the previous reports. These include:

- Although somewhat below national percentages, the percentage of Nevada students tested for advanced placement exams in calculus and science has increased substantively. The percentage of Nevada students achieving qualifying (passing) scores in both areas also has increased.

- Over the last two years, Nevada enrollment in mathematics courses increased by five percent to 83 percent (national = 86 percent).

- Nevada has risen to the top (+95 percent) states from their previous position in the bottom five among states studied four years ago in the percentage of students projected to have taken first year biology by graduation.

- As in the previous study two years ago, female students were well represented in the percentages of students taking initial classes in formal mathematics. In this year's study, however, female percentages increased in trigonometry from 44 percent to 50 percent and in calculus from 36 percent to 43 percent.

- As in the previous study, female students were well represented in the percentages of students taking biology and chemistry classes. However, in this year's study, female enrollment in physics 1 rose from 40 to 44 percent and in physics 2 rose from near zero to 18 percent.

While the improvements at the high school level are encouraging, there are a number of indications that reflect less favorably on high school student outcomes in math and science education in Nevada. Such findings include:

- Considerably lower percentage of Nevada students (31 percent) taking upper level (beyond algebra 1) formal mathematics classes than the national percentage (39 percent). This placed Nevada thirty-seventh among the 38 states, District of Columbia, and Puerto Rico studied.

- A lower percentage of Nevada high school students (73 percent) were enrolled in science classes than the national percentage (80 percent).

Twenty-three percent were enrolled in upper level (beyond biology 1) science courses (national = 26 percent).

- Nevada's estimated enrollment in advanced mathematics courses are below the national estimated enrollment percentages. Although Nevada has risen in the last four years from only 33 percent to 44 percent in students projected to have taken algebra 2 by graduation, this does not compare well to an estimate of 60 percent nationally. The projected estimate of course taking for Nevada in calculus is five percent (national = 10 percent), in geometry is 52 percent (national = 65 percent), and in trigonometry is 28 percent (national = 33 percent).

- Nevada's estimated enrollment in advanced science courses by graduation are below the national estimates. The Nevada estimates for first year chemistry is 45 percent (national = 51 percent) and for first year physics is 17 percent (national = 22 percent).

In terms of Nevada's science and mathematics teacher preparation, findings included:

- Only 34 percent of Nevada secondary teachers with primary assignment in science courses had college degrees in a science area or in science education. The national percentage was 69 percent of secondary teachers with primary assignment in science courses. In similar statistics for mathematics, Nevada's percentage was 57 percent and the national percentage was 61 percent.

- The large majority of high school mathematics and science teachers in Nevada have met the State's requirements for teaching in those areas, and, in each area, the percent of teachers with certification was above the national percent of certified teachers (see *Figure 8*).

- In Nevada, a teacher may get a minor area certification to teach a class, e.g., mathematics, with only 16 college credits. In mathematics, this was the lowest credit requirement among 36 states reviewed. This requirement will be raised in the near future to 24 credits in a minor area.

Indicators of Science and Mathematics Education in Nevada

One of the six national goals proposed for American education by the year 2000 is for U.S. students to be first in the world in science and mathematics achievement. The Nevada Department of Education (NDE) has joined with the Council of Chief State School Officers' (CCSSO) cooperative effort to develop and report a system of indicators to track progress toward state and national goals of improving mathematics and science education. The present report combines the data resulting from this cooperative effort with other information and with norm-referenced measures of student achievement in order to provide an initial glimpse at the condition of science and mathematics education in Nevada's public schools.

Four broad categories of indicators derived from various sources are reviewed here. First, student achievement indicators were taken from the 1993-94 school year results of the statewide assessment program. Results are reported here from the mathematics portion of the Comprehensive Test of Basic Skills (CTBS/4) required of all fourth and eighth grade students in Nevada. Also reported are the results of the mathematics section of the Nevada High School Proficiency Examination, a test given to all eleventh grade students as a requirement for high school graduation in Nevada. Unfortunately, similar information on students' achievement in science education is not available since there is no comparable statewide testing of science achievement. (For the reading and language/writing proficiency results, see Klein, 1995.)

A second set of indicators is the proportion of students taking advanced placement examinations and the proportion receiving a passing (qualified) score. This information is provided by the College Board as reported in Blank and Gruebel (1995).

The third set of indicators involve instructional time and student participation in science and mathematics courses. Elementary class time spent on science and math is taken from the results of the National Center for Educational Statistics' 1991 Schools and Staffing Survey as reported by Blank & Gruebel (1993). Student enrollment patterns in Nevada's secondary science and mathematics education courses for the 1993-94 school year are derived from the data reported to CCSSO by NDE and comparative information from other states as reported by CCSSO (Blank & Gruebel, 1995).

The procedure for data collection on secondary enrollment was initiated in Fall, 1993 when NDE staff sent a data request to individual school districts in Nevada for a list of math and science courses offered, the number of classroom periods each course was offered, and the enrollment by sex of student in each course. The returned list of courses was coded using standard definitions

provided by CCSSO. Science courses were categorized according to content area, and mathematics courses were categorized according to level. For grades 9-12 mathematics courses, there were three categories (review, informal, and formal mathematics) with levels for each category. In the formal mathematics category, for example, levels one, three, and five were most often algebra 1, algebra 2, and calculus, respectively.

Finally, indicators involving teacher preparation in mathematics and science subject areas were derived from results of the Schools and Staffing Survey as reported by Blank and Gruebel (1995) and from data regarding teacher assignments reported to CCSSO by NDE.

Student Achievement in Mathematics

Nevada uses the Comprehensive Test of Basic Skills (CTBS/4) for testing the academic proficiency of students in grades four and eight. Since the CTBS/4 is a norm-referenced test, it is possible to compare the performance of Nevada students to a national reference group on the mathematics section of the examination. The present report will discuss the mathematics achievement scores on the CTBS/4 in terms of mean Normal Curve Equivalence (NCE) scores and stanines.

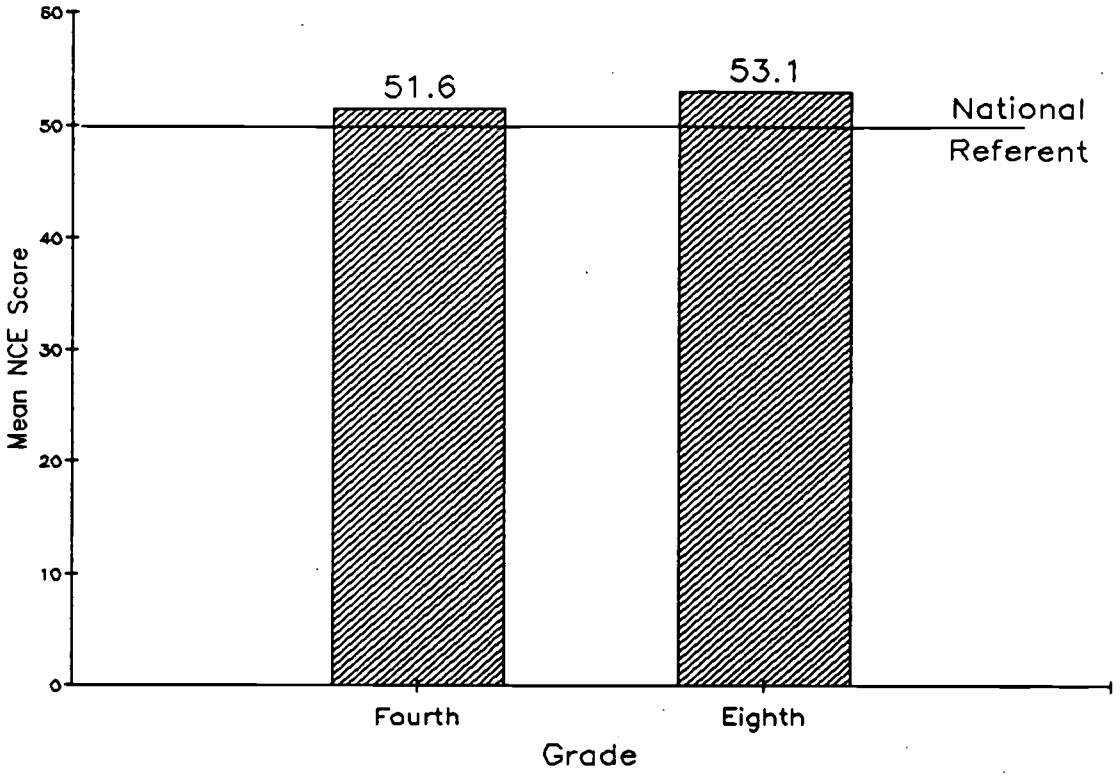
For NCE scores, the scores of the reference group are transformed into a normal (bell-shaped) distribution with a mean, or average score, of 50. Thus, a reported mean NCE score over 50 is above the national group's average and an average percentile under 50 is below the national group's average. *Figure 1* illustrates the results for Nevada students on the mathematics section of the CTBS/4 for school year 1993-94. In terms of mean NCE scores, Nevada public school students, as a group, fared somewhat better than the national reference group at both grades.

