Level Playing Field Institute

Dissecting the Data 2012: Examining STEM Opportunities and Outcomes for Underrepresented Students in California

March 2012

543 Howard St, 5th Floor, San Francisco, CA 94105 · www.lpfi.org

report by
Allison L. Scott
Alexis Martin

Level Playing Field Institute
543 Howard St, 5th Floor,
San Francisco, CA 94105
www.lpfi.org

Level Playing Field Institute is a San Francisco-based non-profit that is committed to eliminating the barriers faced by underrepresented people of color in science, technology, engineering and math (STEM) and fostering their untapped talent for the advancement of our nation.

We help reveal and remove the barriers that prevent underrepresented groups from achieving all they can.

NOTE: This data brief examines the STEM outcomes of African-American and Latino students in California, two subgroups who are underrepresented in STEM fields relative to their overall population, although the Level Playing Field Institute is also concerned with the underrepresentation of additional groups in STEM (e.g., Native Americans, women). The phrase "underrepresented students of color" is used within this report to refer to African-American and Latino students, who by definition are underrepresented in STEM. This phrase does not include Asian students who may identify as "students of color" but are not underrepresented in STEM. When discussing achievement gaps, research has traditionally used White students as the comparison group, although Asian students in California outperform White students on most measures. Therefore, in this brief, the performance of both Asian and White subgroups are examined in comparison with African-Americans and Latinos. It is important to note that achievement levels vary significantly between certain Asian subgroups (e.g., Chinese and Hmong), however, much of the data on Asian student achievement is not disaggregated to allow for examinations of Asian subgroup differences. While we acknowledge these limitations, we believe that this data brief shines a spotlight on the inequities in STEM education and outcomes across California, and that implementing the recommended reforms can increase equitable access and opportunity, and positively impact all students.

Executive Summary

California is struggling to keep up with the increasing demand for a skilled workforce in Science, Technology, Engineering, and Mathematics (STEM), and the insufficient preparation of underrepresented students of color—who make up the majority of California's school-aged population—is a major concern. By focusing on activating the untapped STEM talent pool, the United States can ensure students of color are prepared to enter the fastest-growing and highest-paying occupations of the future, and can increase the preparation of a homegrown talent pool to support continued growth in STEM fields and in the economy.

The pervasive achievement and opportunity gaps across California negatively impact the chances underrepresented students have to successfully matriculate through the STEM pipeline and into STEM careers. Disparities in funding, qualified teachers, course offerings, technology, and resources at the K-12 level by race and socioeconomic status impact the performance of African-American and Latino students.

Acknowledging the importance of improving STEM outcomes among California's diverse population for both economic growth in the state and the country, this report examines the opportunities and outcomes of underrepresented students as they progress through the public education system in California. As an updated version of the previous Dissecting the Data report (2010), this report examines the most recent data on STEM preparation from K-12 through higher education in California and also highlights national and international comparisons in STEM education and outcomes. This report contains several key findings:

In the early elementary grades, African-American and Latino students demonstrate much lower STEM proficiency rates than their White and Asian peers, and these trends persist.

- In 2nd grade mathematics, just over half of African-American students (51%) and Latino students (57%) reached proficiency, compared to 78 percent of White and 86% of Asian students.
- In 5th grade science, just 43% of African-American and 45% of Latino students reached proficiency. By comparison, nearly 80% of Asian and White students reached proficiency.
- By 6th grade forty-six percentage points separate African-American (35%) and Asian students (81%) in mathematics proficiency.
- The knowledge and skills developed in the early elementary years create a critical foundation for the development of later competencies, hence the educational disparities present at the elementary level significantly impact later STEM outcomes.

In the middle and high school years, proficiency rates decline and African-American and Latino students are less likely to access and achieve success in rigorous college-preparatory coursework than their White and Asian peers.

- Eighth grade Algebra I is viewed as a critical gatekeeper course, yet the majority of African-American and Latino students don't enroll until 9th grade. Of those who did enroll in 8th grade Algebra I, just 29% of African-American and 37% of Latino students reached proficiency.

- Of the students enrolled in Algebra II, just 16% of African-American and 21% of Latino students reached proficiency, while Asian and White students demonstrated Algebra II proficiency rates two to three times higher.
- Less than 2 in 10 African-American students reached proficiency in chemistry in 2011, and of the students who go on to take physics, just 25% of African-American and 35% of Latino students reached proficient levels of performance.
- African-American and Latino students are considerably underrepresented in AP coursework in math and science. Latino students represent 18% of AP science and 19% of AP math test-takers, although they represent 48% of the high-school aged population in California. African-American students represent only 2% of the AP math and science test takers in California, roughly a third of their percentage within the high-school aged population.
- On the ACT college readiness exam, 40-50 percentage points separate African-American and Latino students from their White and Asian peers. On the SAT, African-American students trail their White and Asian peers by over 115 points on the SAT mathematics section, and Latinos are outperformed by roughly 90 points.

