

Silicon Valley Education Foundation

Silicon Valley STEM Education

Part 2 (of 3): Current State of Silicon Valley STEM



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Introduction

In 1887, when horse and mule pulled wagons were the only way to transport large objects, equipment and building supplies were hauled up Mount Hamilton to the James Lick Observatory, the first permanently staffed mountain top observatory in the world was constructed and opened.

In 1939, when anything that flew was either a bird or had a propeller, the National Advisory Committee for Aeronautics opened what is now the NASA Ames Laboratory at Moffett Field.

In 1962, when most computers were operated by vacuum tubes, planning began for the Stanford Linear Accelerator, now known as SLAC, which opened four years later.

Long before Santa Clara Valley, one of the most productive agricultural areas in the world became synonymous with high tech and earned its moniker Silicon Valley, science and technology and their partners engineering and mathematics had found a home among the orchards of our community.

These pioneering institutions have made tremendous contributions in many fields and continue to do so today. Lick has discovered six of Jupiter's moons and six extra-solar system planetary systems. NASA Ames directed the Pioneer Missions to distant parts of the solar system and designed the International Space Station's solar arrays. SLAC has produced three Nobel Prizes in physics, led to another in chemistry and, through loaning meeting space to the Homebrew Computer Club, led to the development of today's ubiquitous personal computer.

What will be the future of Science, Technology, Engineering and Mathematics in our valley? Much of our community's transition from a sleepy agricultural valley to a fast paced, high tech hub has been led by a nexus of major universities and their graduates who chose to locate their startup high tech companies here. Another major factor has been a workforce constantly replenished by the graduates of our public education system. The valley's future as a technological and scientific center may well be determined by a continuing supply of well educated high school graduates, ready to attend and graduate from first class universities and becoming the scientists, technological leaders, engineers and mathematicians of the coming decades.

The Silicon Valley Education Foundation's first STEM report, "The Need," gave a high-level overview of the importance of and challenges in STEM education in Silicon Valley. This second report looks at how schools and districts in Santa Clara County have been faring in STEM-related subjects in recent years.

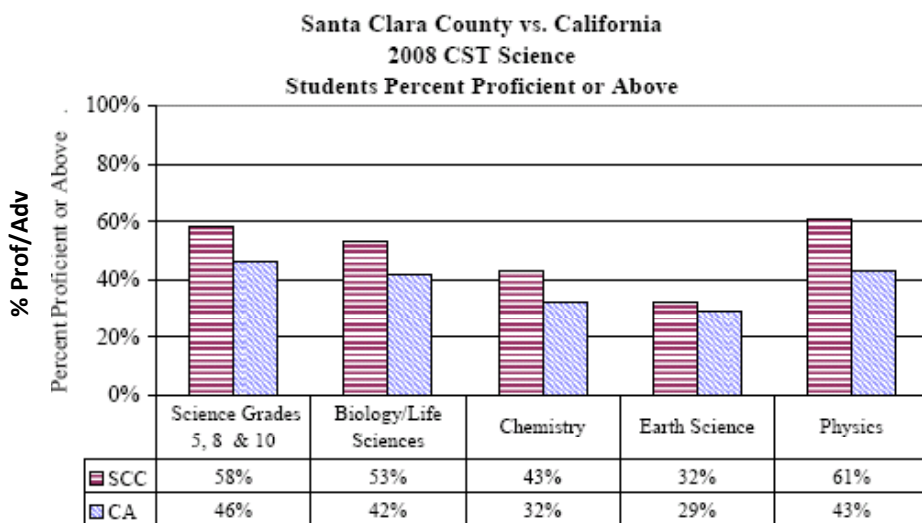
The Current Situation in STEM—Where Do Our Students Stand?

It is commonly accepted that students in the United States lag behind their peers in many countries in math and science. Several recent studies support this assertion. The Programme for International Student Assessment (PISA) indicated that the U.S. ranked 24th out of 30 countries in math. Because of

testing difficulties, U.S. students could not be ranked on the PISA science tests. (Baldi, et al.) A more recent report, the 2007 Trends in International Mathematics and Science Study (TIMSS), showed that American 4th grade students ranked 9th of 35 nations in math and 5th in science. At the 8th grade level, American students ranked 6th in math and 10th in science. While our students' science scores showed no significant improvement over the 2003 TIMSS study, math scores did show marked improvement. (Gonzales, et al.)

At the national level on the most recent National Assessment of Educational Progress (NAEP), California students ranked 44th out of 51 states and DC in 4th grade math and 40th at the 8th grade level. In science, California students ranked 42nd out of 44 jurisdictions at the 4th grade and 37th at the 8th grade. (Lee, et al and Grigg, et al.)

In Santa Clara County, 63% of 2nd through 7th grade students scored proficient or above on the Math California Standards Tests (CST) compared to 53% statewide, and had a higher percentage of proficient and above (10-12% except for Earth Science) on each of the Science CST's than their peers statewide.(Figure 1) (Santa Clara County Office of Education-2008 CST Analysis)



Source: Santa Clara County Office of Education, 2008.

Figure 1. Percentage of students in Santa Clara County and California with passing CST scores in science classes.

It is important to remember that none of the tests involved in the studies cited above are the same, and at the national and international level not all students are tested. These results do suggest, however, that U.S. students are behind students in many countries. California students are behind students nationwide, but Santa Clara County students are ahead of other students in across the state.

The Ideal Situation in STEM—Where Should Our Students Be?

Students in our community should score equal to or above their peers across the nation and internationally in both math and science. This is a lofty goal, but California’s students had the biggest science gains on the NAEP test of any state and U.S. students had significant math gains on the TIMSS assessment.

To maintain our valley’s high stature in both innovation and technology, our valley we needs to produce students who have math competence. This means that students would be on a track to take and successfully complete a series of Algebra I, Algebra II, and an additional math class beyond Algebra II. Additionally, our students would successfully complete at least two lab science courses at the high school level. With this type of minimal STEM background our students would successfully graduate from a post-secondary institution and a significant proportion of them would be qualified for employment in Silicon Valley’s high tech industry with or without a baccalaureate or higher degree.

Acquisition of Mathematics Skills

By its nature, mathematics involves a set of skills and concepts which need to be learned in a sequential fashion that begins in elementary school and continues through middle and high school. Research suggests that there are several critical courses in the math sequence, shown in Figure 2, that can predict future success. Fifth grade mathematics, Algebra I and Algebra II followed by at least one further high school math course are the major predictors.

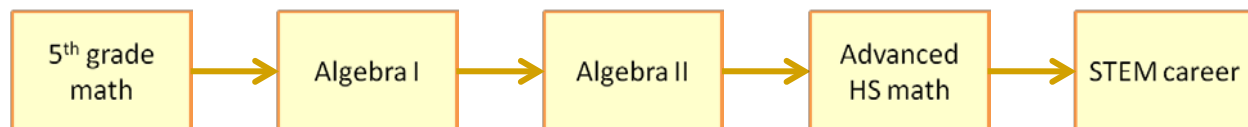
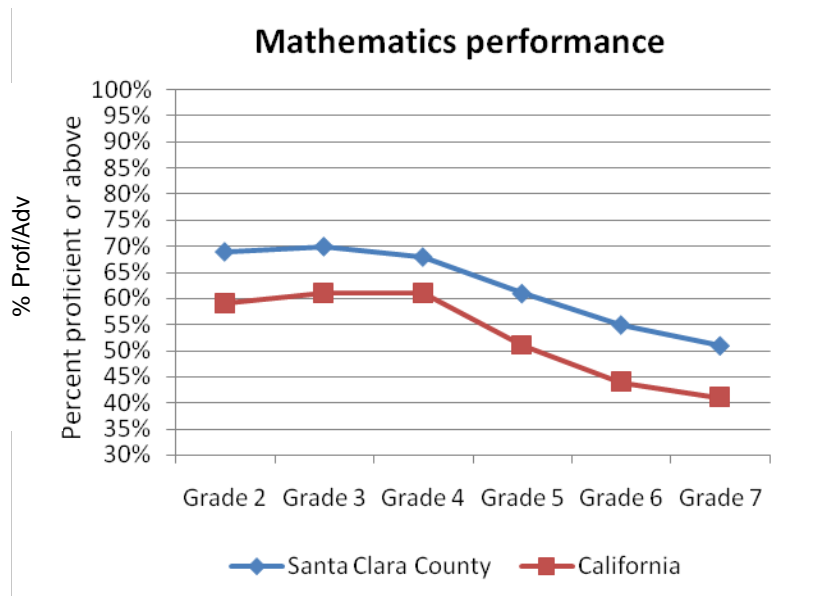


Figure 2. Critical sequence of mathematics courses from elementary through high school.

- Fifth grade math is crucial because it emphasizes operations with fractions. The National Mathematics Advisory Board has reported that, “proficiency with fractions is the most important foundational skill,” in determining success in Algebra (National Mathematics Advisory Panel). It is at this level that we begin to see a diminution in student performance as measured by the California Standards Tests. (Figure 3



Source: California Department of Education / Santa Clara County Office of Education, 2008.

Figure 3. Percentage of Santa Clara County and California students passing Math CST in grades 2 through 7.

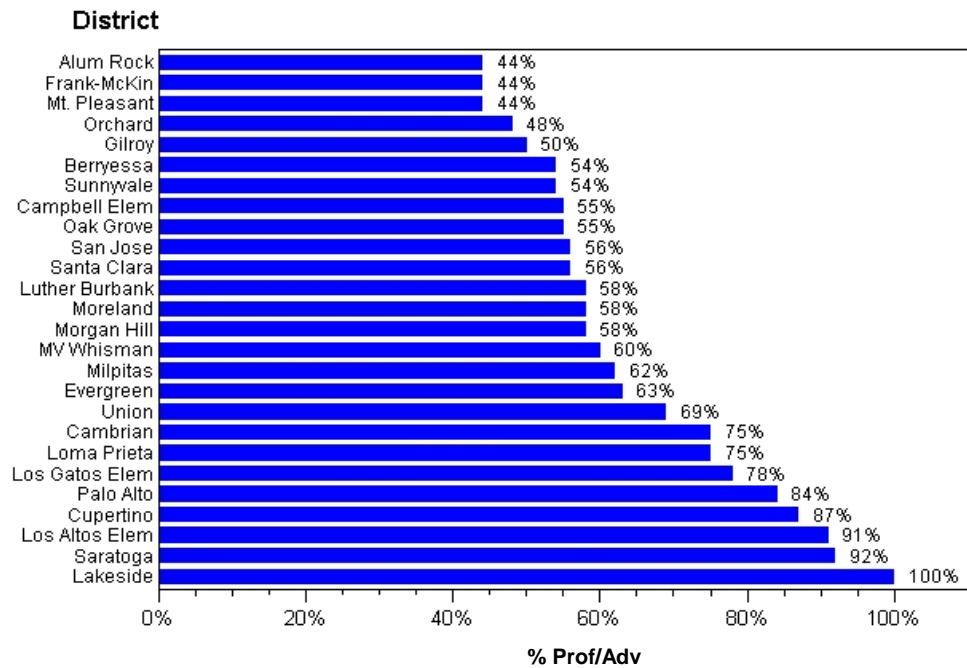
- Success in Algebra I has proven to be an excellent predictor of college entrance. (Adelman) In 2000, Algebra I became a high school graduation requirement starting with the graduating class of 2004. Last year, the State Board of Education’s decision to mandate that 8th graders take the Algebra I CST made Algebra I the de facto 8th grade math course, although this decision has been set aside by court action.
- Success in Algebra II, in turn, is a good predictor of college graduation. (Adelman) Most school districts require or highly recommend Geometry be taken between the two Algebra courses.
- A post-Algebra II course has value in promoting STEM careers because of the math emphasis each of the STEM fields require. Further, many colleges and universities have found that students who do not take a math course every year in high school are much more likely to need math remediation when they enter higher education.