Tables 1-2 (third column) provide mean NCE scores on the mathematics section of the CTBS/4 for each of the county school districts in Nevada. Mean NCE scores among the school districts ranged from 44 to 60.7 for fourth grade and 41 to 63 for eighth grade. Nine of the 17 districts in Nevada averaged above the national reference mean of 50 on the fourth grade mathematics section of CTBS/4. The number of districts averaging above the referent mean rose to 10 of the 17 districts at the eighth grade level.

Stanines form a scale that divides a range of scores into nine groups, with the first stanine being the lowest scoring group (lowest four percent of scores), the ninth being the highest (four percent) scoring group, and the fifth stanine being average (the middle 20 percent of scores). Stanines are clustered here in groups of three: LOWER (stanines 1-3), MIDDLE (stanines 4-6), and UPPER (stanines 7-9) scoring groups. The cutoff scores that separate

Figure 1

Statewide Mean Normal Equivalence Scores
Comprehensive Test of Basic Skills/4
Mathematics Section, 1993-94



the three groups are determined by the scores that break the national referent group into the three stanine groups such that the MIDDLE group contains the middle 54 percent of reference scores and twenty-three percent of the reference group's scores fall within each of the LOWER and UPPER groups. **Ideally, one would like to see the percentages of Nevada students in the LOWER, potentially at-risk, group under the 23 percent expected and, at the same time, above the 23 percent expected in the UPPER scoring group.**

The statewide and district-level percentages of Nevada students falling within each of the three clusters are provided in the last three columns on the right in *Tables 1-2*. As can be seen from the **Statewide** rows on each of these tables, the percentage of Nevada public school students in the LOWER scoring group was lower than would be expected if they were performing at the level of the national reference group, and, conversely, there was a higher percentage of Nevada public school students in the UPPER achievement group. This is especially true at the eighth grade level.

Table 1. **GRADE 4 district-level results in mean NCE scores and stanine clusters for mathematics section of CTBS/4, School Year 1993-94.**

	Number Tested	Mean NCE Score	Percentage of 4th Grade Students in: Lower Group (Stanines 1-3)	Middle Group (Stanines 4-6)	Upper Group (Stanines 7-9)
(Referent)*		(50.0)	(23.0)	(54.0)	(23.0)
Statewide	17107	**51.6**	**22.8**	**51.8**	**25.3**
Carson City	534	44.0	24.8	60.3	15.0
Churchill	298	49.0	20.8	57.3	21.8
Clark	10519	51.3	23.3	51.3	25.4
Douglas	488	54.0	18.1	55.8	26.2
Elko	657	52.4	19.8	56.2	24.0
Esmeralda	14	49.4	21.4	71.4	7.1
Eureka	21	56.0	19.0	47.6	33.3
Humboldt	283	48.0	20.5	56.2	23.3
Lander	123	58.0	9.8	62.7	27.6
Lincoln	66	56.0	24.2	40.9	34.9
Lyon	372	49.0	25.5	53.8	20.7
Mineral	85	54.0	27.1	41.1	31.8
Nye	250	49.0	25.2	55.6	19.2
Pershing	68	48.0	20.6	64.7	14.8
Storey	37	60.7	21.6	37.8	40.5
Washoe	3176	54.0	22.8	49.5	27.9
White Pine**	116	47.1	-----	-----	-----

*Expected mean score and expected percentage of students within each cluster of stanines based on national sample.

**White Pine County did not provide a frequency distribution report.

Of the 16 districts reported in *Tables 1-2*, seven districts at the fourth grade and six districts at the eighth grade level demonstrated this ideal pattern of both lower than expected percentages of students in the low scoring group and higher than expected percentages of students scoring in the high scoring group.

Table 2. **GRADE 8 district-level results in mean NCE scores and stanine clusters for mathematics section of CTBS/4, School Year 1993-94.**

	Number Tested	Mean NCE Score	Percentage of 8th Grade Students in: Lower Group (Stanines 1-3)	Middle Group (Stanines 4-6)	Upper Group (Stanines 7-9)
(Referent)*		(50.0)	(23.0)	(54.0)	(23.0)
Statewide	**15604**	**53.1**	**19.6**	**52.6**	**27.8**
Carson City	512	48.0	23.3	54.1	22.7
Churchill	258	59.0	10.9	53.2	36.0
Clark	9378	55.0	19.0	49.5	31.5
Douglas	509	54.0	15.4	55.0	29.5
Elko	573	50.5	18.9	60.6	20.6
Esmeralda	15	54.0	26.6	40.0	33.3
Eureka	30	49.0	26.7	43.3	30.1
Humboldt	246	47.0	22.8	57.7	19.5
Lander	84	63.0	7.2	51.2	41.7
Lincoln	87	53.0	22.9	49.4	27.6
Lyon	359	47.0	26.0	56.9	17.3
Mineral	86	55.0	11.6	62.8	25.6
Nye	281	46.0	24.6	58.4	17.0
Pershing	65	41.0	37.1	55.4	7.7
Storey	31	49.2	9.7	83.8	6.4
Washoe	2936	50.0	20.9	58.2	21.0
WhitePine**	154	51.3	-----	-----	-----

*Expected mean score and expected percentage of students within each cluster of stanines based on national sample.

**White Pine County did not provide a frequency distribution report.

Testing on the mathematics section of the CTBS/4 is not required beyond the eighth grade level. Beyond that examination, mathematics achievement is measured statewide by the Nevada High School Proficiency Examination. In the 1993-94 school year, 85.8 percent of the 12,047 juniors

passed the mathematics section. The percentage passing the mathematics section is lower than in 1991-92 by 0.7 percent. By the senior year, the percentage passing the mathematics section of the Proficiency Examinations in each district is over 90 percent. On the annual school accountability reports for 1993-94, eight of the 16 districts with secondary schools reported 100 percent of seniors passing the mathematics section of the exam.

Advanced Placement Examinations

Tables 3 and 4 allow comparisons between states on the percentages of students taking advanced placement (AP) examinations in calculus and science (biology, chemistry, or physics), the percentage of exam-takers who receive a qualified (passing) score, and the percentage of females taking the examination. The statistics are based upon information provided by Blank and Gruebel (1995) from the College Board, and include both public and private students. Nationally, about 80 percent of AP exams are taken by public school students.

The percentage of Nevada twelfth graders taking the AP exams in mathematics and in science in 1993-94 were below the national percentages. The percentage of Nevada twelfth graders taking the advanced placement exam in calculus increased from two percent in 1991-92 to three percent in 1993-94. The Nevada percentages taking the AP science exam increased from one percent to three percent. Compared to 1991-92, the percent of Nevada female examinees increased in mathematics and remained the same in science.

The percentage of Nevada test-takers receiving qualifying scores in mathematics was above the national percentage and in science was below the national percentage. However, the percentage increases in Nevada from 1991-92 in both areas were notable. The percent receiving qualifying scores in mathematics rose from 66 percent to 70 percent. In science, the percentage rose from 41 percent to 55 percent.