African-American and Latino students are severely underrepresented in STEM enrollment in higher education in California, and demonstrate shockingly low retention and graduation rates within STEM fields.

- There are only 4,405 African-American students enrolled in STEM disciplines across both the University of California and the California State University entire systems (3% of the population). Latinos account for only 18% of the STEM majors across both University systems.
- Only 72 African-American students are enrolled in computer science across the UC system.
- There are roughly 7,000 more Asian students in life sciences at UC than Latino students (11,427 compared to 4,238).
- Among first-time freshman entering the CSU system in 2004, only 13% of African-American and 22% of Latino students graduated with a degree in STEM within 6 years.
- Using estimates, the total number of underrepresented students of color who graduated from UC and CSU with a degree in a STEM discipline in 2008 was 1,688.

The findings demonstrate profound inequities in both access and outcomes throughout the STEM educational pipeline. Coordinated and systematic efforts across sectors are needed to reverse these trends and re-invest in STEM education, particularly for underrepresented students of color. Drawing upon promising initiatives and practices, we highlight the following recommendations for improving the preparation of underrepresented students of color for success in STEM education and careers:

1. **Increase training and professional development opportunities for teachers within science and mathematics from pre-service to career.**
2. **Expand programs that develop early interest and counteract psychological barriers to STEM among underrepresented groups.**
3. **Increase access to rigorous and Advanced Placement courses, especially in mathematics and science.**
4. **Expand STEM acceleration and pre-college bridge programs.**
5. **Expand higher education programs that recruit and retain scholars of color in STEM fields and ensure their completion of STEM degrees.**

To receive information about Dissecting the Data 2012, or to receive a copy of the report, please e-mail info@lpfi.org or call 415.946.3030.

Dissecting the Data

INTRODUCTION

"To meet our needs for a STEM-capable citizenry, a STEM-proficient workforce, and future STEM experts, the nation must focus on two complementary goals: We must prepare all students, including girls and minorities who are underrepresented in these fields, to be proficient in STEM subjects. And we must inspire all students to learn STEM and, in the process, motivate many of them to pursue STEM careers."

-President's Council of Advisors on Science and Technology, 2010.

Why is STEM so important for the future of California and the nation?

Now more than ever, the United States must make significant progress on improving its performance and its international competitiveness in the fields of Science, Technology, Engineering, and Mathematics (STEM). Despite the increasingly widespread knowledge of the STEM deficits facing the United States, as recently addressed by the America COMPETES Act (2007, 2010) and President Obama's Educate to Innovate campaign, the United States has significant challenges to overcome.

Projections for the next 10 years and beyond indicate that the fastest growing jobs are in STEM fields (seven of the 10 fastest-growing occupations over the next ten years are in STEM).[i] Occupations within STEM fields have grown 8% in the last 10 years (2000-2010) and are expected to grow twice as fast (17%) in the next ten years.[ii] Nationwide, there are 2.4 million job vacancies for STEM workers projected between the years 2008 and 2018, and 65% of these jobs will require a Bachelor's degree or beyond. In California, there will be a demand for 1.1 million STEM jobs by 2018, and 93% will require postsecondary degrees.[iii] In addition to increased opportunities for employment, STEM occupations are also among the highest-paying. Sixteen of the 25 highest-paying jobs in the U.S. in 2010 required STEM preparation, and STEM workers earn 26% more on average than their non-STEM peers.[iv][v]

Yet, to keep up with this projected increase in demand and to capitalize on the economic benefits of job growth in STEM, American workers must be adequately educated and prepared to enter STEM professions. According to the World Economic Forum's global competitiveness report, the United States ranks 51st in the quality of mathematics and science education and 5th (and declining) in overall global competitiveness among OECD countries.[vi] Dismal STEM outcomes begin at an early age, where international assessments reveal that in 4th grade American students are consistently outperformed in math and science by countries including Singapore and Japan, and the U.S. falls even further behind by 8th grade.[vii]

In higher education, there are also disheartening statistics. The United States ranks 27th among developed nations in the proportion of college students receiving undergraduate degrees in science or engineering.[viii] As a result, there are more foreign students studying STEM in U.S. graduate schools than there are U.S. students,[ix] and over 2/3 of the engineers who receive Ph.D.'s from American universities are not United States citizens.[x]

With America's future economy highly dependent on skilled STEM workers, and without drastic improvements in STEM preparation, there are projected to be significant shortages of American citizens to fill open STEM

positions. The inability to prepare home grown talent to meet the needs of the economy then forces the United States to heavily rely on foreign-born professionals. Evidence of the shortage of home grown STEM professionals is already apparent: Foreign-born workers comprise approximately 17% of the U.S. STEM labor force, and in the physical sciences, that number reaches 25%.[xi] In addition, numerous companies have recently lobbied to reform H1B visa restrictions to allow more foreign workers to fill vacancies in high-tech occupations. Without major education reforms and initiatives, the United States workforce will not be in a position to take advantage of the future economy and fast-growing STEM occupations.