How are Santa Clara County students performing at each of these critical points in their mathematics careers?

Fifth Grade Math Performance in Santa Clara County

Results from the 2008 California Standards Test in 5th grade math are shown in Figure 4.

Math CST - 5th grade



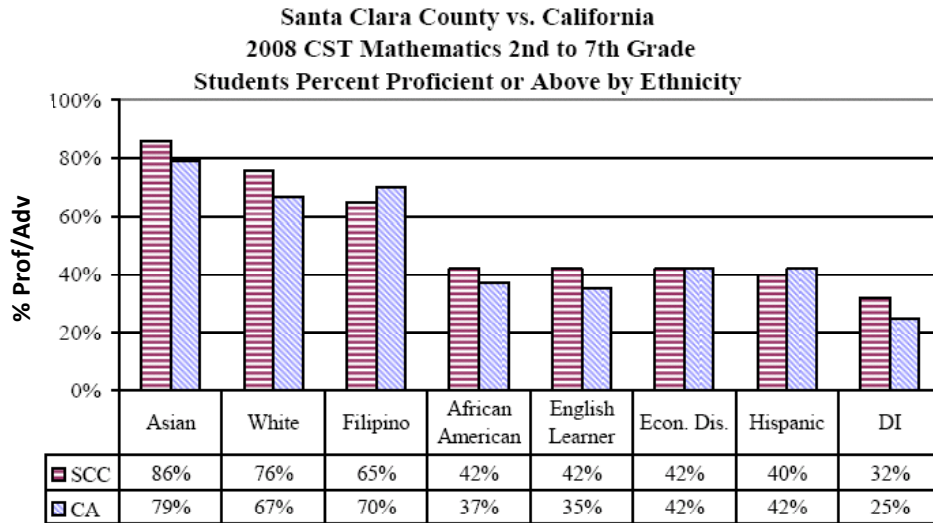
Source: California Department of Education, 2008

Figure 4. Percentage of students in Santa Clara County passing Math CST in 5th grade.

California has defined 5 performance levels for all of the California Standards Tests. The state’s goal is for every student to be at least at the “proficient” level. Using 75% Proficient/Advanced as a benchmark toward this goal, Figure 4 shows that only about one-third of Santa Clara County districts have achieved that level. It is important to remember that the definition of “proficient” on the CST means being on track for admission to the California State University system, while “advanced” means being on track for admission to the University of California system.

Achievement Gap Issues in Elementary Mathematics

There is wide variation in performance levels among student groups. Many students of color, students from low economic backgrounds and English learners consistently underperform their peers throughout Santa Clara County, California and the nation. See Figure 5.

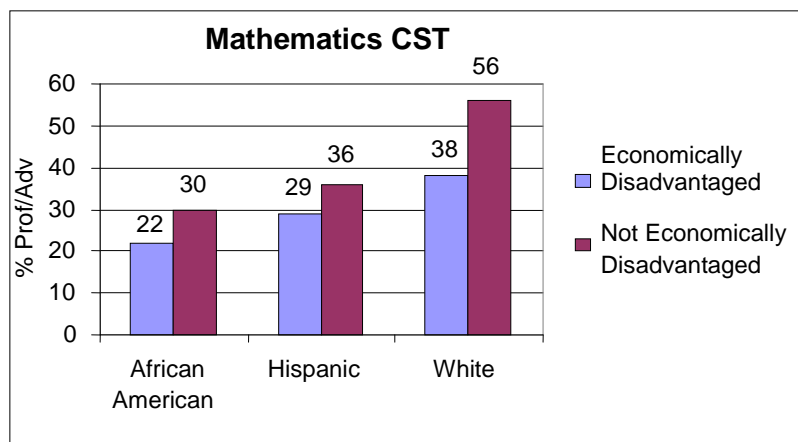


Source: Santa Clara County Office of Education, 2008

Figure 5. Percentage of Santa Clara and California students passing Math CST in grades 2 through 7 by ethnicity.

Many students fall into more than one of the groups displayed above. For example, an English Learner may also be Hispanic and/or economically disadvantaged. Despite the fact that scores for African-American, Hispanic, English Learner and Economically Disadvantaged students are roughly equal, it is a mistake to attribute all of the difference between these four groups and their Asian, White and Filipino peers to economic status alone.

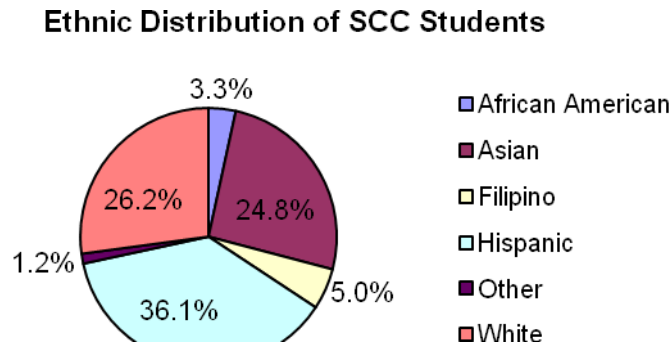
Superintendent of Public Instruction Jack O’Connell has reported that an analysis of statewide data shows that Non-Economically Disadvantaged students of color did poorer than Economically Disadvantaged white students. This suggests that here are cultural and other issues involved. It is important also to look at resources allocated to schools serving large percentages of minority, low income and students learning English, such as teacher experience, facilities, materials, etc. O’Connell’s analysis, based on 2007 CST results, is summarized in Figure 6.



Source: California Department of Education, 2008.

Figure 6. Percentage passing Math CST by ethnicity and socio-economic status.

The ethnic distribution of students in Santa Clara County is shown in Figure 7.

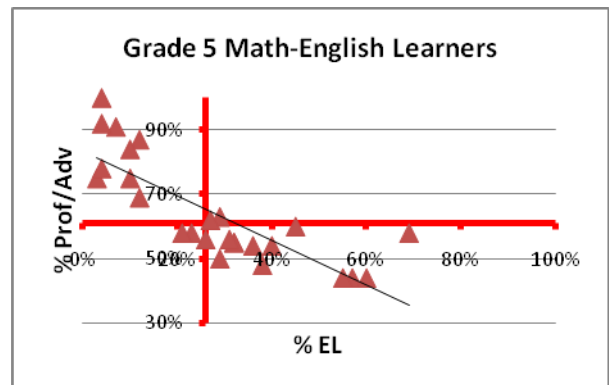
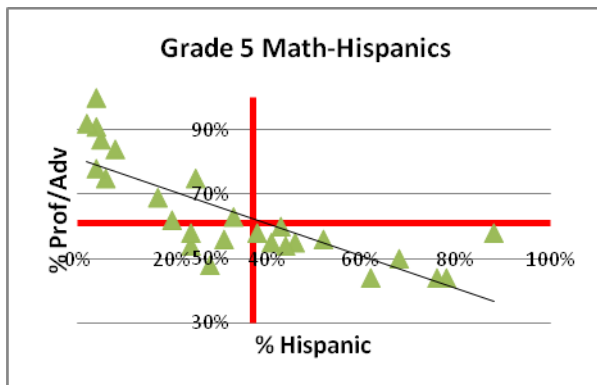


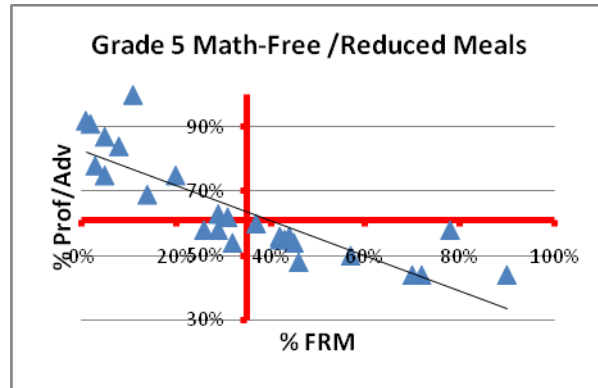
Source: Santa Clara County Office of Education, 2008.

Figure 7. Ethnic distribution of students in Santa Clara County.

In Santa Clara County, 26% of students are English Learners and 35% are on the Free or Reduced Lunch program, the most commonly used measure of economic status. (CA Dept. of Education)

The county has an uneven distribution of ethnic minorities, English Learners and students on Free or Reduced Meals. This uneven distribution is reflected in the performance of students in elementary math. Much of the variation among districts in student performance in 5th grade math shown in Figure 4 can be explained by this uneven distribution. Figure 8 compares 5th grade math performance against each district's percentage of students who are Hispanic, English Learner and receiving free or reduced meals.





Source: California Department of Education, 2008

Figure 8. District 5th Grade math performance in Santa Clara County compared to percentage Hispanic, English Learner and Free/Reduced Meals

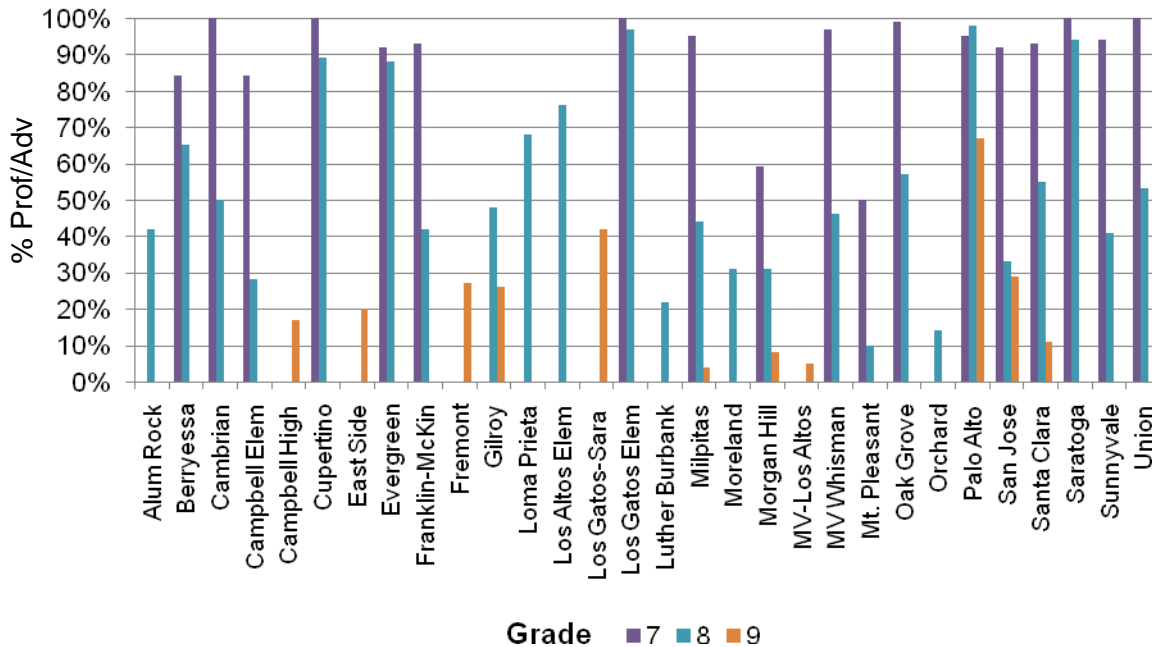
The red axes in each graph represent the County average in each category. The districts clustered in the lower right quadrant of each graph represent those above the County average in the category being considered but below the County average of 61% Proficient/Advanced on the test. These districts are virtually the same in each category. Alum Rock, Franklin-McKinley, Mt. Pleasant, Gilroy Unified, Sunnyvale, Campbell USD, Oak Grove, Luther Burbank and Mt. View-Whisman fall into this quadrant in all three categories. San Jose Unified (% Hispanic and % Free/Reduced Meals), Morgan Hill Unified (% Hispanic and % English Learners) and Orchard (% English Learners and % Free/Reduced Meals) are in this quadrant in two categories while Santa Clara Unified (% English Learners) is in one. This list of districts accounts for all but two of the districts which are below the County average in students Proficient/Advanced on the 5th Grade Math CST (Berryessa and Moreland). Similarly, the districts in the upper left quadrant which have high performance on the test but low percentages of Hispanics, English Learners and students on Free/Reduced Meals are the same for each category. This list includes Lakeside, Saratoga, Los Altos, Cupertino, Palo Alto Unified, Los Gatos, Loma Prieta, Cambrian and Union.