Elementary Class Time on Science and Mathematics

Using data from the Schools and Staffing Survey of 1991, Blank and Gruebel (1993) report state-by-state comparisons on elementary class time spent on science and mathematics. Class time spent on science in grades 1-3 ranges from 2.0 hours per week (Hawaii, Massachusetts) to 4.2 hours (South Carolina). The figure reported for Nevada is 2.3 hours per week, up from 1.9 reported in 1988 but under the national average of 2.6 hours per week and low enough to place Nevada in a two-way tie with Kansas for 41th among the fifty states and the District of Columbia. By grades 4-6, the range of class time

Table 3. Percentages of students taking AP examination in calculus, 1994.

STATE	% of Grade 12	% Qualified Score	% Female Examinees
Dist. of Columbia	9	78	47
Utah	8	79	38
New York	8	69	46
Massachusetts	7	76	43
Maryland	7	73	45
New Jersey	7	72	43
Virginia	7	64	49
Delaware	7	62	47
South Carolina	7	60	51
Hawaii	6	79	47
Connecticut	6	77	43
California	6	73	45
Florida	6	62	47
North Carolina	6	61	52
Georgia	6	52	48
Indiana	6	42	43
Illinois	5	73	46
New Hampshire	5	50	49
Michigan	4	73	45
Colorado	4	72	44
Rhode Island	4	70	39
Vermont	4	63	48
Texas	3	73	45
Wisconsin	3	71	39
Nevada	3	70	43
Wyoming	3	70	43
Pennsylvania	3	68	46
Arizona	3	68	44
Ohio	3	68	43
Alaska	3	67	48
Tennessee	3	67	45
Maine	3	55	46
Alabama	3	54	47
New Mexico	3	49	44
Iowa	2	79	38
Idaho	2	75	39
Oregon	2	75	33
Missouri	2	73	44
Washington	2	72	39
Oklahoma	2	71	41
Minnesota	2	69	47
Nebraska	2	69	42
Kentucky	2	54	48
West Virginia	2	49	47
North Dakota	1	84	35
South Dakota	1	79	40
Kansas	1	75	46
Louisiana	1	63	42
Arkansas	1	63	41
Montana	1	62	41
Mississippi	1	52	50
National	**4**	**68**	**45**

Adapted from Blank & Gruebel (1995).

Table 4. Percentages of students taking AP examination in science, 1994.

STATE	% of Grade 12	% Qualified Score	% Female Examinees
Dist. of Columbia	13	69	43
New York	10	73	45
Utah	9	74	38
New Jersey	9	71	42
Delaware	8	72	47
Hawaii	7	76	42
Massachusetts	7	73	41
Connecticut	7	72	43
Maryland	7	69	44
Illinois	6	74	41
California	6	67	43
Virginia	6	67	43
South Carolina	6	54	54
North Carolina	6	51	53
Georgia	6	43	47
Florida	6	37	45
Indiana	6	29	45
Vermont	5	74	52
New Hampshire	4	79	37
Michigan	4	71	42
Colorado	4	67	46
Rhode Island	4	65	40
Pennsylvania	4	64	41
Arizona	4	56	46
Tennessee	3	65	44
Ohio	3	63	43
Alaska	3	61	49
Maine	3	60	38
Nevada	3	55	47
New Mexico	3	54	45
Alabama	3	49	47
Kentucky	3	42	52
Oregon	2	74	38
Idaho	2	73	36
Washington	2	71	41
Missouri	2	68	44
Wisconsin	2	65	37
Oklahoma	2	60	38
Texas	2	58	40
West Virginia	2	51	43
North Dakota	1	74	47
Iowa	1	74	27
Montana	1	71	34
Nebraska	1	67	39
Minnesota	1	66	42
South Dakota	1	65	38
Kansas	1	65	31
Louisiana	1	62	47
Arkansas	1	58	45
Wyoming	1	58	45
Mississippi	1	43	53
National	**5**	**64**	**44**

Adapted from Blank & Gruebel (1995).

spent on science increases slightly from 2.3 (Connecticut) to 4.3 (North Dakota) hours per week. In Nevada, 4 hours per week is reported as spent on science in grades 4-6, above the national average of 3.1 hours per week and high enough to place Nevada third among the forty-nine states with sufficient respondents for a reliable estimate.

The time spent on mathematics/arithmetic in grades 1-3 ranges from 4.3 (Iowa/Wisconsin) to 5.7 (Tennessee) hours per week. Nevada is reported to spend 5.5 hours per week in grades 1-3 on mathematics/arithmetic, tied for sixth overall with West Virginia and well above the national average of 4.9 hours per week. In grades 4-6, the time spent on mathematics/arithmetic ranges from 3.8 (Mississippi) to 5.5 (Illinois) hours per week. Nevada is reported to spend 5.2 hours per week on mathematics/arithmetic in grades 4-6, more than the national average of 4.8 hours per week and tied for sixth with six other states among the 49 states reported.

Science and Mathematics Enrollments in Grades 7 and 8

Data was collected by NDE on the level of mathematics and science being taught in the seventh and eighth grade. As noted in a previous report (Smith, 1993), to complete a five course college preparatory mathematics sequence ending in calculus by high school graduation, students usually must take algebra 1 in eighth grade. Further, Blank and Gruebel (1993) cite evidence that mathematic achievement scores and level of high school attainment in mathematics is related to mathematic course work taken in the eight grade.

Eighty-nine percent of eighth graders in Nevada are enrolled in a mathematics course compared to the national figure of 91 percent among the 33 states, Puerto Rico, and the District of Columbia reporting. Both figures are down from those reported in 1992 (Nevada = 96 percent; National= 95 percent). However, 37 percent of Nevada's eighth graders are enrolled in enriched math classes or in algebra 1, an increase over 1992, compared to 31 percent nationally. Twelve states reported higher percentages of students enrolled in advanced mathematics courses in the eighth grade. In the seventh grade, 92 percent of students are enrolled in mathematics courses in Nevada, somewhat below the national figure of 94 percent. However, of these seventh grade students, 23 percent are enrolled in accelerated math classes compared to a national figure of 15 percent. Both figures are increases over 1992. Eight states reported higher percentages of enrollment in seventh grade accelerated mathematics courses. For Nevada statewide and district-level results, see *Table 5*.

Grades seven and eight were combined in analyses of science course enrollments. Roughly 64 percent of Nevada's seventh and eighth graders were

Table 5. **Percent of Grade 7-8 students taking accelerated mathematics and enriched/algebra 1, School Year 1993-94.**

School District	Grade 7 Accelerated Math	Grade 8 Enriched/Algebra1
National	15%	31%
Statewide	**23%**	**37%**
Carson City	----	12%
Churchill	37%	77%
Clark	24%	19%
Douglas	29%	99%
Elko	16%	72%
Esmeralda	----	----
Eureka	----	----
Humboldt	21%	31%
Lander	----	95%
Lincoln	----	----
Lyon	----	34%
Mineral	----	----
Nye	8%	18%
Pershing	----	----
Storey	23%	26%
Washoe	27%	76%
White Pine	37%	70%

enrolled in a science course. Unlike the findings for mathematics course enrollment above, this finding does not compare well with the national figure of over 79 percent of seventh and eighth grade students enrolled in science courses. Indeed, compared to national figures, Nevada students were under-represented in each area of seventh and eighth grade science, except physical science. The national figures were 35 percent in general science, 20 percent in life science, 15 percent in earth science, 9 percent in physical science, and an

undetermined percent in integrated science since too few states reported in this category. Nevada's figures were 24 percent in general science, six percent in life science, four percent in earth science, 29 percent in physical science, and one percent in integrated science. See *Table 6.*

Much of the difference between Nevada and national figures in total science enrollment appears to be accounted for by lower science enrollments

Table 6. **Percent of Grade 7-8 students taking courses in various areas of science, School Year 1993-94.**

District	General	Life	Earth	Physical	Integrated	TOTAL
National	35%	20%	15%	9%	*	79%
Statewide	**24%**	**6%**	**4%**	**29%**	**1%**	**64%**
Carson	91%	----	----	----	----	91%
Churchill	----	50%	48%	----	----	98%
Clark	----	2%	----	46%	----	48%
Douglas	13%	43%	43%	----	----	99%
Elko	16%	48%	38%	----	----	102%
Esmeralda	100%	----	----	----	----	100%
Eureka	93%	----	----	----	----	93%
Humboldt	92%	----	2%	----	----	94%
Lander	----	54%	----	44%	----	98%
Lincoln	92%	----	----	----	----	92%
Lyon	90%	----	----	----	----	90%
Mineral	92%	9%	----	----	----	101%
Nye	85%	----	----	----	----	85%
Pershing	----	46%	54%	----	----	100%
Storey	100%	----	----	----	----	100%
Washoe	74%	----	----	----	5%	79%
White Pine	----	45%	----	50%	----	95%

in Nevada's two largest districts, especially in Clark County. All but one of the smaller districts have over 90 percent of total enrollment in science classes, and all are above the national percentage.