Why are underrepresented students of color critical to the future STEM workforce?

"The minds and talents of underrepresented minorities are a great, untapped resource that the nation can no longer afford to squander. Improving STEM education of our diverse citizenry will strengthen the science and engineering work force and boost the U.S. economy."

-Freeman Hrabowski III, President, University of Maryland, Baltimore County, 2010

African-Americans, Latinos, and Native Americans are highly underrepresented in STEM professions, relative to their overall population. In comparison to their White and Asian peers, underrepresented students demonstrate lower levels of achievement, dismal high school graduation rates (some estimates are around 50%), and enter higher education studying STEM at much lower rates. Underrepresented students of color also earn Bachelor's Degrees in STEM at rates much lower than their White and Asian peers.[xii] In fact, only 4% of African-Americans and Native Americans, and 2% of Latinos, have earned a Bachelor's degree in science or engineering.[xiii] In 2009, African-Americans and Latinos earned only 9% of all science and engineering degrees.[xiv]

In examining graduate education, of the U.S. citizens that earned Ph.D.'s in science and engineering in 2008, African-American, Latino, and Native Americans combined comprised only 11%.[xv] Furthermore, African-Americans and Latinos represent only 10% of faculty members in STEM departments,[xvi] 7% of the entire science and engineering workforce [xvii], and African-Americans represent just 1% of technology startup founders.[xviii]

These numbers represent a crisis. They suggest that a vast amount of untapped talent has been excluded from opportunities to pursue occupations in STEM due to pervasive inequalities throughout the STEM pipeline. Racial diversity in the United States is increasing rapidly and the current disparities in the educational system affecting underrepresented students of color are contributing to our talent shortage in STEM. For example, in California, where Latinos make up 43% of the college-age population, only 15% of Bachelor's degrees awarded to Latinos in 2007 were in STEM majors (compared to 22% of degrees awarded to Whites and 34% of degrees awarded to Asians). This trend is of great concern to the state, as it will limit the supply of STEM workers as Latinos become an increasingly larger percentage of the California labor force.[xix]

By focusing on activating the hidden STEM talent pool, the United States can ensure students of color are prepared to enter occupations which will further their economic security and ensure that they are included in the future economy (rather than being relegated to low-wage jobs and unemployment, based on educational attainment) and prepare homegrown talent to fill the future STEM positions and strengthen the economy.

Preliminary data has indicated that closing gaps in achievement and increasing mathematics performance among students of color would increase the GDP, increase individual wage earning, and increase taxpayer benefits substantially.[xx] [xxi] Applying these findings to STEM occupations suggests that preparing underrepresented people of color in STEM is a resource that is vital to the future of the United States.

California, the home of Silicon Valley, the center of innovation and technology, and the state with the largest K-12 population, must lead in education reform and initiating programs and policies to improve the outcomes for underrepresented groups in STEM. Acknowledging the importance of improving outcomes among California's diverse student populations for both

economic growth in the state and the country, this report will examine the opportunities and outcomes of underrepresented students as they progress through the public education system in California. As an updated version of LPFI's previous Dissecting the Data report (2010), this report will examine the most recent data on mathematics and science proficiency levels, gaps in achievement between subgroups, coursetaking and college preparation, and STEM higher education enrollment, retention, and graduation rates among underrepresented groups. This report will also highlight national and international comparisons in STEM education and outcomes.

Drawing upon promising initiatives and practices, this report will conclude by highlighting recommendations for improving the preparation of underrepresented students of color for success in STEM education and careers.

BARRIERS FACING UNDERREPRESENTED STUDENTS OF COLOR IN STEM EDUCATION

The underrepresentation of people of color in STEM fields is a highly complex issue and a substantial body of literature suggests that both educational inequities and psychological barriers impact the STEM outcomes of these groups. The most prominent barriers include inadequate access, opportunity, and preparation in K-12, inadequate support by colleges and universities, and psychological barriers that limit success and persistence in STEM fields.[xxii]

Inadequate Access, Opportunity and Preparation in K-12 Education

In California and across the nation, disparities in funding, quality teaching, course offerings, technology, and resources at the K-12 level negatively impact the opportunities that students of color have to prepare to enter and achieve success in STEM fields of study.