Santa Clara County has growing ethnic, economic and language diversity but this diversity is unevenly spread geographically. As a result, any attempt to increase elementary and early middle school mathematics performance of below-grade level students that does not focus on students of color, language status and economic status and on the districts where there are high concentrations of these student populations will have little marked/significant effect.

Algebra I Performance in Santa Clara County

Because students have traditionally taken Algebra I in different grades (7th, 8th or 9th), depending on the availability of the courses and previous student success, comparisons between districts can appear cumbersome. Nevertheless, 2008 Algebra I CST results from all districts can be summarized as follows (Figure 9).

Algebra I CST - grades 7,8,9



Source: California Department of Education, 2008

Figure 9. Percentage of students passing Algebra I CST.

In Santa Clara County, about 10% of 7th grade students, 53% of 8th graders and 50% of 9th graders take Algebra I. Except for the 7th grade cohort, each grade has some students who are repeating the class (including into 10th grade) because of failing performance. Regardless, by the end of the 9th grade virtually every student has taken Algebra I with varying degrees of success. Students who take Algebra I in 7th grade average 90% Proficient/Advanced, while 8th graders achieve Proficient/Advanced at 53% and 9th graders at 23%. There is a marked trend downward by grade level countywide and in most districts.

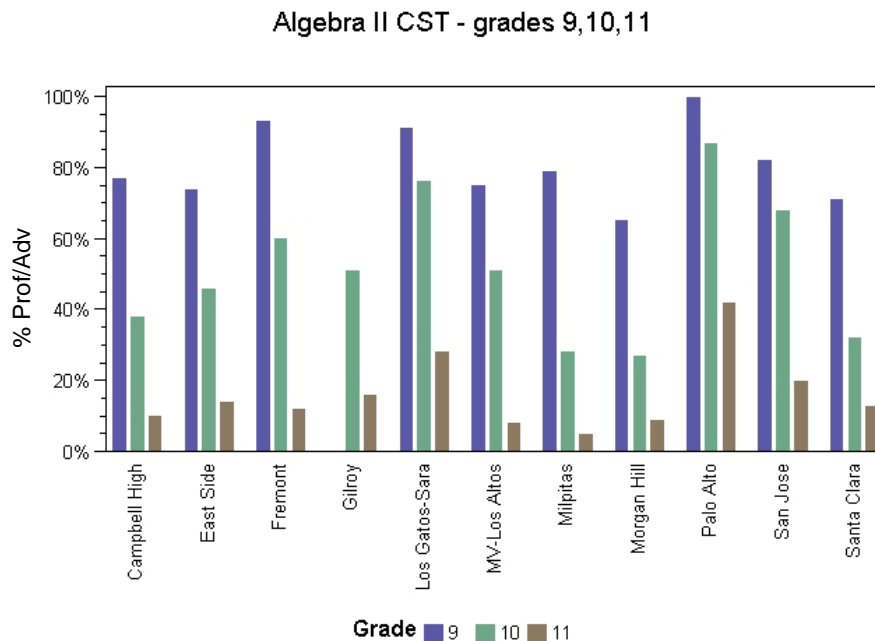
Teacher Quality Issues in Middle School Algebra

A recent report by the Center for the Future of Teaching and Learning described a statewide problem with teacher qualifications for the teaching of Algebra I in California's middle schools. The report states that 34% of teachers teaching 8th grade Algebra I were not fully certificated with a mathematics authorization. While county level or district level data is not readily available, there is no reason to think that the situation is much different in Santa Clara County. Even if our districts make a concerted effort to

ensure fully credentialed math teachers in every 8th grade Algebra I classroom, there will be a significant number of students who receive instruction in this crucial course by teachers who are not fully prepared. The report also demonstrates that the issue of under-qualified teachers is worse in low-performing districts, which may be a contributing factor to the achievement gap issues discussed below (Guha, et al.).

Algebra II Performance in Santa Clara County

A full academic year traditionally exists between successful completion of Algebra I and beginning Algebra II. During this year students take Geometry. Thus, Algebra II students have the benefit of a couple of years of maturation and experience, but they have been away from purely algebra skills for almost 15 months. Santa Clara County high school results on the 2008 Algebra II CST are shown in Figure 10.



Source: California Department of Education, 2008

Figure 10. Percentage of students passing Algebra II CST in grades 9, 10, 11.

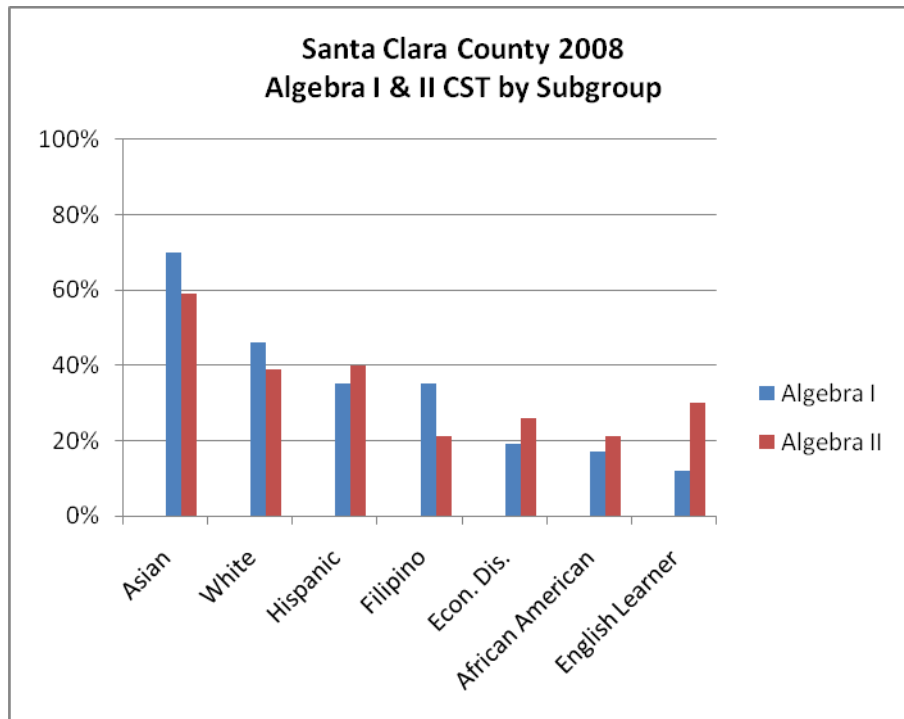
As with Algebra I, there is a downward trend in achieving Proficient/Advanced status depending on the grade in which the student takes the course. Countywide, the averages are 84% in the 9th grade, 52% in the 10th and 16% in the 11th grade. In aggregate, these scores are somewhat lower than Algebra I performance referenced above.

Another issue must be considered when looking at student progression through the math sequence. While all students take and complete Algebra I (it is a high school graduation requirement), there is a serious drop-off in the number of students who complete Algebra II.

Countywide, only 60% of students had taken Algebra II by the end of the 11th grade. Since some students in 10th and 11th grades were repeating the course and are therefore being counted twice, we lose over 40% of our students who do not continue through the high school math sequence. This loss actually begins a year earlier when students should move from Algebra I to Geometry. By the end of the 10th grade, 67% of Santa Clara County students had completed Geometry. Again, some students who repeat a course are counted twice, so the actual number is most likely in the 60-65% range.

Achievement Gap Issues in Algebra I and II

Results on the Algebra I and Algebra II CST's reflect the same achievement gaps discussed earlier among elementary math students. Figure 11 shows CST results for Santa Clara County for major subgroups.



Source: Santa Clara County Office of Education, 2008.

Figure 11. Percentage of students passing Algebra I and II CST by subgroup.

The report of the Silicon Valley Community Foundation titled “Education: Closing the Middle School Achievement Gap in Mathematics,” discusses strategies and options for dealing with some of the issues illustrated in the figure above.

Another issue is the participation rate of subgroups in the college prep math sequence. For example, Hispanic students, like all students, take Algebra I at some point in middle or high school. However, only 33% of them take Algebra II by the end of the 11th grade compared to 60% for all students countywide. The largest single ethnic group of Santa Clara County students (Hispanic) is continuing in college prep math at just over 50% of the rate of all county students.

Post Algebra II Options

Because Algebra II is the highest level of math tested by the California Standards Tests, it is impossible to obtain comparable data about student performance and the number of students taking post-Algebra II courses. There are many options available in most districts with high schools as shown in Figure 12.

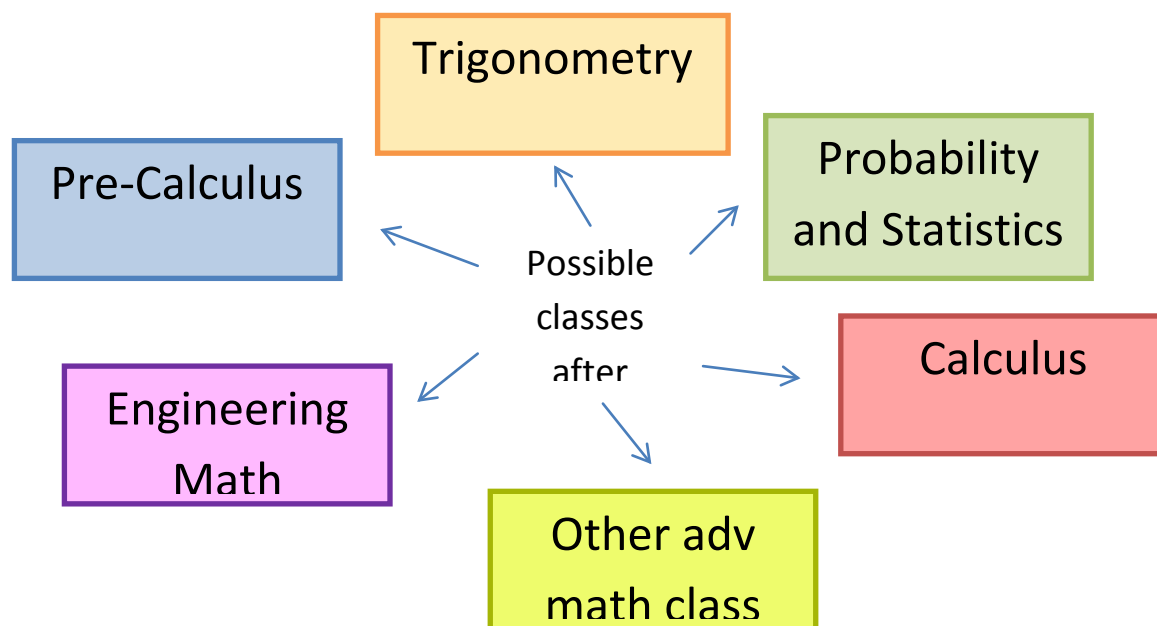


Figure 12. Post Algebra II Course Options.

Colleges and universities stress the importance of students taking a math class in the 12th grade. For example, the California State University has a program which allows students to use SAT math results from the 11th grade for placement purposes. In some cases, student placement is made conditional on taking a math class in 12th grade to keep math skills sharp before university entrance.

The grade a student begins the high school math sequence determines how far down the mathematics road that student can go. Some very well prepared math students begin Algebra I in the 7th grade and, as Figure 5 shows. They do very well on the Algebra I CST and that trend continues when they take Algebra II in the 9th grade (Figure 13).

Figure 13 shows the usual progression of students through the math sequence and some of their options.