High School Enrollments in Science and Mathematics

Actual enrollments for fall, 1993 indicate that 83 percent of Nevada public school students in grades 9-12 were enrolled in mathematics courses, compared to a 38 state, Puerto Rico, and District of Columbia total of 86 percent of all students in grades 9-12. The Nevada enrollment is five percent higher than in fall, 1991.

Review Mathematics courses include remedial, consumer/vocational, and general mathematics. *Informal Mathematics* courses include pre-algebra and basic geometry classes. *Formal Mathematics* courses contains five levels of classes. They are, by level: 1) algebra 1, 2) geometry, 3) algebra 2, 4) trigonometry/pre-calculus, and 5) calculus/AP calculus. Nevada had a higher percentage of students enrolled in review (16 percent) and informal (13 percent) mathematics than the national totals (13 and 12 percent, respectively), and a lower percentage of students enrolled in formal mathematics (54 percent) courses than the national percentage (61 percent). Twenty-three percent of Nevada's students in grades 9-12 were enrolled in algebra 1 in 1993-94, compared to the national average of 22 percent. For state percentages taking upper level mathematics (formal mathematics courses beyond algebra 1), see *Figure 2*.

Table 7 contains statewide and district-level results for mathematics course enrollments in Nevada public high schools. The percentages of 9-12 grade students enrolled in mathematics classes ranged from 58 percent in Lincoln County School District to 95 percent in Lander County School District. For 9-12 grade enrollments in upper level mathematics courses, the percentages range from 15 percent in Lincoln County School District to 48 percent in Lander County School District. Churchill County School District had the largest percentage (36) of high school students enrolled in review and informal mathematics courses.

In the two year period since the last report, Nevada's high school enrollment in science courses was relatively stable at nearly 73 percent for the 1993-94 school year. The Nevada figure is compared to a 38 states, District of Columbia, and Puerto Rico total of 80 percent of high school students enrolled in science courses. The national figure rose from 75 percent in 1991-92.

Twenty-four percent of Nevada's public high school students were enrolled in introductory science courses, 26 percent were enrolled in first year

Figure 2

Percent of Grade 9-12 Students Taking Upper Level Math Courses, SY 1993-94

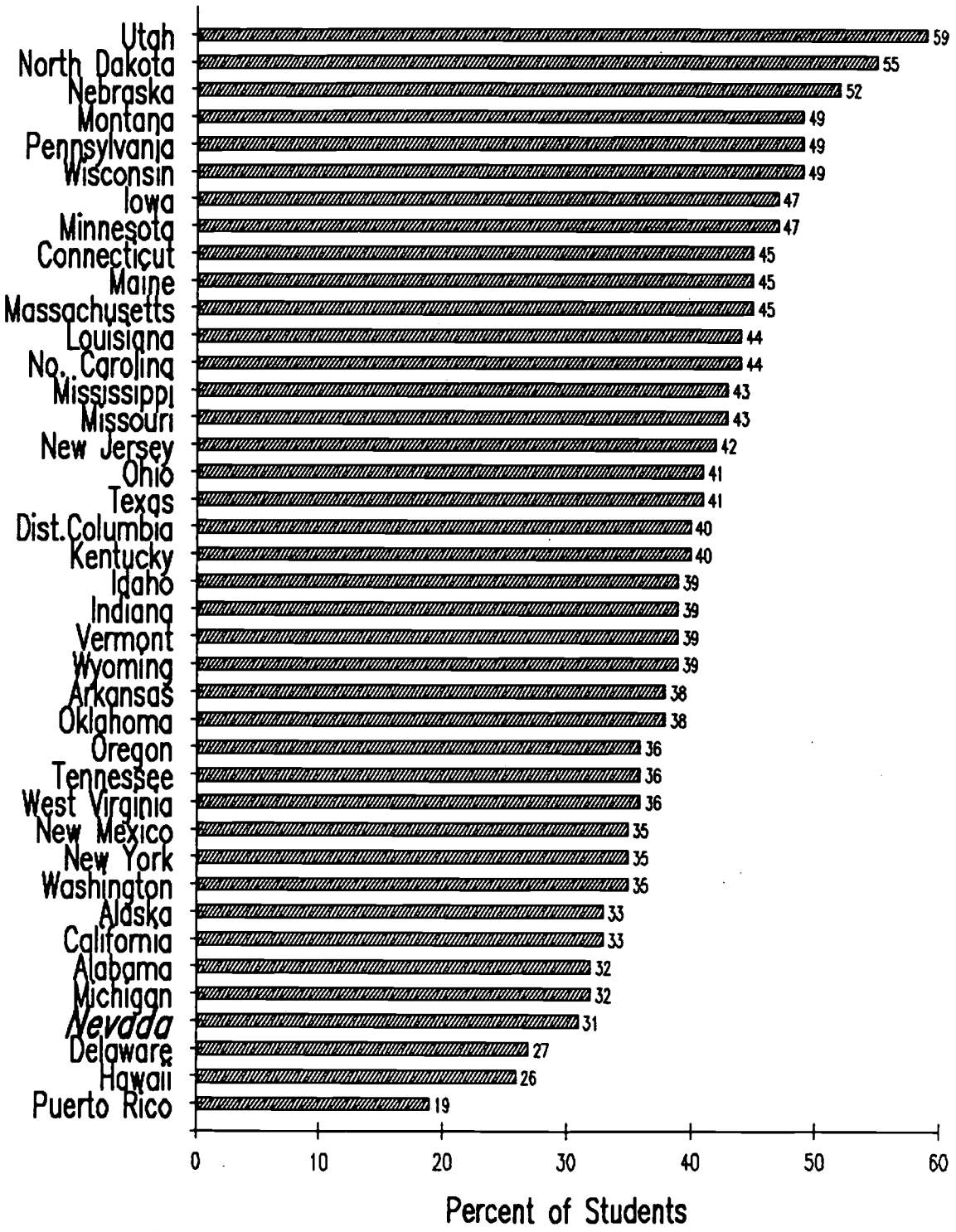


Table 7. **Percent of Nevada students in grades 9-12 taking mathematics courses, School Year 1993-94.**

School District	Percent of 9-12 Grade Students Taking Mathematics: Total	Upper Level	Algebra 1	Review & Informal
National	86	39	22	25
Statewide	**83**	**31**	**23**	**29**
Carson City	79	38	23	17
Churchill	92	39	16	36
Clark	82	31	22	29
Douglas	85	45	22	18
Elko	77	30	23	23
Eureka	79	45	15	19
Humboldt	86	24	36	26
Lander	95	48	24	23
Lincoln	58	15	17	26
Lyon	73	26	26	22
Mineral	82	26	23	32
Nye	82	28	21	33
Pershing	81	34	26	21
Storey	94	43	28	23
Washoe	79	36	23	20
White Pine	82	34	19	29

Upper Level are courses at Formal Math Levels 2-5 (e.g., geometry, algebra 2, trigonometry, calculus). Review & Informal are courses in remedial, general, and applied math, pre-algebra and basic geometry.