- School funding policies leave school districts that have the largest concentration of low-income students with substantially less per-pupil spending and fewer resources to allocate to student learning than wealthier districts—an average of $620 less per student per year, according to one study.[xxiii]
- On average, teachers in schools with high concentrations of low-income, minority students have less education, fewer qualifications, and less experience than teachers in schools with low concentrations of low-income, minority students.[xxiv xxv]
- In high-poverty, high-minority secondary schools, over 25% of math classes are taught by teachers with neither a certification nor a major in the subject (compared to 11% of low-poverty schools)[xxvi], despite evidence that deep content knowledge and mastery of pedagogy are key elements of effective STEM teachers.[xxvii]
- Teachers in schools serving the highest percentages of students in poverty were more likely to report that facilities were a major challenge in science education (35% vs. 13%), that they received too little support in assessing student learning in science (82% vs. 65%), and they were much less likely to have school-wide science initiatives in the last 5 years than schools with fewer students in poverty (33% vs. 68%).[xxviii]
- As compared to their more advantaged peers, students of color have less access to computers and internet-connected classrooms, and when computers are used in classrooms they are more likely to use them for independent learning or remedial skills and less likely to be instructed on the sophisticated use of computers to accomplish complex learning objectives.[xxix]
- The availability of courses vary significantly across schools and districts; high-minority, high-poverty schools offer fewer high-level math and science courses, engineering and

technology electives and extracurricular activities, and Advanced Placement STEM courses that are a critical component of college preparation and readiness.[xxx]

- Students of color are more likely to be formally or informally tracked into lower level math and science courses, despite actual ability,[xxxi] and subsequently are much less likely to be enrolled in advanced level math and science courses.

These inequities disproportionately affect low-income students of color, creating unnecessary burdens and preventing them from opportunities to develop the mathematical and scientific knowledge and skills needed for success in STEM studies.

Psychological Barriers to Involvement and Persistence in STEM

In addition to academic barriers in access and opportunity, there are also significant psychological (both conscious and unconscious) barriers that affect the involvement, engagement, and performance in STEM fields of study for underrepresented students of color. Oftentimes, the psychological barriers within individuals are a direct or indirect result of the racial inequity within STEM fields.

- Pervasive stereotypes about which racial/gender groups are capable of success in STEM fields leads to 'stereotype threat' or the fear of confirming negative stereotypes, decreases the academic performance of students who are negatively stereotyped within a domain (e.g., math/science) and can decrease their identification and engagement with the domain.[xxxii]

- Underrepresented groups in STEM also face challenges identifying with STEM professions and may perceive STEM subjects as difficult despite their demonstrated abilities.[xxxiii]

- A lack of role models within the field can have a detrimental effect on student engagement and persistence. Instructors of color are infrequent in STEM fields in both K-12 and higher education, despite the positive psychological impact that same-race instructors have on the outcomes of underrepresented students. [xxxiv]

- Although not specific to STEM fields of study, research indicates that among African-American students, perceived inequality within the educational context is significantly related to a decrease in engagement in academic endeavors.

Inadequate Support by Colleges and Universities

Even among the students who are admitted to four-year colleges and universities and intend to major in a STEM field of study, substantially lower persistence and completion rates exist among students of color, in comparison to their White and Asian counterparts.[xxxv] Numerous studies have highlighted barriers at the higher education level that contribute to lower persistence and completion rates among underrepresented students of color, ranging from inadequate high school preparation to encountering negative classroom climates.

Academic preparation in high school, including advanced coursework and rigorous high school curriculum, is one of the most important predictors of earning an undergraduate STEM degree.[xxxvi] In addition, research has pointed to the influence of the learning environment and classroom climate on the outcomes of students of color, where perceived negative climate in gatekeeper courses and reported experiences of negative racial interactions reduce persistence to degree completion in STEM. [xxxvii] Furthermore, there is evidence to suggest that the environmental factors at highly selective and predominantly White institutions are negative predictors of STEM degree completion for underrepresented students of color. Underrepresented students have a greater likelihood of graduation from minority-serving institutions, which provide a more supportive environment and increased engagement between students and faculty.[xxxviiixxxix]

It is important to understand the institutional, social and educational factors which impact the performance of underrepresented students of color in STEM. Examining outcome data from a deficit or gap analysis lens without an understanding of the factors creating disparate outcomes is insufficient.