7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade
Gr. 7 Math	Gr. 8 Math	Algebra I	Geometry	Algebra II	Pre-Calculus, Trig, Statistics, etc.
	Algebra I	Geometry	Algebra II	Pre-Calculus, Trig, Statistics, etc.	AP Calculus AB AP Calculus BC AP Statistics
Algebra I	Geometry	Algebra II	Pre-Calculus, Trig, Statistics, etc.	AP Calculus AB AP Calculus BC AP Statistics	College Math or other Math course

Figure 13. Traditional Math Course Progressions with Options

Advanced Placement Mathematics

Little data is available on the performance of Santa Clara County students in Advanced Placement math and statistics courses. Recent data from the Santa Clara County Office of Education shows that there has been an increase in the number of classes offered and the number of students enrolled. In 2005-6, 164 AP Math classes serving 4,730 students were offered in the county. In 2007-8, these had grown to 295 classes serving 5,706 students, an increase of 31 classes and 1,066 students. Conversely, the number of AP Computer Science classes fell from 15 classes for 377 students to 10 classes for 257 students. While passing rates on the AP Exams for specific subjects is not available, Santa Clara County students have a passing rate of 71.7% on ALL AP Exams, an increase of 4.3% from 2003 to 2007. In comparison, students statewide and nationally have seen declines in their passing rates. In that same time period, there has been a 35% increase in the number of AP Exams taken by County students. (Santa Clara County Office of Education-Vital Signs, 2008))

Mathematics Goals for Santa Clara County

- Improve student performance in 5th grade in order to better prepare them to successfully complete Algebra I.
- Increase the % of students who are ready to take and successfully complete Algebra I in the 8th grade. (See *A Strategy for the “Algebra I Success Initiative” in the Silicon Valley* prepared by SVEF which can be found on the SVEF website: www.SVEFoundation.org)
- Increase the % of students who continue on to and successfully complete Algebra II after Algebra I.
- Increase the % of students who take and successfully complete a math course beyond Algebra II.
- Increase the % of students who take and successfully complete AP Calculus and AP Statistics
- Improve the performance of low-achieving subgroups across the county at every level of mathematics.
- Increase the percentage of underrepresented student groups in Algebra II and higher math courses and their success rate.
- Ensure that all middle school mathematics teachers are fully credentialed with proper math authorizations.

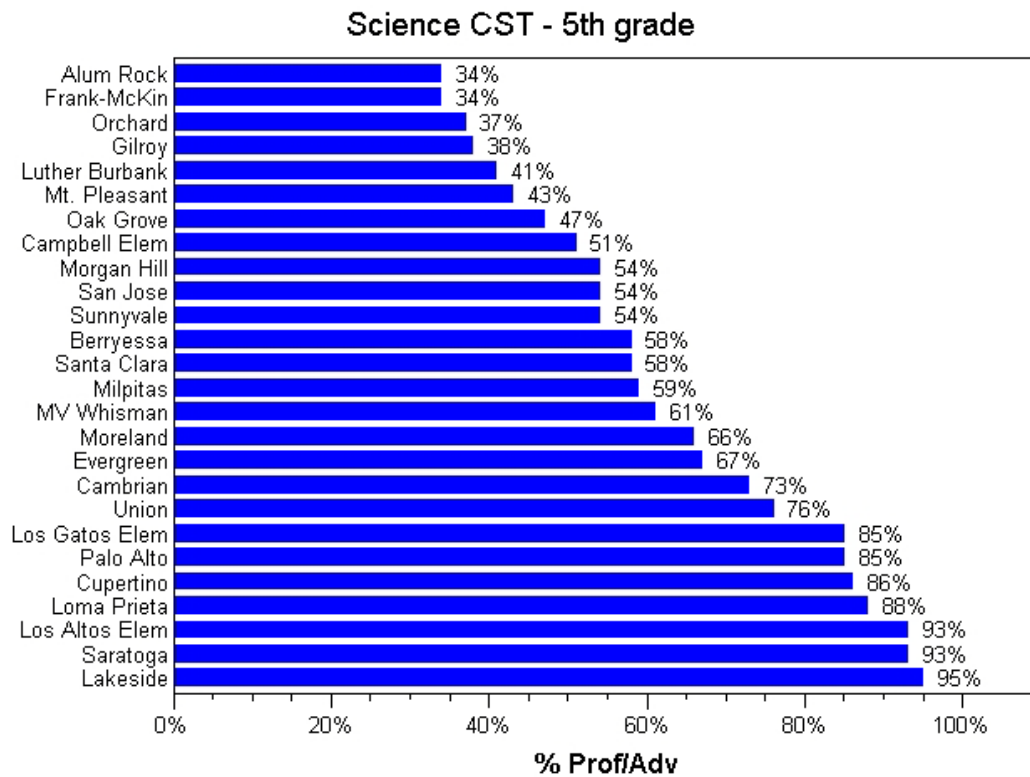
Science Education and Achievement in Santa Clara County

Unlike mathematics, which is tested by the California Standards Tests every year from 2nd through 11th grade, students are tested on their knowledge of science standards in the 5th, 8th and 10th grades. The 5th grade test includes 4th and 5th grade standards, the 8th grade test is on the 8th grade standards and the 10th grade test is a life science test and is taken by all 10th graders regardless of the particular science class in which the student is enrolled. Students in each of the high school lab sciences of Earth Science, Biology, Chemistry and Physics are tested in end-of-course tests in the year the course is taken.

It should be noted that science education, as measured by class time devoted to the sciences, varies from district to district. While there is no data available to compare Santa Clara County districts directly, a 2007 study of the Bay Area compiled by WestEd and the Lawrence Hall of Science showed that 60% of Bay Area elementary teachers reported that they spent less than 60 minutes per week in science instruction. Furthermore 16% reported spending no time on science lessons. (Dorff) This situation is exacerbated by the fact that low-performing schools in Performance Improvement (PI) status under the No Child Left Behind Act, are mandated to focus on English/Language Arts and mathematics to the exclusion of all other subjects. For many students, science instruction prior to high school is focused into the two grades in which it is tested.

Fifth, Eighth and Tenth Grade Science Performance

Santa Clara County students were 58% Proficient/Advanced level on the 2008 5th grade Science California Standards Test. There was a wide variation in this achievement across districts. Individual district results are shown in Figure 14.



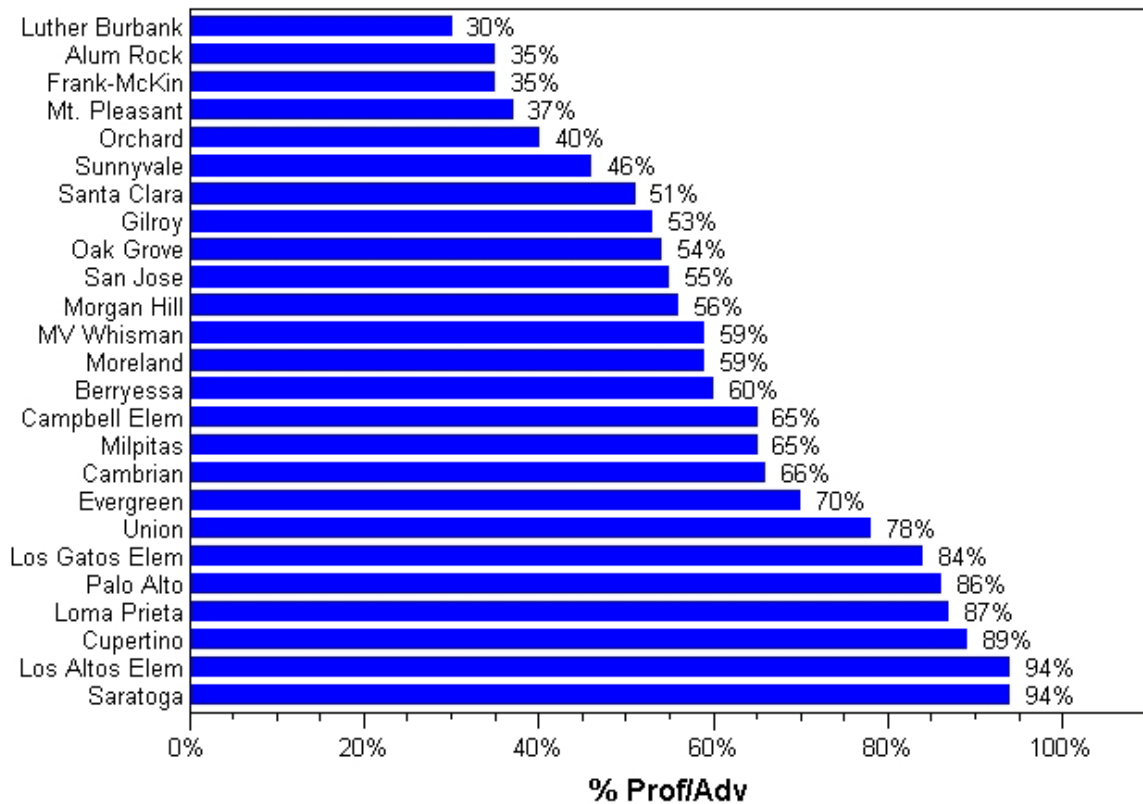
Source: California Department of Education, 2008.

Figure 14. Percentage of students passing 5th grade Science CST.

The pattern of performance in 5th grade science by district is very close to that in 5th grade math as shown in Figure 4. California’s goal is to have every student achieve at least at the proficient level and Figure 15 indicates that we still have much to do to come close to meeting this goal.

On the 2008 8th grade Science California Standards Test, 63% of Santa Clara County students were at the Proficient/Advanced level. Individual district results are shown in Figure 15.

Science CST - 8th grade



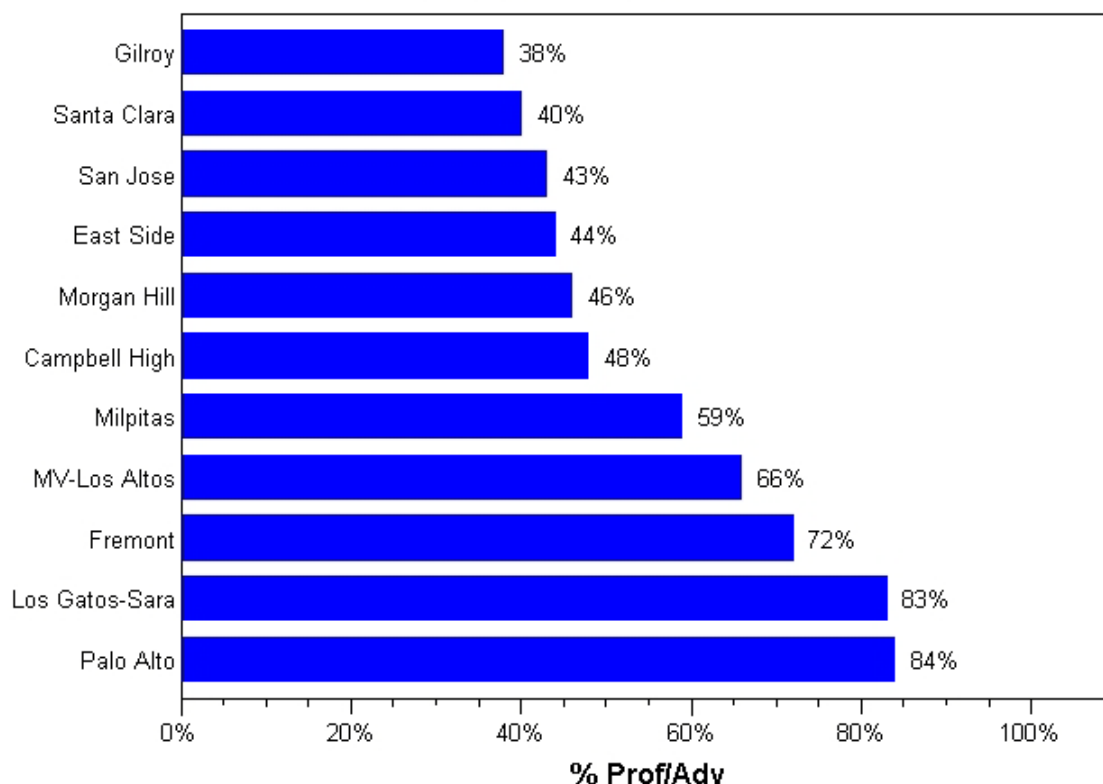
Source: California Department of Education, 2008.