biology, 23 percent were enrolled in upper level science (i.e., chemistry, physics, and advanced/second year science courses). *Table 8* provides statewide and district-level science enrollments. Total school district enrollment in science courses ranged from a low of 58 percent of high school students in Douglas County to a high of over 100 percent in Eureka County. Eureka County School District also had the highest high school enrollment in upper level science courses (39 percent), while Nye County had the lowest enrollment (18 percent). White Pine County School District had the highest Biology I

Table 8. **Percent of Nevada students in grades 9-12 taking science courses, School Year 1993-94.**

School District	Percent of 9-12 Grade Students Taking Sciences: Total	Upper Level	Biology 1	Introductory
National (38 states)	80	26	26	28
Statewide	**73**	**23**	**26**	**24**
Carson City	85	23	36	27
Churchill	82	36	33	13
Clark	74	23	28	23
Douglas	58	27	18	13
Elko	67	22	22	23
Eureka	107	39	26	42
Humboldt	80	22	20	38
Lander	67	20	28	19
Lincoln	60	23	19	19
Lyon	75	25	31	20
Mineral	71	30	30	11
Nye	78	18	31	28
Pershing	76	30	35	10
Storey	84	24	18	42
Washoe	67	20	21	25
White Pine	74	25	39	9

Upper Level are first year chemistry or physics courses or advanced or second year science courses. Introductory are first year earth, physical, environmental, or general science courses.

enrollment at 39 percent and Douglas and Storey Counties had the lowest Biology I enrollment (18 percent).

Projected High School Enrollments in Science and Mathematics Courses

Based upon enrollments in mathematics courses in grades 9-12 in

Nevada during fall, 1993, it is estimated[1] that 92 percent of Nevada's public high school students will have taken an algebra 1 (i.e., a Formal Math Level 1) course by graduation. This figure is below the estimated 95+ percent nationally taking algebra 1 by graduation.

Likewise, Nevada's estimated enrollment in advanced mathematics courses are below the national estimated enrollment percentages. Although Nevada has risen from only 33 percent in 1989 to 44 percent in 1993 for high school students projected to have taken an algebra 2 (Level 3) course by graduation, this does not compare well to an estimate of 60 percent nationally. For state estimates on algebra 2 enrollment by graduation, see *Figure 3*.

Five percent of Nevada's high school students are estimated to have taken a calculus (Level 5) course by graduation. The national estimate is that 10 percent will have taken a calculus course by graduation. Fifty-two percent of Nevada students are projected to have taken geometry by graduation, and 28 percent are estimated to have taken trigonometry. The national estimates for geometry and trigonometry are 65 and 33 percent, respectively. These estimates suggest that Nevada's students are not taking their share of formal mathematics courses.

In the sciences, as in 1991, it is estimated that Nevada is tied at the top with a number of states with 95+ percent of public high school students taking first year biology by graduation. The estimate for chemistry is not as high, however. Forty-five percent of Nevada high school students are projected to have taken a first year chemistry course by graduation compared to 51 percent of high school students estimated nationally. For state estimates on chemistry enrollment by graduation, see *Figure 4*. An estimated 17 percent of Nevada high school students are projected to have taken a first year physics course by graduation compared to a national estimate of 22 percent of high school students. The figures for Nevada in chemistry is up two percent and in physics is down one percent over the 1991 estimates of enrollment by graduation.

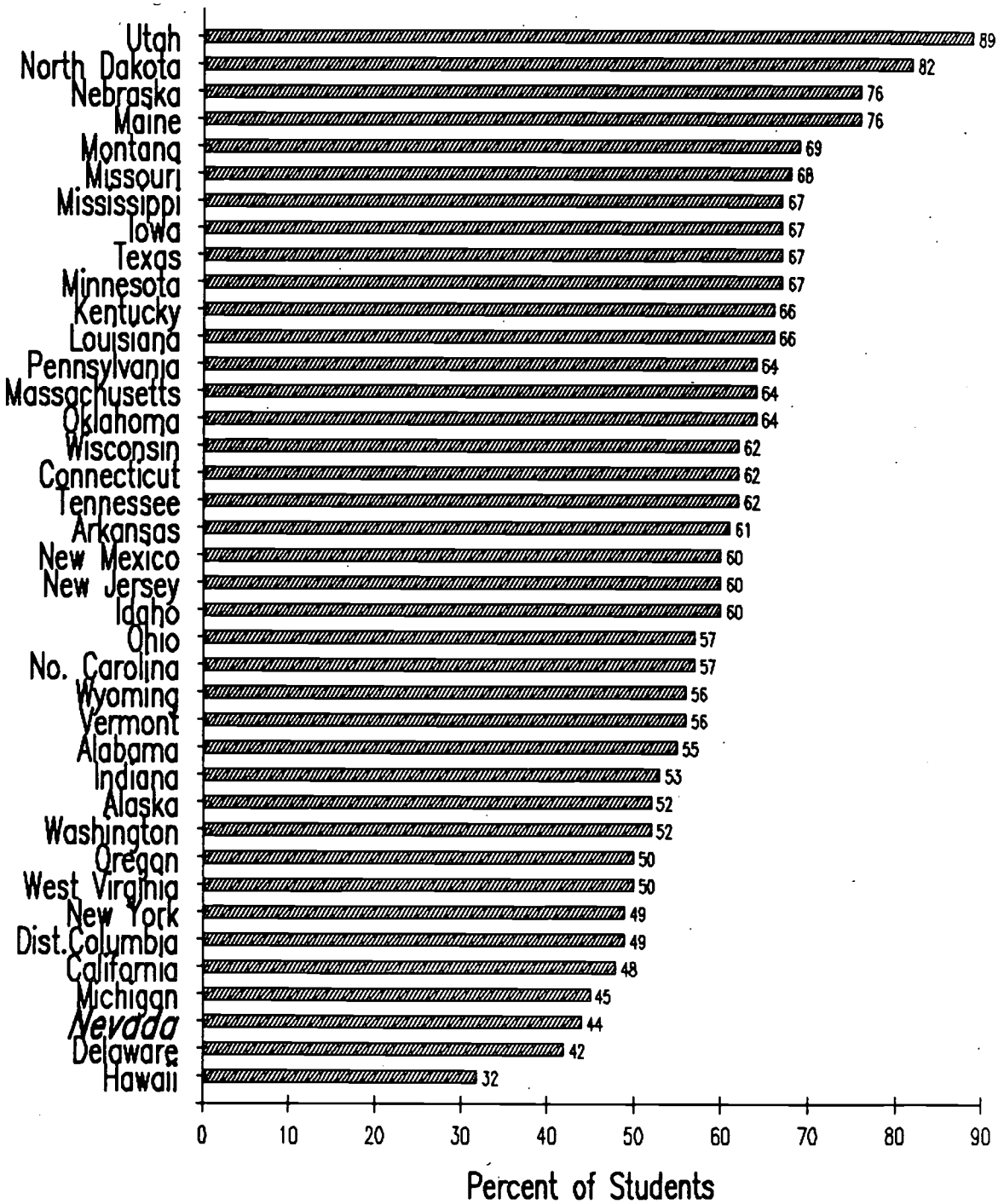
High School Science and Mathematics Enrollments by Sex of Student

Women's under-representation in much-needed technical careers that require advanced training in science and mathematics has been the subject of

[1]The percentages provided in this section are statistical estimates of course taking of Nevada high school students by the time they graduate. Their computation is based on the total course enrollment for Nevada in grades 9-12 as of Fall, 1993 divided by the estimated number of students in a grade cohort during four years of high school. The estimating method is imprecise above 95 percent. For greater discussion of rationale behind selection of this estimation method and for the actual formula used in computation, see Blank and Gruebel (1995), pp. 130-131.