STEM PREPARATION IN CALIFORNIA: THE NUMBERS

Research indicates that the state of California (as well as the nation) is struggling to keep up with the increasing demand for skilled professionals in STEM fields and the insufficient preparation of underrepresented students of color—who make up the majority of California's school-aged population—is a major concern. Prior to developing systemic interventions to improve proficiency rates, increase rigorous coursetaking, and improve college preparation and success in higher education, outcomes among the underrepresented students of color in STEM in California must be examined. The STEM pipeline begins with early educational opportunities to develop basic academic skills, gain exposure to hands-on and inquiry based instruction, and to develop interest and identification with math, science, and technology. This pipeline extends through middle and high school, where students must develop more sophisticated reading, mathematical, and analytical skills, and take a rigorous course sequence to prepare them for college-level coursework.

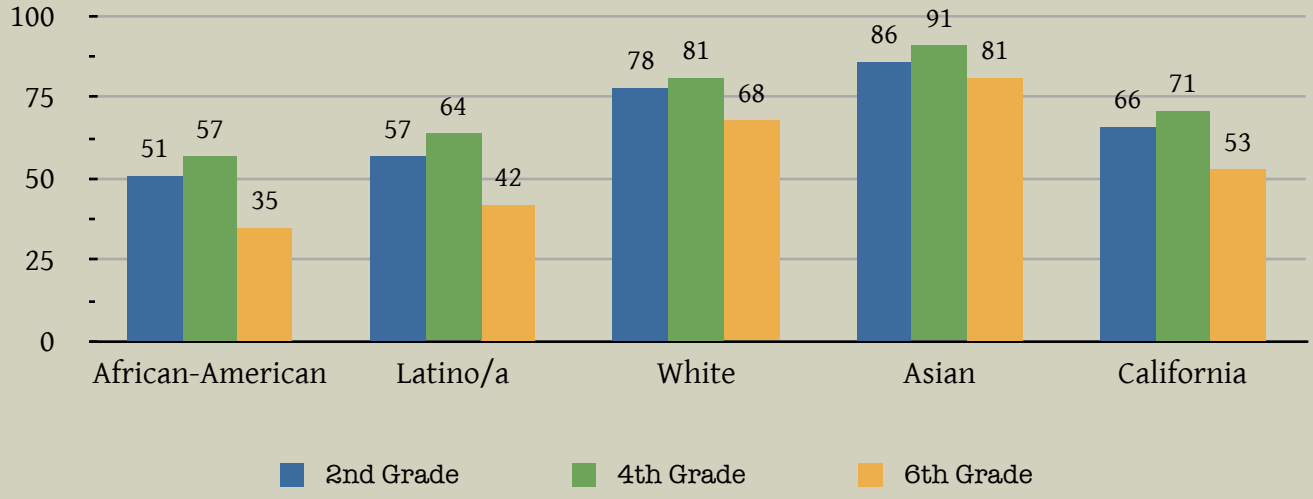
After gaining proficiency in math and science courses in high school, taking college entrance exams, and enrolling in college, students must pass critical lower division gatekeeper courses, declare majors and persist through undergraduate and graduate STEM programs. However, across California, pervasive achievement and opportunity gaps across all levels of schooling negatively impact the chances under-represented students of color have to successfully matriculate through the STEM pipeline and into STEM careers.

Elementary Years: Developing Early Proficiency in Math and Science

In early elementary school, African-American and Latino students demonstrate much lower proficiency rates on the 2011 California Standards Test (CST)[xl] in mathematics than their White and Asian peers. Just over half of all African-American students (51%) and Latino students (57%) reached proficiency in second grade mathematics (compared to 78% of White and 86% of Asian students). In fourth grade, math proficiency rates among students increase, and gaps decrease slightly so that only 17 percentage points separate White and Latino students.

In fact, over the past five years, proficiency rates among African-American and Latino fourth grade students have increased by 16 and 18 percentage points, respectively (See Appendix 1). However, by sixth grade proficiency rates dramatically decline. In sixth grade mathematics forty-six percentage points separate African-American and Asian students, with only 35% of African-American

Figure 1: CST Mathematics: 2nd, 4th and 6th Grade Proficiency Rates, by Race/Ethnicity (2011)



Source: California Department of Education, 2011.

students performing at grade level. Similarly, only 42% of Latino students reached grade-level proficiency in sixth grade math (See Figures 1 and 2).

In fifth grade science, the earliest tested grade in which students are assessed on basic knowledge of earth, life, and physical science, just 43% of African-American and 45% of Latino students reached proficiency. By comparison, nearly 80% of Asian and White students reached proficiency (See Figure 3).