Figure 15. Percentage of students passing 8th grade Science CST.

Again, districts displayed a wide variation in achievement levels with about two-thirds falling below 75% Proficient/Advanced.

Santa Clara County students were 46% Proficient/Advanced level on the 2008 10th grade California Standards Test. Individual district results are shown in Figure 16.

Science CST - 10th grade



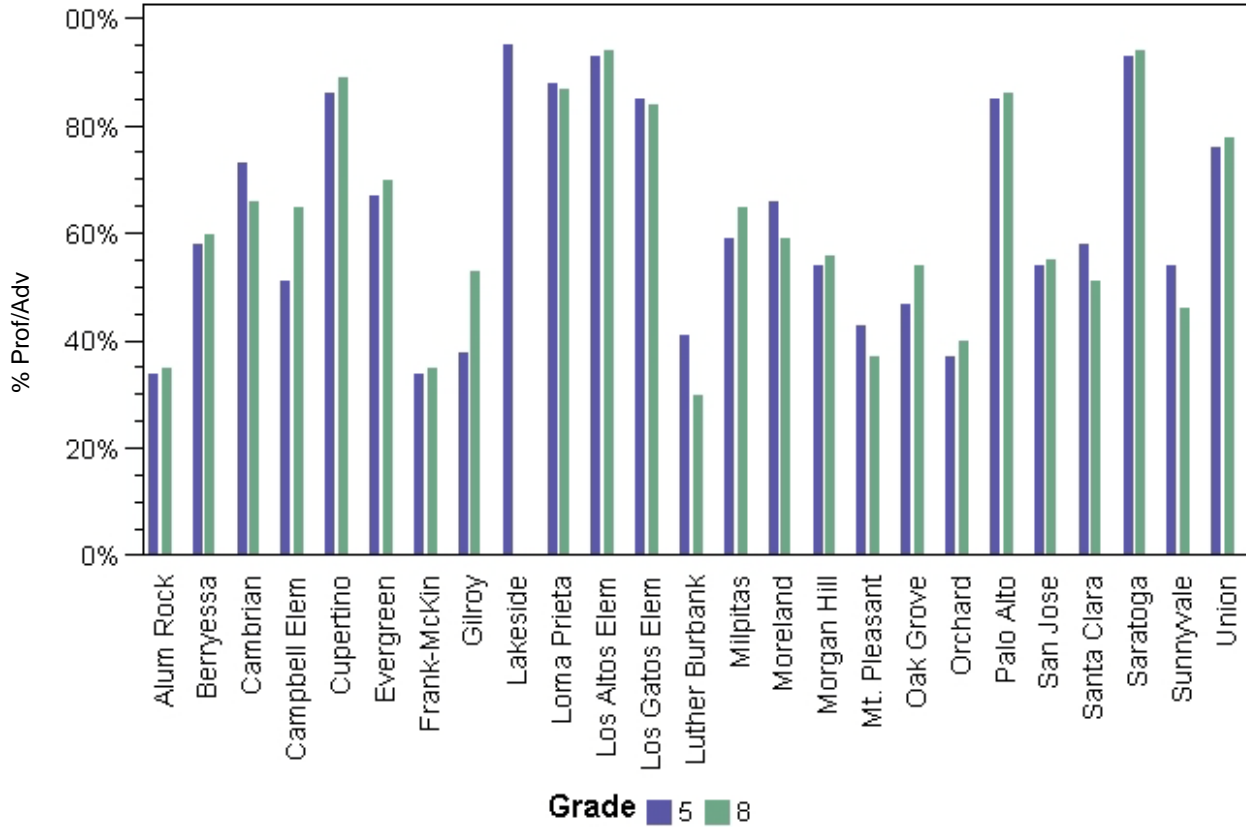
Source: California Department of Education, 2008.

Figure 16. Percentage of students passing 10th grade Science CST.

Because of differing district grade configuration (elementary districts, high school districts, unified districts), 10th grade scores come from somewhat different entities.

Since there is some variation between the three grades tested on a countywide basis, (58% Adv/Prof in 5th grade, 63% Adv/Prof in 8th grade and 46% Adv/Prof in 10th grade), it is interesting to make a similar comparison within districts. Figure 17 compares 5th and 8th grade science results within elementary districts.

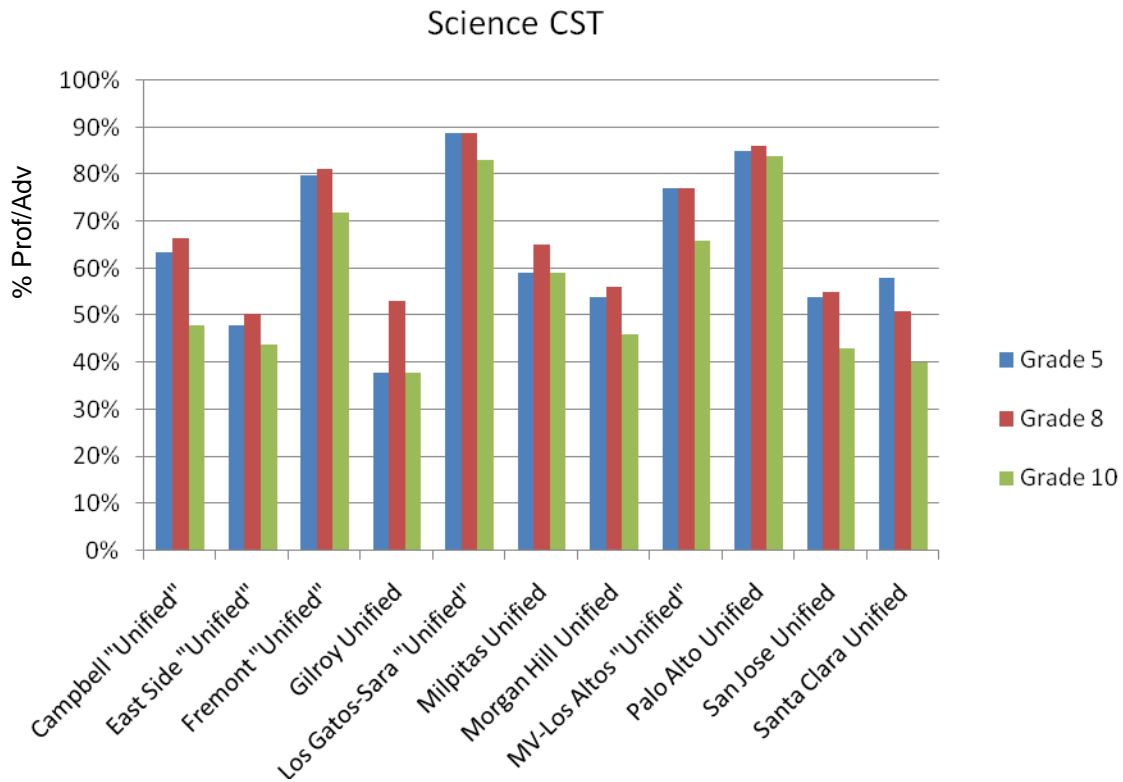
Science CST - Grades 5, 8



Source: California Department of Education, 2008.

Figure 17. Percentage passing Science CST in 5th and 8th grades.

Generally speaking, there are only small differences between the performance of a district’s 5th and 8th grade students. However, there appears to be a decline between 8th grade scores and 10th grade scores. These are more difficult to compare on a district basis because many students move from a K-8 elementary district to one of the county’s five high school districts, while others continue in one of the county’s six K-12 unified districts. Some comparisons are possible by creating a weighted average of a high school district’s feeder elementary districts for 5th and 8th grade science and comparing the results to the high school district’s 10th grade scores. The results of this unified and “quasi-unified” analysis are shown in Figure 18.



Source: California Department of Education, 2008.

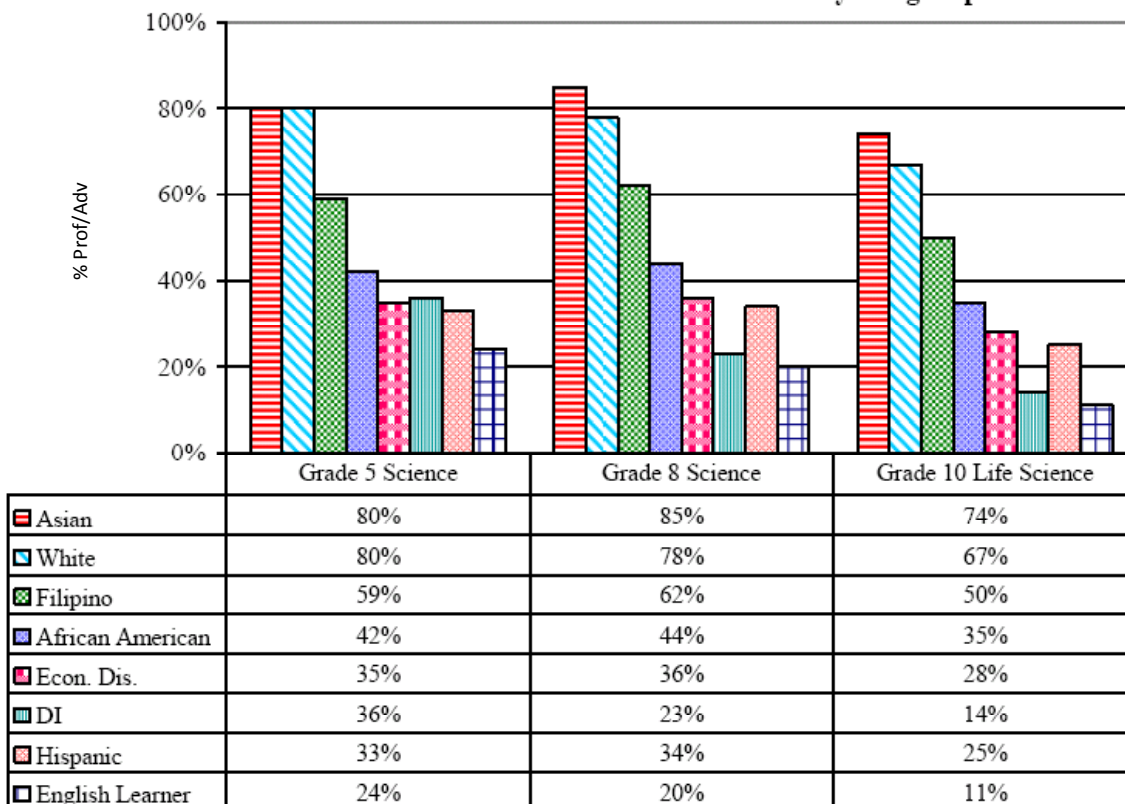
Figure 18. Percentage of students passing 5th, 8th and 10th grade Science CST.

The most likely explanation for this change between 8th and 10th grade scores is the nature of the 10th grade test. The 10th grade science CST is a Life Science test. Unless the student has taken Biology, he/she has received no instruction in this subject since the 7th grade.

Achievement Gap Issues in Elementary/Middle School Science

As with Mathematics, there is a clear achievement gap in performance on elementary and middle school science CST's, as well as on the 10th grade Life Science CST. These gaps are demonstrated in Figure 19.