Figure 3

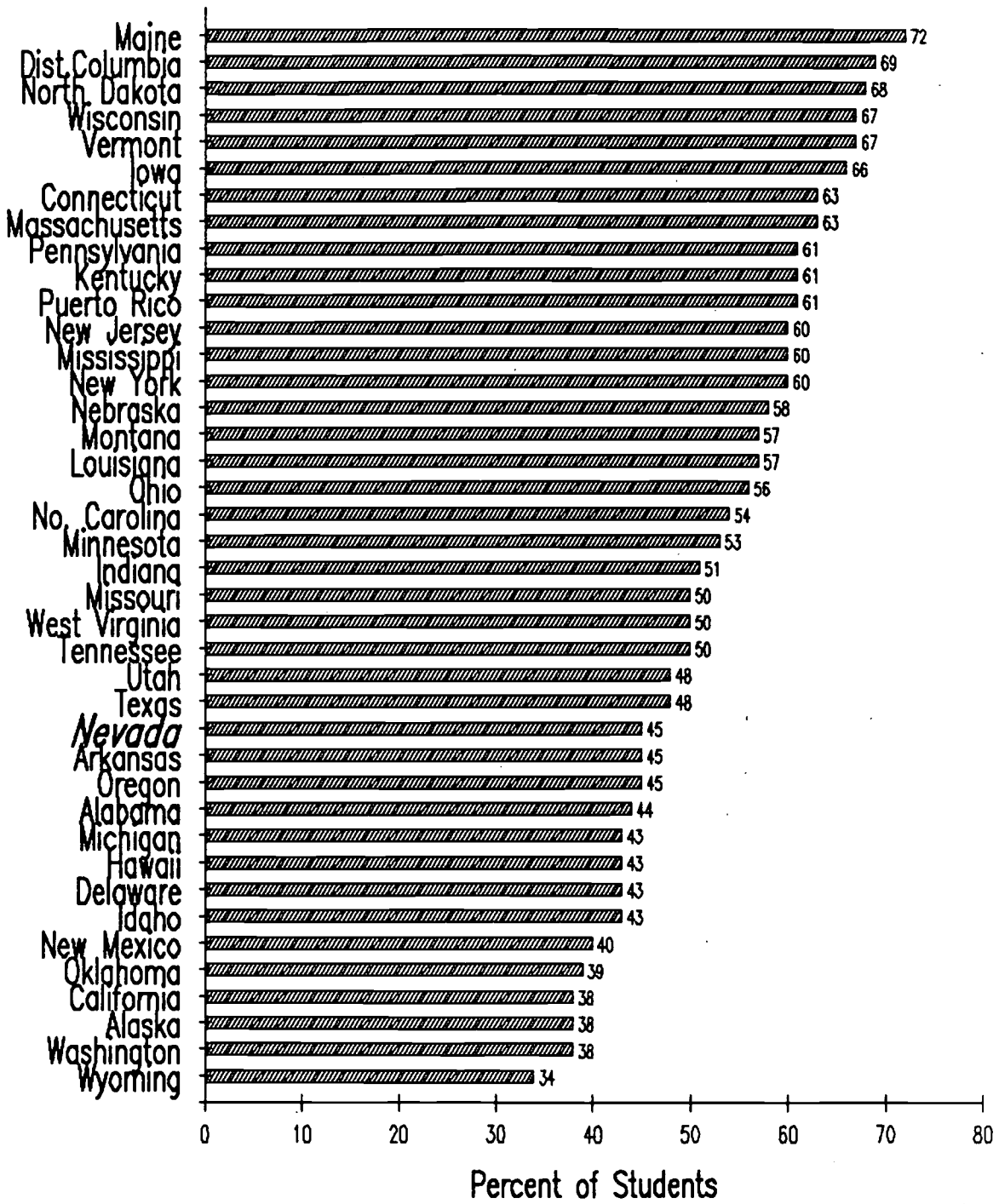
Estimated Percent of Public High School Students Taking Algebra 2 by Graduation



Adapted from Blank & Dalkilic (1995) by permission.

Figure 4

Estimated Percent of Public H. S. Students Taking 1st Year Chemistry by Graduation



Adapted from Blank & Dalkilic (1995) by permission.

considerable research interest (e.g., Friedman, 1989; Linn & Hyde, 1989; Maple & Stage 1991). Perhaps the most significant variable in women's decision to pursue a specific field of study has been the mathematics and science courses taken in high school (Ethington & Wolfe, 1988). Female enrollment traditionally has dropped as the level of science or mathematics courses increases. This finding is supported in the original math/science report in 1989-90 in Nevada. However, the present study indicates changes in female enrollment percentages in advanced science and mathematics courses for 1993-94 in Nevada.

Figure 5 and *Figure 6* illustrate changes from 1989-90 to 1993-94 in female enrollments in formal mathematics and formal science courses in Nevada. As in the first study, higher number of females enrolled in the first three levels of courses in mathematics. In 1993-94, more females than males enrolled in algebra 1, geometry, and algebra 2. In the last two levels of mathematics courses, however, there were some changes in 1993-94. A little over half of the enrollments in trigonometry were female. The six percent increase in female enrollments in trigonometry was the largest increase between 1990 and 1994 reported by any of the 19 states that indicated male/female enrollments (Blank & Gruebel, 1995). Calculus enrollments rose from 36 percent female to 44 percent female.

Figure 5

Percentage of Women Enrolled in Nevada's Secondary Mathematics Classes 1989-90 to 1993-94

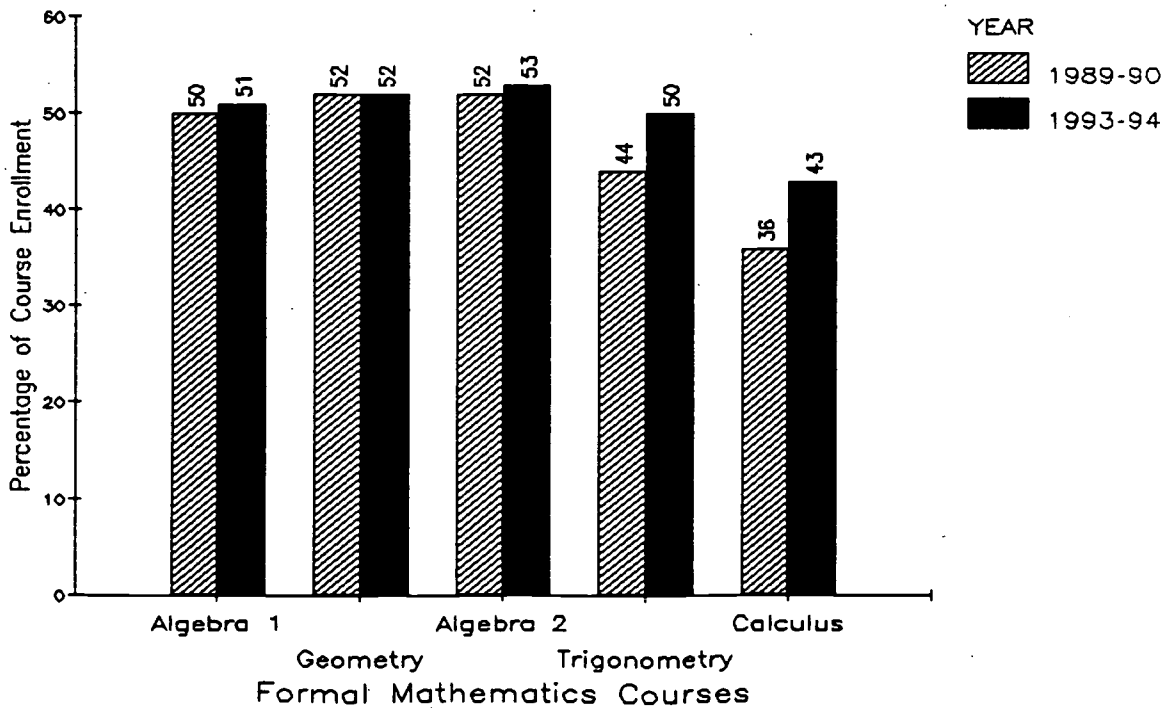


Figure 6

Percentage of Women Enrolled in Nevada's Secondary Science Classes 1989-90 to 1993-94