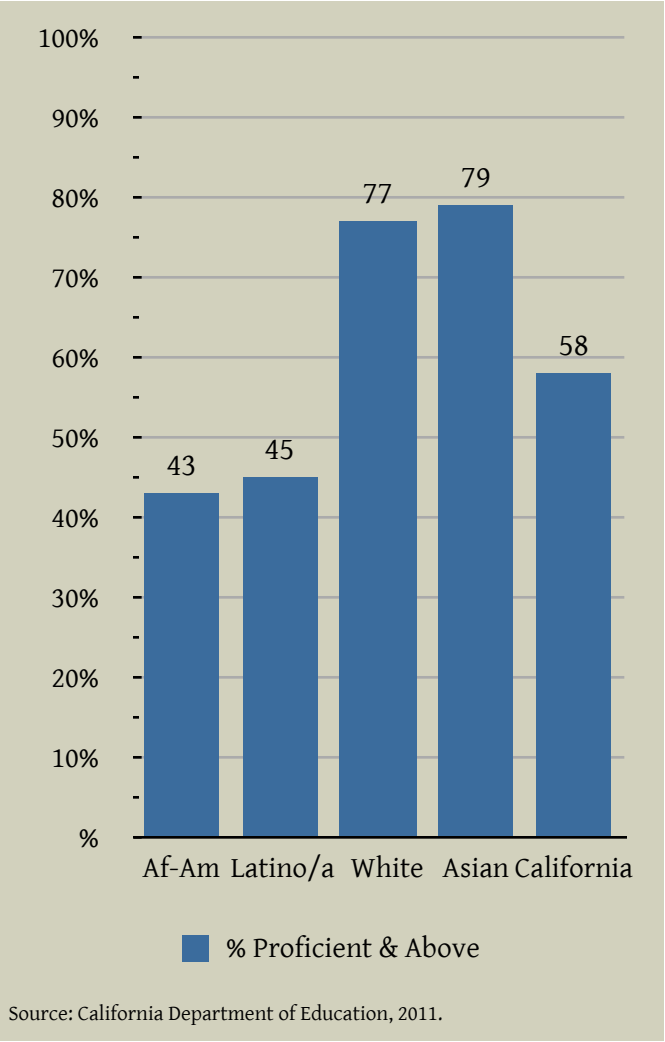
Math and science proficiency rate gaps within and between groups are even more dramatic when taking socioeconomic status into account. Gaps as large as 24 percentage points separate high-income and low-income students within the same racial/ethnic groups (e.g., Asian, Latino) in science proficiency. Looking between groups, in fourth grade mathematics, 95% of high-income Asian students reach proficiency, compared to 53% of low-income African-American students. In fifth grade science, over 50 percentage points separate high-income Asian students from low-income African-American students (88% compared with 37%; See Figures 4 and 5).

Figure 2: Achievement Gaps by Grade and Subject

Mathematics				
	B-W Gap	**B-A Gap**	**L-W Gap**	**L-A Gap**
2nd Grade	27	35	21	29
4th Grade	24	34	17	27
6th Grade	33	46	26	39
Science				
	B-W Gap	**B-A Gap**	**L-W Gap**	**L-A Gap**
5th Grade	34	36	32	34

Source: California Department of Education, 2011.

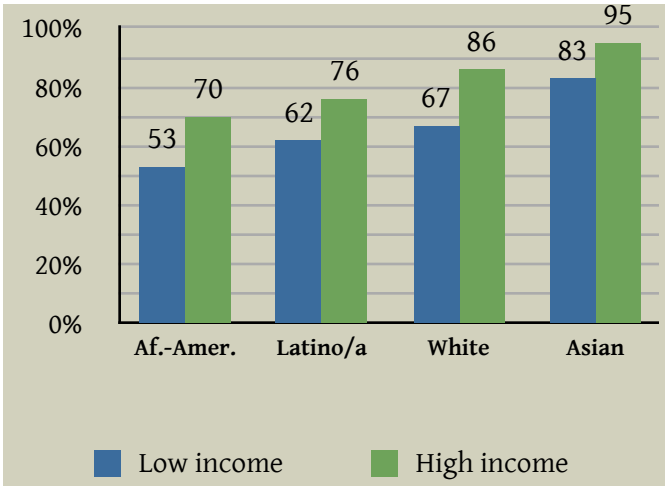
Figure 3: CST Science Proficiency Rates Among 5th Graders, by Race/Ethnicity



Source: California Department of Education, 2011.