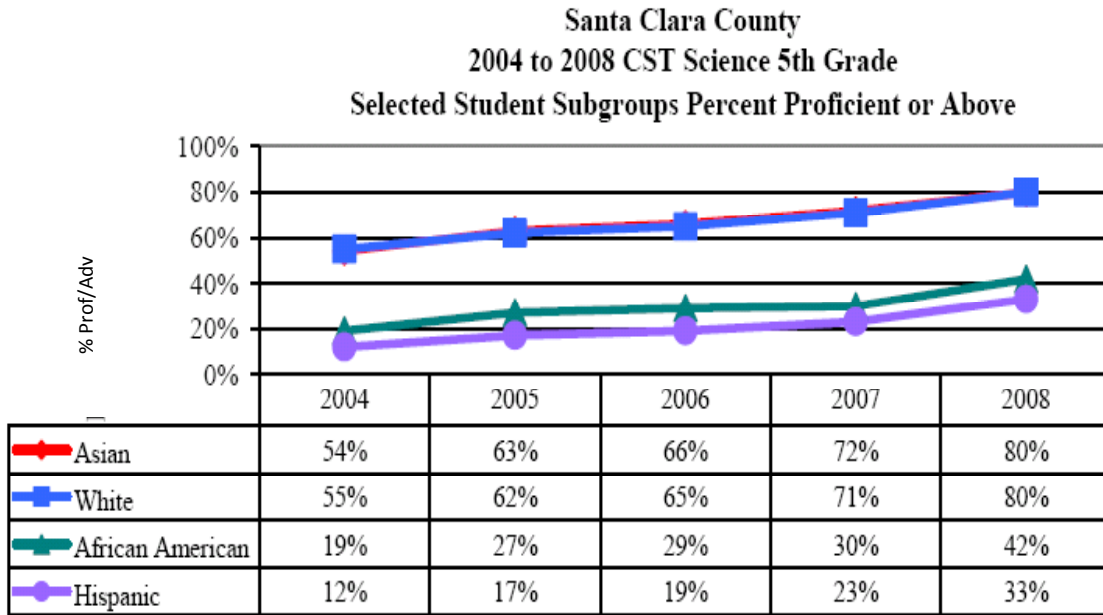
**Santa Clara County
2008 Grade 5, Grade 8 and Grade 10 Life Science
Students Percent Proficient or Above by Subgroup**



Source: Santa Clara County Office of Education, 2008.

Figure 19. Percentage of students passing 5th, 8th, and 10th grade Science CST by subgroup.

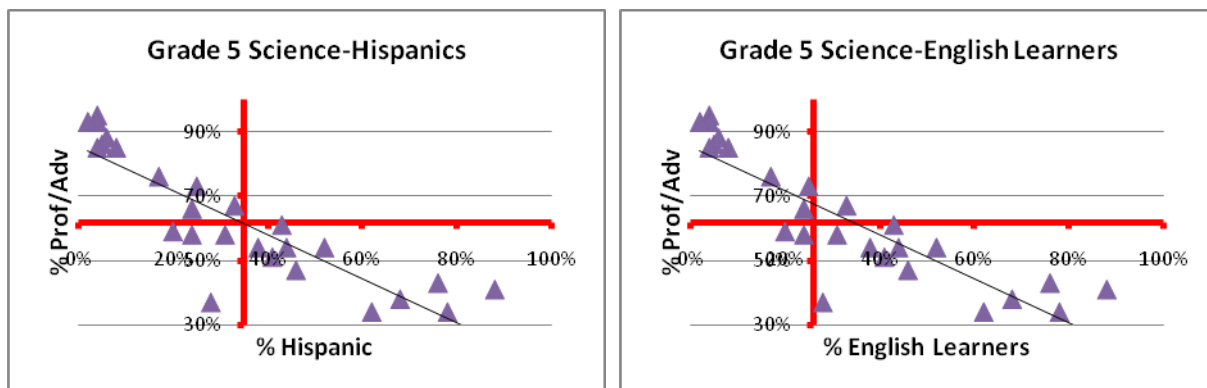
Economically Disadvantaged students, English Learners and students of color (with the exception of Asians) perform at significantly lower levels on the three science tests required of all students. While the good news is that in the last five years science performance has improved by all groups, the achievement gap appears to be consistent over time and is not narrowing. These trends are illustrated by Figure 20.

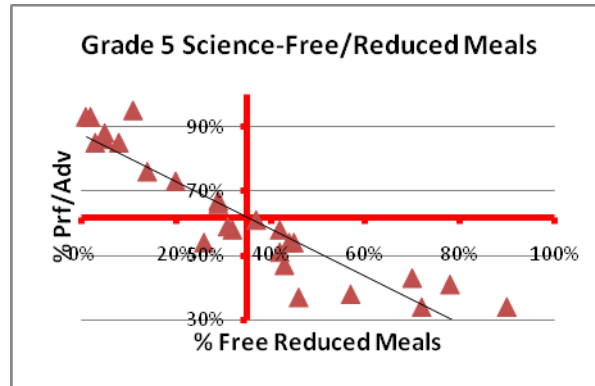


Source: Santa Clara County Office of Education, 2008.

Figure 20. Percentage of students passing 5th grade Science CST by ethnicity.

In addition, district performance by students on the 5th grade science test is not consistent across the county. Similar to Figure 8 discussed above in the discussion of Achievement Gap Issues in Elementary Mathematics, Figure 21 shows that districts performing below the County average of 62% Proficient/Advanced on the 5th grade Science CST generally have percentages higher than the County average in Hispanics, English Learners and students receiving Free/Reduced Meals. Most of the variation in district performance shown in Figure 15 above can be explained by the concentrations of these groups of students across the County.





Source: California Department of Education, 2008

Figure 21. District 5th Grade science performance in Santa Clara County compared to percentage Hispanic, English Learner and Free/Reduced Meals

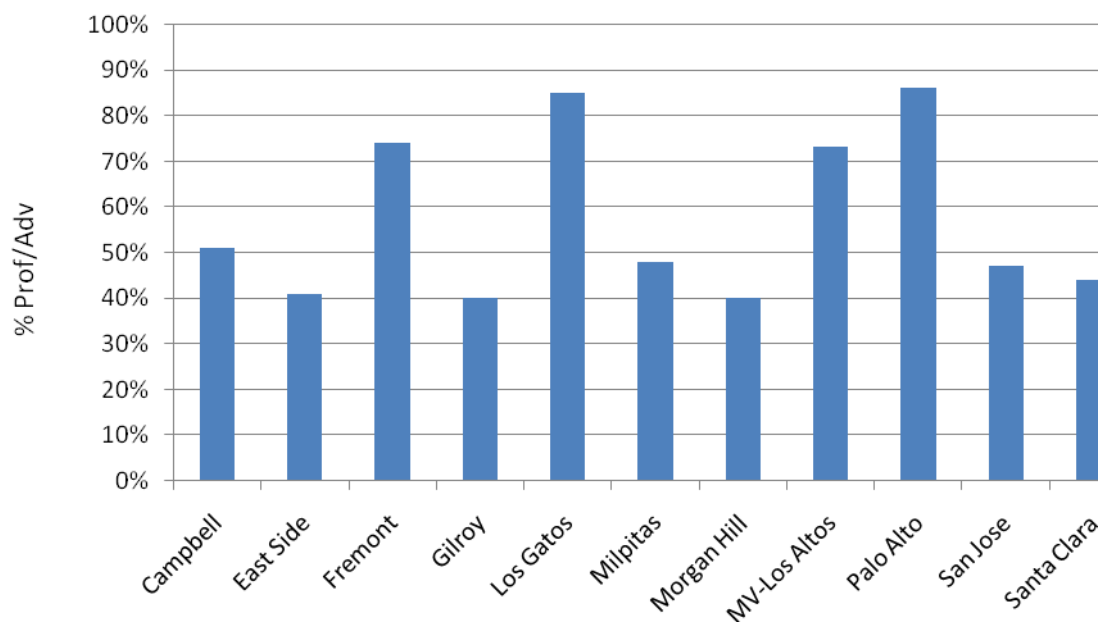
The pattern seen in Figure 8 in 5th grade math is virtually identical in 5th grade science. Alum Rock, Franklin-McKinley, Mt. Pleasant, Gilroy Unified, Sunnyvale, Campbell USD, Oak Grove, Luther Burbank and Mt. View-Whisman all fall into the above County average in all three categories and the below County average of 62% Proficient/Advanced. San Jose Unified (% Hispanic and % Free/Reduced Meals), Santa Clara Unified (% English Learners and Free/Reduced Meals) and Orchard (% English Learners and % Free/Reduced Meals) fall into two of the categories. Four districts, Morgan Hill Unified (% Hispanics), Berryessa, Milpitas Unified and Evergreen (% English Learners) fall into one category. Since the pattern is the same for 8th grade science scores the comparison charts are not included in this paper.

High School Science Performance

The traditional high school science courses of Biology, Chemistry and Physics are the core lab science classes that make up the science component of the UC/CSU A-G admission requirements. Although Earth Science also meets this requirement, it is not considered in this report because students completing this course are not generally those interested in a STEM major at the university level. While there is no mandated sequence in which the courses are taken, nor specific grades assigned to them, the traditional pattern is to take Biology first, followed by Chemistry and Physics. A few high schools have reversed this pattern. Since many students do not begin lab sciences until the 10th grade, it is common for students to take Physics in the 12th grade. California's CST tests are not administered in the 12th grade, so Physics CST results involve many fewer students and those students are the ones who traditionally began lab sciences in the 9th grade. Those students had higher performance levels than students in other grades in each of the earlier lab courses.

Santa Clara County students averaged 53% Proficient/Advanced on the 2008 Biology/Life Sciences CST. Results by district with high schools are shown in Figure 22.

Santa Clara County High School Districts Biology CST

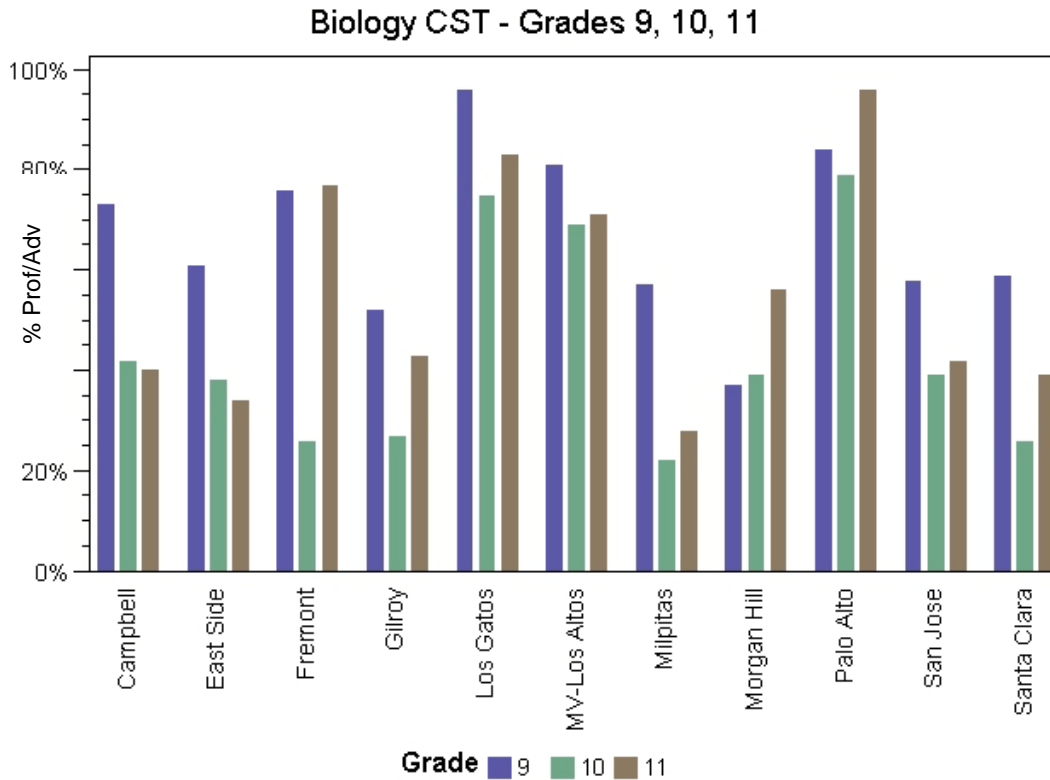


Source: California Department of Education, 2008.