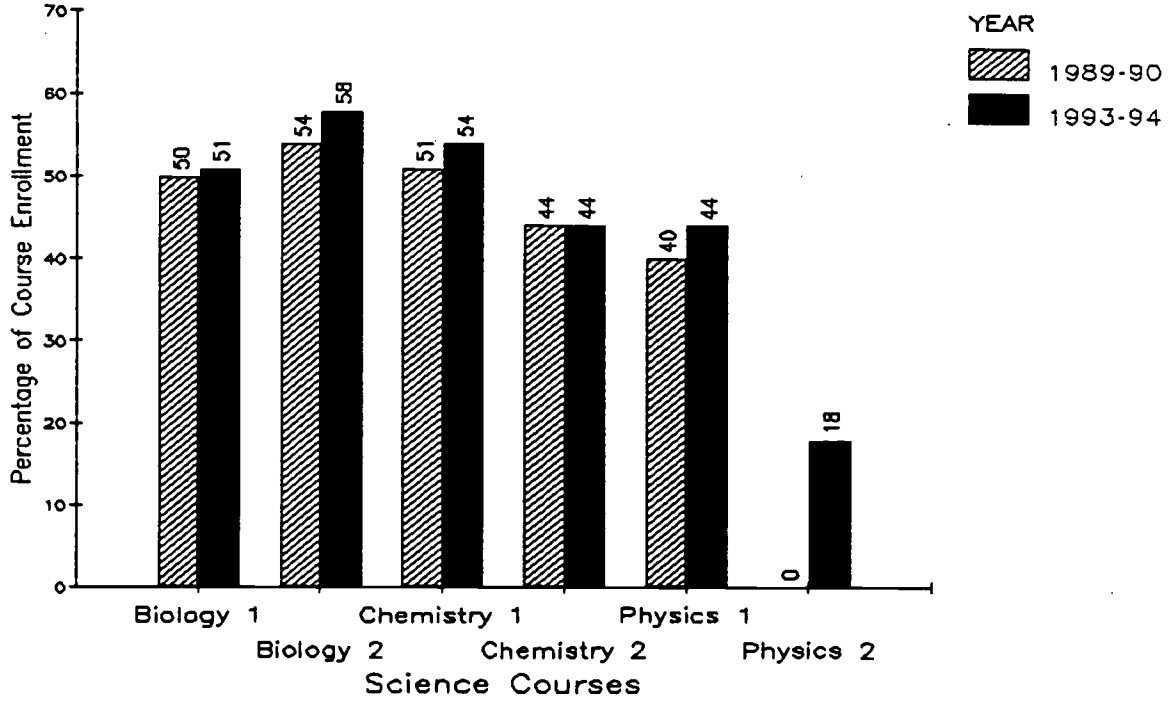


Figure 6 indicates that the female majority in enrollments in biology 1, biology 2, and chemistry 1 increased in 1993-94. The percentage of female enrollment in chemistry 2 did not change over the four years, but there were increases in the percentages of women in physics courses. Although the 1993-94 percentages of females in the advanced science courses do not appear to be as high as in the advanced mathematics courses, the *increases* for female enrollment in the physics courses over the four years are substantial.

Indicators of Current Teacher Preparation

Blank and Gruebel (1995) note that the changing standards in mathematics and science education call for a change in teaching to "emphasize active learning by students, deep understanding of concepts, and developing skills in problem-solving and reasoning" (p. 47). One implication of current changes in standards is that teachers need considerable in-depth knowledge of their fields. Although there are no direct measures of teachers' knowledge and skills for comparison with changing standards, indicators of the educational and professional background of secondary mathematics and science teachers may provide relevant, initial information.

One relevant indicator is the percentage of secondary mathematics and science teachers with mathematics/mathematics education and a science/ science education majors in college. The most recent state-by-state information comes from the Schools and Staffing Survey (National Center for Education Statistics, 1993). *Figure 7* provides a comparison of Nevada and national statistics for mathematics and science based on this data. Among teachers in grades 7-12 with *main assignment* teaching math classes, Nevada's percentage with majors in mathematics/mathematics education is lower than the national percentage. Nevada is tied with Arizona and Hawaii for twenty-eighth out of the 36 states listed by Blank and Gruebel (1995). Especially among secondary teachers with main assignment in science, Nevada's percentage with majors in a science field/science education is especially lower than the national percentage. Indeed Nevada's percentage is the lowest among the 36 states -- 12 percent lower than Louisiana, the thirty-fifth state listed.

Another relevant indicator of teacher preparation is the teacher certification. *Figure 8* provides the 1993-94 Nevada and national percentages of *all* teachers in mathematics and various science areas that are certified in those areas. In each area, Nevada's percentage of math and science teachers certified in the appropriate area is higher than the national percentage.

Figure 7

Percent of Teachers with Primary Assignment In Math or Science That Have College Degree In Math/Math Ed. or Science/Science Ed.

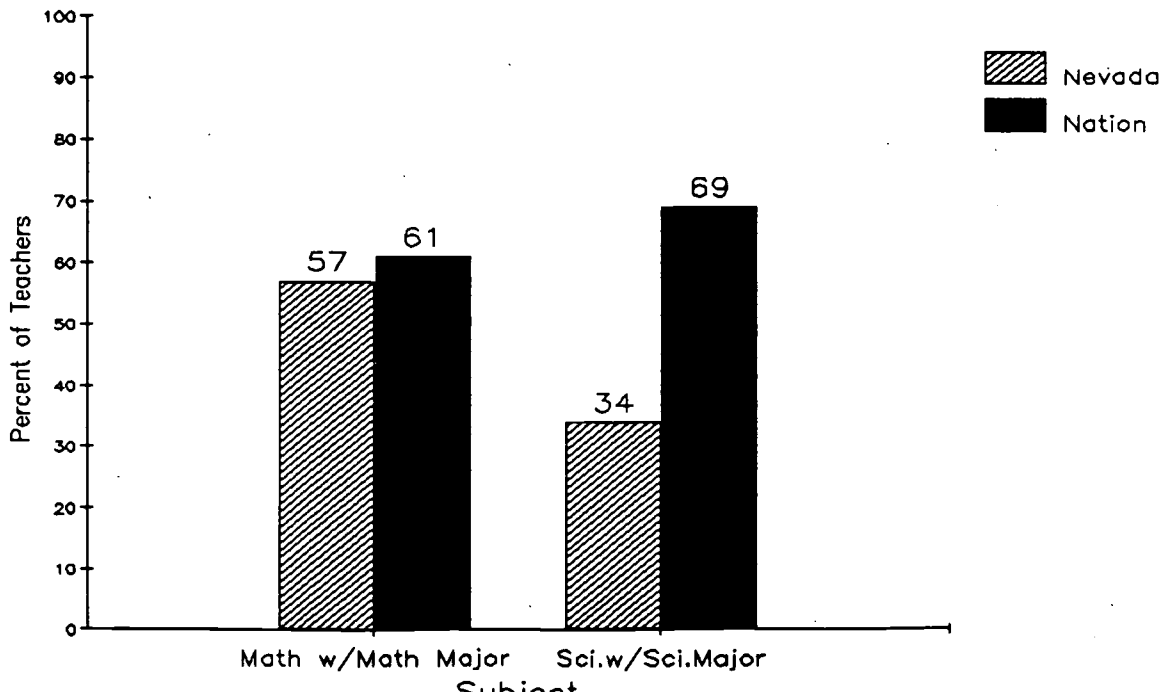
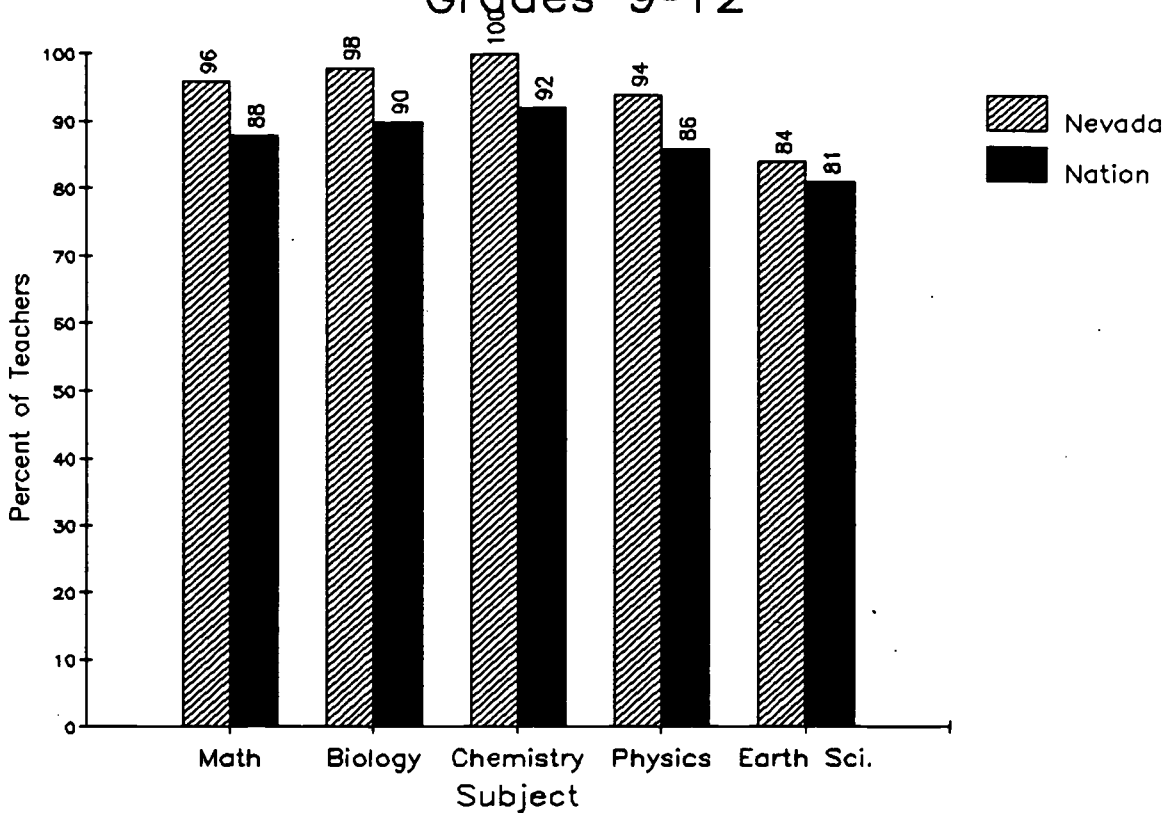