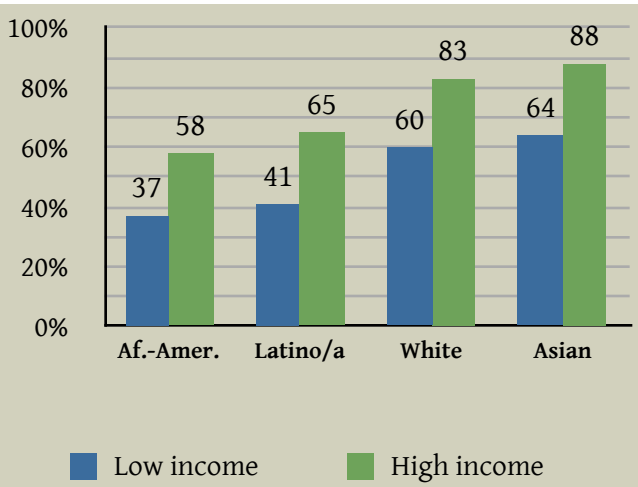
The large disparities between racial and socioeconomic groups in early mathematics and science outcomes are troubling considering that knowledge and skills developed in the early elementary years create a critical foundation for the development of later competencies. These disparities put underrepresented students of color, particularly low-income students, at a distinct disadvantage heading into middle and high school.

Figure 4: CST 4th Grade Math Proficiency Rates by Income and Race/Ethnicity (2011)



Source: California Department of Education, 2011.

Figure 5: CST 5th Grade Science Proficiency Rates by Income and Race/Ethnicity (2011)



Source: California Department of Education, 2011.

How Does California Compare to the Rest of the Nation?

According to the results of the National Assessment for Educational Progress (NAEP, 2011):

- In 4th grade mathematics, only eight states had significantly lower NAEP scores for African-American students than California. One state (Massachusetts) had significantly higher NAEP scores for African-American students.
- In 4th grade science, African-American students in nine states scored higher than African-American students in California.
- Latino students in 35 states scored significantly higher on the 2011 NAEP mathematics and 2009 4th grade science assessment than Latino students in California.

How Does the U.S. Compare to Other Countries?

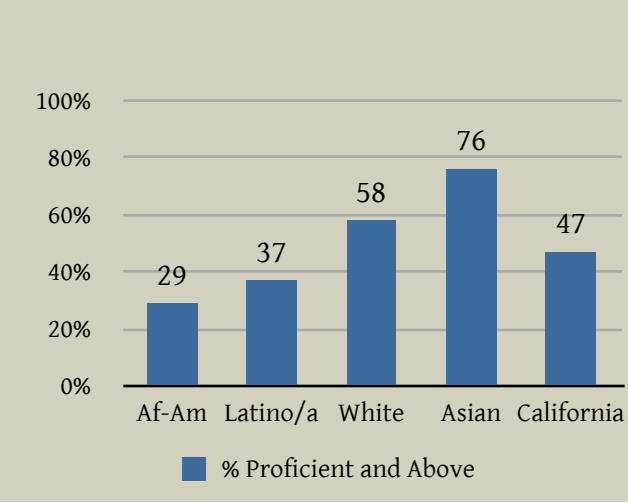
According to the most recent Trends in International Mathematics and Science Study (TIMSS, 2007):

- Fourth graders in eight countries significantly outperform U.S. 4th graders in mathematics. These countries include Hong Kong, Singapore, Chinese Taipei, Japan, and Kazakhstan.
- In 4th grade science, the United States is significantly outperformed by four countries: Singapore, Chinese Taipei, Hong Kong, and Japan (See Appendix 2).

The Critical Years: Middle and High School Achievement in Mathematics and Science

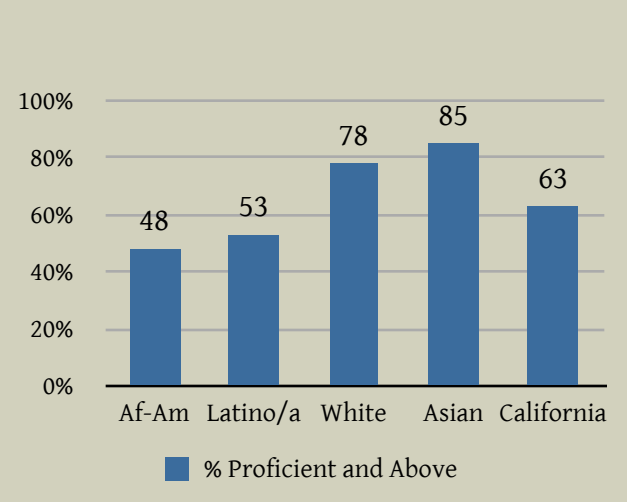
The middle and high school years are critically important periods within the STEM pipeline, where the courses students take and knowledge developed in those courses have implications for college preparation and success in higher education.

Figure 6: CST 8th Grade Algebra I Proficiency Rates by Race/Ethnicity (2011)



Source: California Department of Education, 2011.

Figure 7: CST 8th Grade Science Proficiency Rates by Race/Ethnicity (2011)



Source: California Department of Education, 2011.