Figure 22. Percentage of high school students passing Biology CST.

Figure 22 shows that there are four districts where students perform at the 70-80% Proficient/Advanced level, while in the other seven, performance hovers around 40%. Statewide, the performance level is 42% Proficient/Advanced. While our countywide average is 53%, Figure 20 indicates that much of this increase is attributable to these four districts achievement level.

A variation exists within the Biology CST performance levels in most districts depending on the grade level of students tested. Figure 23 shows this variation.

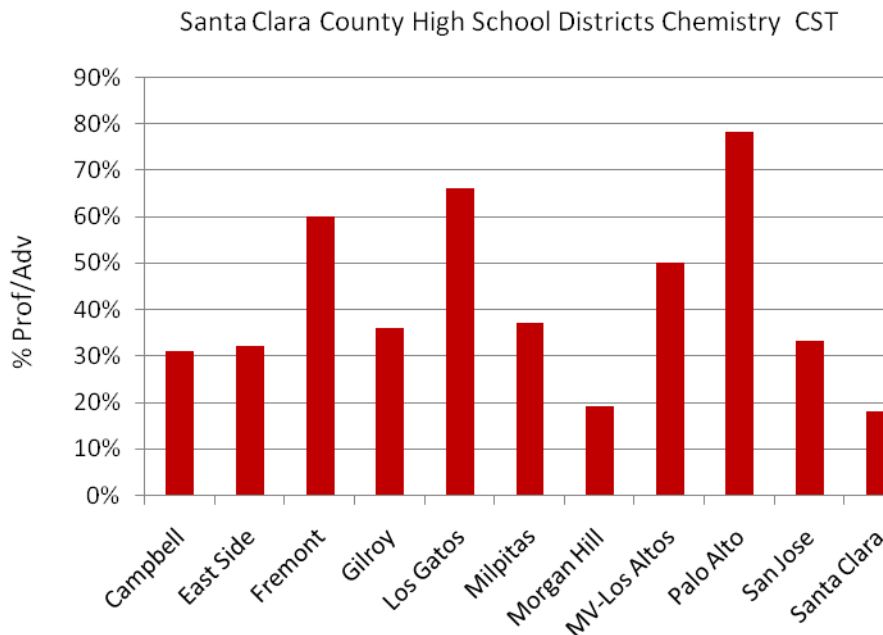


Source: California Department of Education, 2008.

Figure 23. Percentage of high school students passing Biology CST by grade.

In many districts, 9th grade students outperformed their older peers on the Biology CST. Ninth grade students taking a STEM-related lab science tend to be those who are better prepared in middle school and who did well in middle school math and science courses. The availability of an Advanced Placement Biology course whose students would be expected to perform at higher levels may partially explain results in districts which do not show this variation.

Santa Clara County students averaged 43% Proficient/Advanced on the 2008 Chemistry CST. Results by district with high schools are shown in Figure 24.

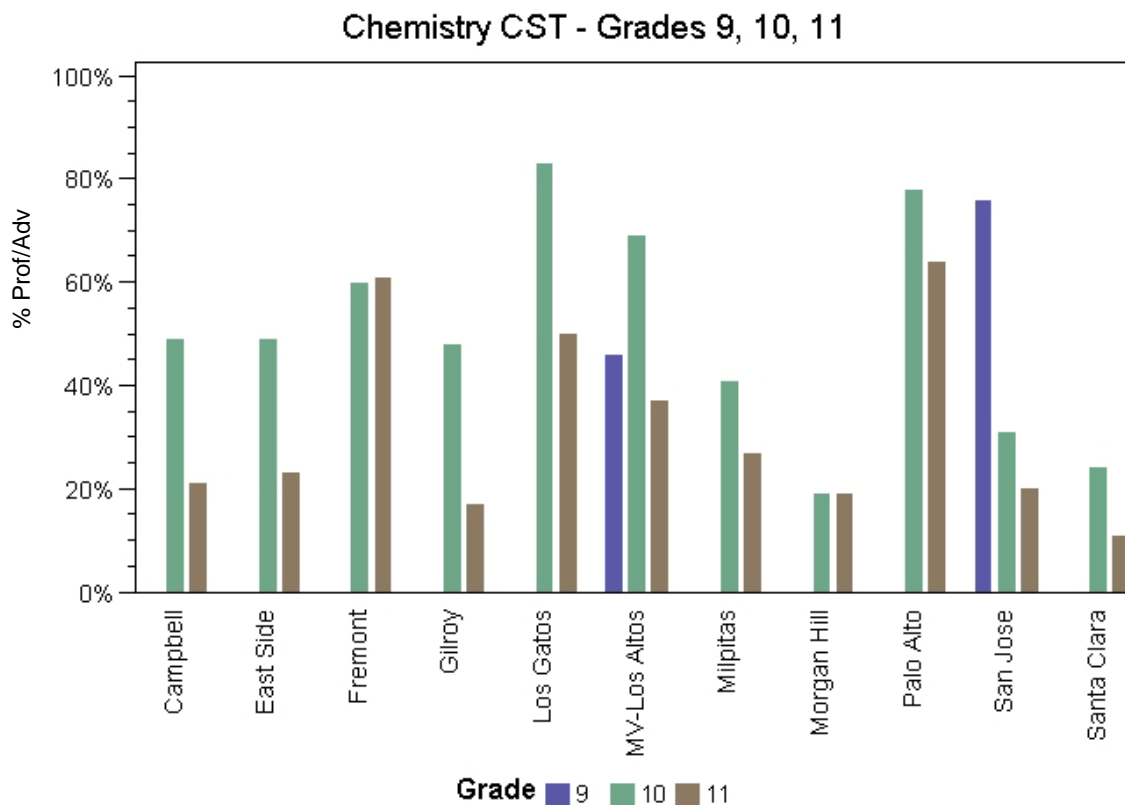


Source: California Department of Education, 2008.

Figure 24. Percentage of high school students passing Chemistry CST.

Similar to the results seen on the Biology/Life Sciences CST, a few districts show higher levels of achievement. Statewide, 32% of students perform at the Proficient/Advanced level, which is about where five of our districts perform. Two perform at lower levels.

As with Biology, performance level variations exist in Chemistry in most districts depending on the grade level of students tested. Figure 25 shows this variation.

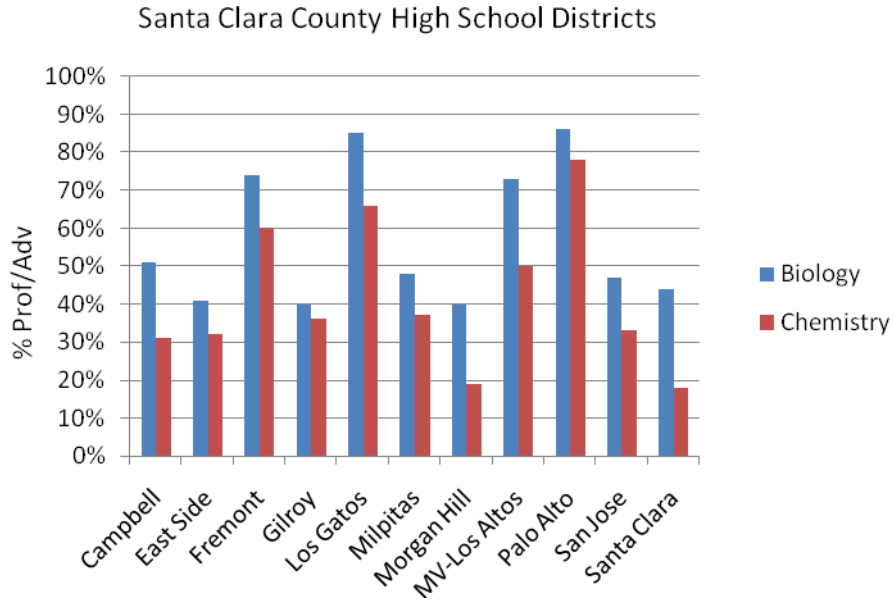


Source: California Department of Education, 2008.

Figure 25. Percentage of high school students passing Chemistry CST by grade.

As with Biology in the 9th grade, students taking Chemistry in the 10th grade generally outperformed their older peers on the Chemistry CST. Generally, these students previously took Biology in the 9th grade. The same reasoning explained above holds in the case of 10th grade Chemistry results as with 9th grade Biology.

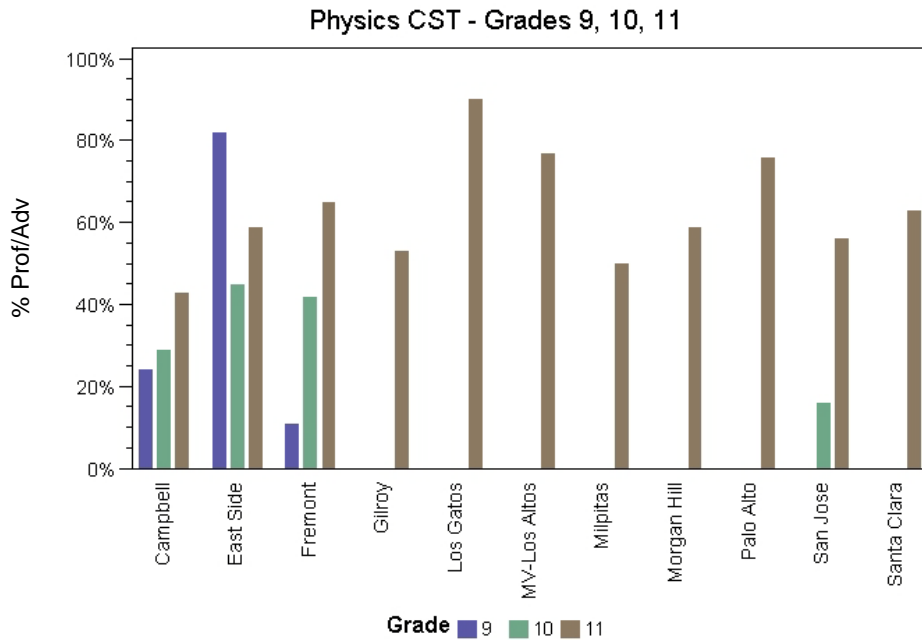
A general decline exists in student performance between Biology and Chemistry. This change is shown in Figure 26 below. These results are somewhat puzzling since Biology is taken by almost all high school students. Chemistry tends to attract students who have already met high school science graduation requirements and are pursuing college entrance requirements.



Source: California Department of Education, 2008.

Figure 26. Percentage of students passing Biology and Chemistry CST.

Santa Clara County students averaged 61% Proficient/Advanced on the 2008 Physics CST. Results by district high schools are shown in Figure 27.



Source: California Department of Education, 2008.

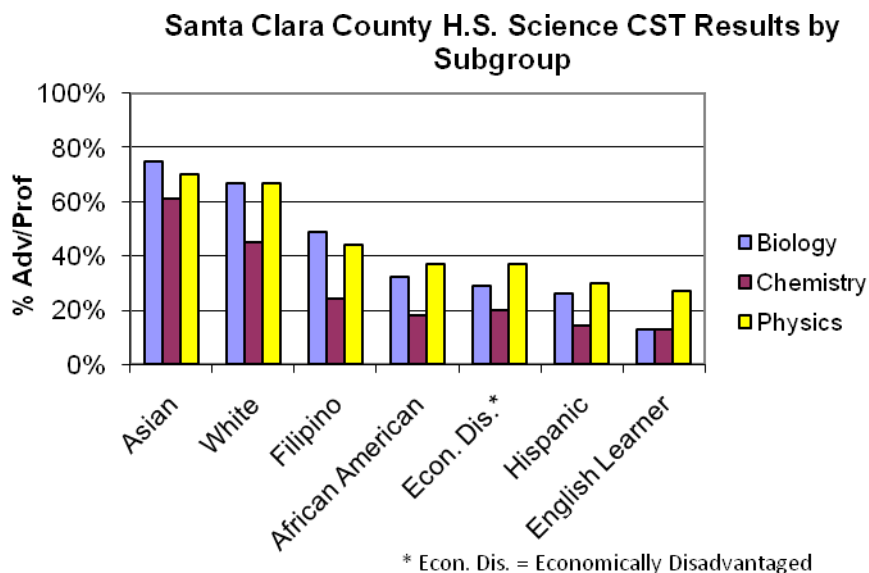
Figure 27. Percentage of high school students passing Physics CST by grade.