Figure 8

Percent of Teachers in Each Subject With Certification in that Subject Grades 9-12



The principal notion to gain from *Figure 8* is that most mathematics and science teachers in Nevada have met the State's requirements for teaching in those areas. The comparison with the national figures are not direct since different states have different requirements to be certified to teach in an area. In Nevada, a certification in a major area, e.g., math, requires 30 credits in that area. This credit requirement is near the middle of the credit requirements among states.

However, in some states, including Nevada, a teacher can have certification in a major area, e.g, English, and still teach a class in another area, e.g., math, with certification in that minor area. In Nevada, a teacher can get a certification in a minor area for mathematics or a science area with only 16 credits in that area. In mathematics, for example, this is the *lowest* credit requirement needed in any of the 36 states reviewed in Blank and Gruebel (1995). This requirement will be raised in the near future to 36 credits in a major area and 24 in a minor area. Also, at present, a math teacher cannot teach a class higher than algebra 1 without having taken calculus.

Summary and Conclusions

The indicators of the status of math and science education used in the present study suggest that Nevada has made progress over the last four years, but still has areas needing improvement. At the elementary level, the amount of time spent on mathematics compared well with the other states studied. The amount of time spent on science during grades 1-3 in Nevada was relatively low, but the amount increased in the second half of elementary school education. In the fourth grade, Nevada public school students performed, on the average, above national norms in mathematics. There was a similar percentage falling within the low achievement, potentially at-risk group and a higher percentage falling into the high achievement group when compared to a national referent fourth grade group.

At the middle school level, eighth graders performed above national norms in mathematics, with fewer students falling into the lower, at-risk group and more students falling into the high achievement group. The percentage of seventh and eighth graders taking mathematics and science classes were below the national average. However, the percentages taking accelerated and enriched mathematics classes and algebra were above the percentages of seventh and eighth grade students nationwide.

At the high school level, the eleventh grade mathematics exam is not nationally norm referenced, and proficiency tests are not available in science. The percentage of Nevada students taking advanced placement (AP) examinations in calculus and science were below national percentages taking the exams. However, there was progress since the percentage of Nevada students taking the calculus and the science exams increased significantly and the percentage earning qualifying (passing) scores in each area increased.

There has been an increase in the total percentage enrolled in high school mathematics in Nevada, although the percentage was slightly lower than the national percentage of high school math enrollments. Nevada's percentages were higher than national percentages in review and informal mathematics classes and lower in formal mathematics classes, especially upper level math classes beyond algebra 1. By graduation, the projected percentages of Nevada students enrolled in advanced math classes, e.g., algebra 2, were rising, but were still below national averages.

The total percentage of Nevada high school students enrolled in science classes have remained fairly stable, but below national total percentages. The percentage enrolled in biology 1 classes were the same as the national percentage, but the percentages enrolled in introductory and upper level high school science classes were below the national percentages. The projected percentage enrolled in biology 1 classes by graduation were very good. The projected enrollment in upper level science classes by graduation were below

the national average.

Nevada has made very good strides in female enrollment in formal mathematics and science courses over the last four years. In the first four levels of formal mathematics (algebra 1 to trigonometry), equal percentages of females or more females than males were enrolled in courses. The percentage of females enrolled in calculus had increased from 36 percent to 44 percent. More females than males were enrolled in biology and chemistry 1 courses, and there were substantial increases in female enrollment in physics courses.

Nevada's progress in mathematics and science education over the last four years is encouraging. However, given the importance of technology to the present and future economy of the state and the nation, some effective means of encouraging more students to take more mathematics and science courses, *especially upper level courses*, must be established. Also, changes in standards in mathematics and science education that emphasize active learning, problem-solving, and reasoning must be reflected in teacher preparation in math and science education. Further, future mathematics and science teachers should be encouraged to earn college majors in those areas in an effort to increase in-depth knowledge.

Extensive efforts have been made recently to diversify the economy of the state, to improve the capacity of the state's postsecondary institutions to provide training in technical fields, and to expand students' exposure to core academic areas prior to graduation. Success in each case is tied to some extent to enlarged enrollment of secondary students in quality science and mathematics classes. Hopefully, future studies like the present one will provide further indications of progress in addressing the issues identified here that pertain to the successful delivery of math and science education in Nevada's public schools.

Reference

Blank, R. K., & Gruebel, D. (1995). *State indicators of science and mathematics education, 1995.* Washington, DC: Council of Chief State School Officers.

Blank, R. K., & Gruebel, D. (1993). *State indicators of science and mathematics education, 1990.* Washington, DC: Council of Chief State School Officers.

Ethington, C. A., & Wolfe, L. M. (1988). Women's selection of quantitative undergraduate fields of study: Direct and indirect inferences. *American Educational Research Journal, 25*, 157-175.

Friedman, L. (1989). Mathematics and the gender gap: A meta-analysis of recent studies on sex differences in mathematical tasks. *Review of Educational Research, 59,* 185-213.

Klein, T. W. (1995, April). *EdTab report: Nevada Proficiency Examination Program: Statewide results for 1993-94.* Carson City, NV: Nevada Department of Education.

Linn, M. C., & Hyde, J. S. (1989). Gender, mathematics, and science. *Educational Researcher, 18,* 17-27.

Maple, S. A., & Stage, F. K. (1991). Influences on the choice of math/science major by gender and ethnicity. *American Educational Research Journal, 28*, 37-60.

National Center for Education Statistics (1993). *Schools and staffing in the United States: A statistical profile, 1990-91.* Washington, DC: U.S. Department of Education.

Smith, D. L. (1994). *Indicators of science and mathematics education in Nevada: School year 1990-91.* Carson City, NV: Nevada Department of Education.

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