As discussed earlier in this report, district level Physics CST results include only those students who had completed the course by the end of the 11th grade. The vast majority of Physics students take Physics in the 12th grade and are not included in the CST results. Those students who take the course in grades 9-11 tend to fall into the same categories as those taking Biology in the 9th grade and Chemistry in the 10th grade, thus explaining the higher achievement level in Physics over Chemistry and Biology.

As with mathematics, attention needs to be paid to the number of students completing each of the three science courses discussed above. Looking at the students who had completed the 11th grade countywide in 2008, 103% had taken the Biology/Life Sciences CST at least once in their three year high school career. The three year total is over 100% because some students who did not do well chose to take the class again and were retested. It can be said, however, that virtually all high school students had taken Biology by the time they had completed the 11th grade. As with mathematics, a serious drop-off takes place after this first STEM-related science course. By the end of the 11th grade, only 65% of students had taken the Chemistry CST and 21% had taken the Physics CST. A few of the 65% taking Chemistry are students repeating the course and many more 11th grade students will take Physics in the untested 12th grade. Nevertheless, this decline from almost all students taking Biology to less than two-thirds taking Chemistry is a matter of concern.

Achievement Gap Issues in High School Science

As with all of the levels of math and science discussed previously, wide variation exists between subgroups of students ethnically, economically and by language status. Figure 28 illustrates these differences in the high school lab sciences.



Source: Santa Clara County Office of Education, 2008.

Figure 28. Percentage of students passing Biology, Chemistry and Physics CST.

Hispanic students, the largest single ethnic group in our county’s schools, are succeeding in these three subjects at between one fourth to one half the rate of White or Asian students.

Furthermore, there is the issue of how many students of color are actually taking these courses. Among Hispanic students, virtually all take Biology, but only 35% take Chemistry and 8% take Physics. This compares to overall percentages of students in the county who take the courses -- 65% take Chemistry and 21% take Physics. As with higher math courses, a serious drop-off takes place with the number of Hispanic students who continue the high school STEM science sequence. Advanced Placement science courses are discussed below. Although data is not available on subgroup enrollment in the AP sciences, it can be assumed that if the subgroups described above are enrolled in the regular science courses at a lower level than others, they are also under-enrolled in the AP counterparts.

Finally, there is the impact of ethnicity, language acquisition and economic status on the variation of district performance in science. Figure C shows the relationship between these characteristics and student performance on the Biology California Standards Test. This test was chosen because it is the science test taken exclusively in high school and by a significant majority of students. Note that this type of analysis was not produced for high school math because there is no one course that fits these two descriptions.

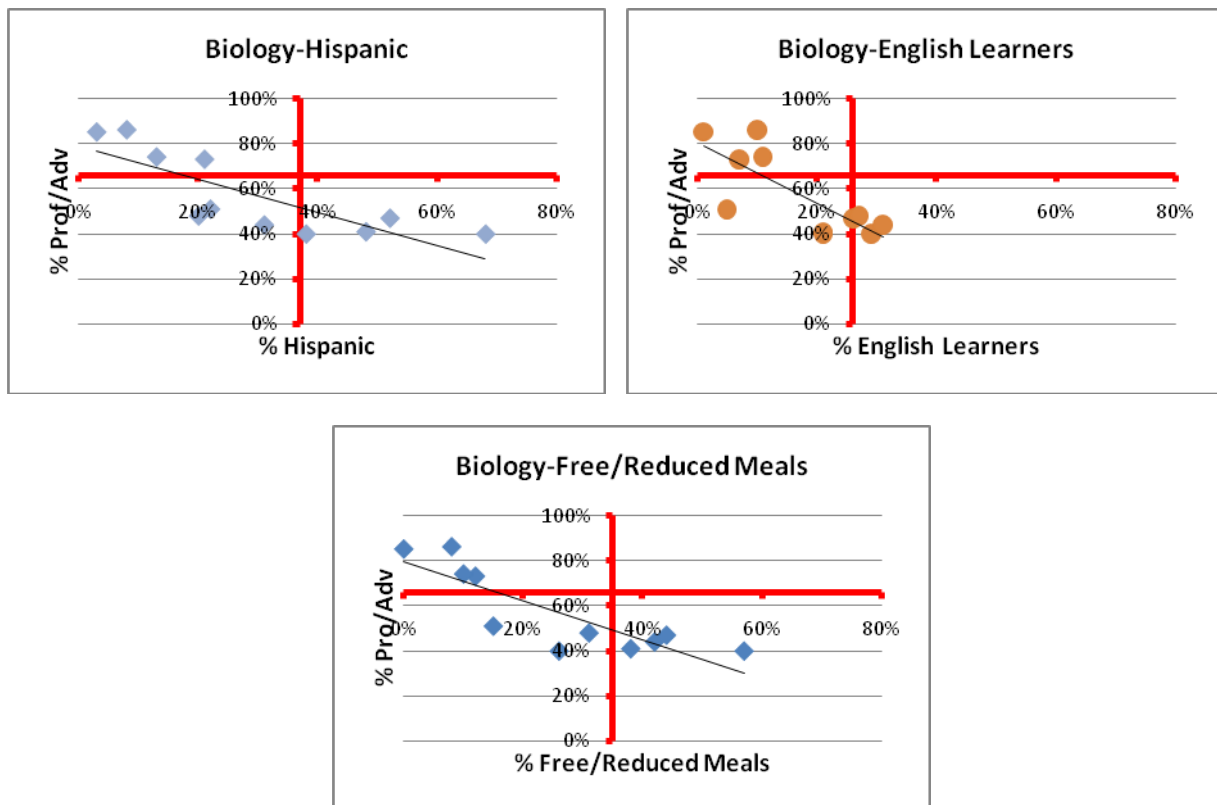


Figure 29. District Biology performance in Santa Clara County compared to percentage Hispanic, English Learner and Free/Reduced Meals

The effect of ethnicity, language and economic status is not as pronounced among districts with high schools as the effects shown in among districts with elementary schools in Figures 8 and 21. The effect of English Learners is especially less pronounced. Only one district, Gilroy Unified, is above the County average in all three categories but below the County average of 66% of students scoring at the Proficient/Advanced Level. Three districts fit this pattern for two characteristics: Santa Clara Unified (%English Learner and % Free/Reduced Meals) and both San Jose Unified and East Side UHSD (%Hispanic and % Free/Reduced Meals). Two districts fit this pattern for one characteristic: Morgan Hill Unified (%Hispanic) and Milpitas Unified (% English Learner). It must be noted that these characteristics do not explain district performance in all situations. There is a group of districts (Campbell UHSD, Morgan Hill Unified, Santa Clara Unified and Milpitas Unified) that score below the County average on the Biology CST but are also below the County average in one, two or all three of the characteristics noted.

Advanced Placement Science

As previously indicated in the section on Advanced Placement Mathematics, little data is available on student performance. There has been an increase, however, in the offerings and the number of students taking these courses. In 2005-6, 162 AP science classes were offered in Santa Clara County high schools serving 4,679 students. In 2007-8, these numbers had increased to 189 classes offered serving 5,161 students. No data is available on student performance on individual AP Exams in science, but a general discussion of countywide performance on AP Exams can be found in the previously referenced Advanced Placement Mathematics section. (Santa Clara County Office of Education-Vital Signs)

Science Goals for Santa Clara County

- Increase the % of students who successfully complete Biology
- Increase the % of students who are ready to take and successfully complete Biology in the 9th grade.
- Increase the % of students who continue on to and successfully complete Chemistry
- Increase the % of students who take and successfully complete a Physics course.
- Increase the % of students who take and successfully complete AP level courses in Biology, Chemistry and Physics.
- Improve the performance of low- achieving subgroups across the county at every level of science

Engineering Education in Santa Clara County

In general, students do not study engineering, per se, in elementary, middle or high school. Science and math courses are prerequisites for student who wish to pursue engineering at the college or university level. These courses remain the K-12 system's major contribution to the engineering field. Data is not available about courses or programs in schools that have an engineering component or attempt to increase student awareness of engineering as a career choice.

Considering that many of our economic competitors abroad are now out-producing the United States in the number of engineering graduates at the college/university level, it appears obvious that increased performance by our students in the math and sciences is a necessary for regional and national production of engineers.

Technology Education in Santa Clara County

Technology education is also difficult to document. Available statistics have tended to concentrate on the number of computers available per school and availability of internet connections. However, no data is collected on what students have actually learned about using technology to do their work. Indeed, technology in schools has tended to focus on word processing, use of spreadsheets, PowerPoint presentations and internet searches. Several authors have suggested that schools need to look at "technological literacy" and need to include technologies beyond learning how to use the basic tools. A recent article by Andrew Trotter entitled "Tech Literacy Confusion: What Should You Measure" points out that many states (under a mandate from No Child Left Behind) have developed technology literacy standards, and more than ten states have technology assessments. California has neither standards nor assessments in this field. Until there are generally accepted standards of just what technology literacy is and how to assess it, technology education in our county and the rest of the nation will be a hit- or- miss affair.

Conclusions

Students in Santa Clara County, as measured by the California Standards Tests, are generally doing better in science and math than their peers statewide. This holds true for all students and all of the subgroups, with the exception of Hispanic students in mathematics. Better is not good enough. If Santa Clara County and the Silicon Valley are to continue their role as leaders in innovation in the high tech world, we must improve the performance of all our students in these vital areas. There is no "silver bullet" that will achieve this result. Increased student performance involves better teaching, better conditions for learning, attitudinal changes and a plethora of other changes. Progress comes down to

the teaching-learning dynamic that goes on daily in our county's classrooms. This report has focused on where we are now. Each of the goals listed in the report (eight in Math and six in Science) will require commitments in time, resources and ideas to accomplish.

It is beyond the scope of this report to suggest specific programs to achieve these goals or to assign priorities to them, but a general comment is in order. It is impossible to improve overall student performance in the STEM areas without addressing the achievement gap issues described at each level of the report. Unless schools, districts and the private sector work together to improve the performance of Hispanics, who make up 37% of our student population -- many of whom are also economically disadvantaged or English Learners -- we will be working at the margins instead of getting to the core of the problem.

Finally, it must be noted that this report focused on the school districts in Santa Clara County and did not look at performance of individual schools. In small districts, school variation may be very slight but in middle to large districts there may be wide variation in performance of students between individual schools. California Standards Test results for the school level can be found by selecting the county, district and school desired at <http://star.cde.ca.gov/star2008/Viewreport.asp> .

A Note on Sources

Most of the data presented in this report comes from the California Department of Education's STAR Reporting website (www.cde.ca.gov) and its companion resource, Dataquest (<http://dq.cde.ca.gov/dataquest/>). Some of the figures in the report are from reports prepared by the Santa Clara County Office of Education including the invaluable "SCCOE Analysis: California Standards Tests" and "Education Outlook: Vital Signs". Both are available at www.sccoe.org.

The information on the early scientific history of Santa Clara County comes from the websites of the institutions mentioned (<http://mthamilton.ucolick.org/>, <http://www.nasa.gov/centers/ames/home/index.html>, and <http://www.slac.stanford.edu/>) as well as the Wikipedia articles on each.

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