Eighth grade Algebra I is viewed as a critical gatekeeper course because students who take and pass Algebra I by the end of 8th grade are more likely to take a college preparatory sequence of mathematics in high school ending with calculus in the 12th grade and are also more likely to enroll in biology, chemistry, and physics.[xli] [xlii]

However, African-American and Latino students are less likely to be enrolled in Algebra I in eighth grade, are more likely to be taking lower-level math courses than their peers, and have lower proficiency rates across these courses than their peers.[xliii]

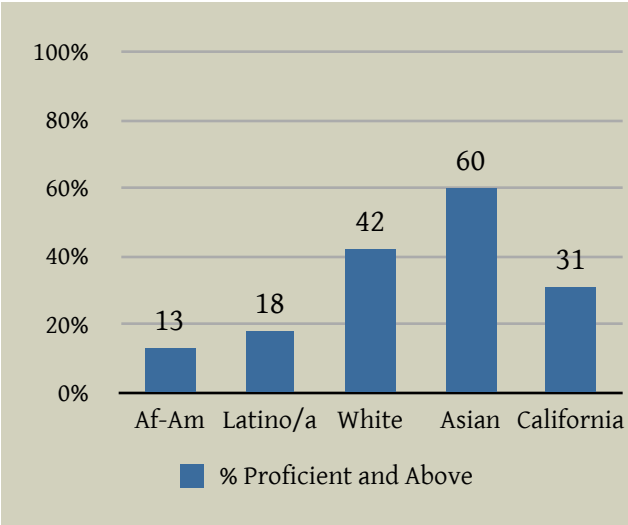
- In 2011, the majority of White and Asian students took Algebra I in 8th grade, while the majority of African-American and Latino students took Algebra in 9th grade.
- Among the students who enrolled in 8th grade Algebra I, proficiency rates varied tremendously. Twenty-nine percent of African-American and 37% of Latino students reached proficiency in Algebra I, while proficiency rates were almost twice as high among White (58%) and Asian (76%) students (Figure 6).
- These low proficiency rates suggest many of the students who took Algebra I as 8th graders would have to retake the course again in ninth grade, thus affecting their mathematics trajectory.
- While the 8th grade science proficiency rates are around 50% for both African-American and Latino students, large gaps still exist between groups (Figure 7).

Without a critical foundation in mathematics and science, proficiency rates decline as students progress through high school and take higher level mathematics courses, including geometry and algebra II, and science courses including chemistry and physics.

- Of all students who took geometry, only 13% of African-American students and 18% of Latino students reached proficiency in geometry standards.
- While 60% of Asian students reached proficiency in geometry, the large disparities between student groups leaves California's overall proficiency rate at less than 1/3 of all students (31%; Figure 8).

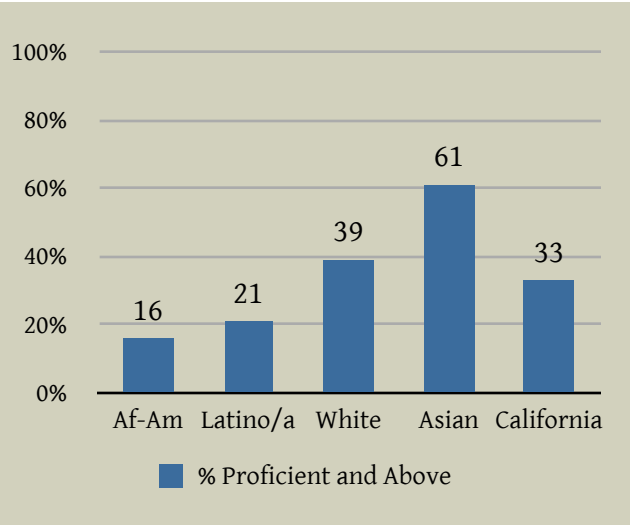
Algebra II is another critical gatekeeper course because it is both required to meet UC/CSU A-G eligibility requirements to attend a public university in California

Figure 8: CST Geometry Proficiency Rates by Race/Ethnicity (2011)



Source: California Department of Education, 2011.

Figure 9: CST Algebra II Proficiency Rates by Race/Ethnicity (2011)



Source: California Department of Education, 2011.

and has been shown to be a strong indicator of college readiness. In fact, research indicates that students completing Algebra II in high school more than doubled their chances of earning a Bachelor's degree. [xliv]

- African-American and Latino 11th graders were more likely to be concentrated in lower level math courses than their peers. For example, African-American and Latino student enrollment in Algebra I in 11th grade is roughly three times higher than Asian student enrollment in this lower level course (13% and 14% compared to 4%; Appendix 3).

- By 11th grade more Asian and White students have moved beyond Algebra II than African-American and Latino students.

- Of the students enrolled in Algebra II, just 16% of African-American and 21% of Latino students reached proficiency. Asian and White students demonstrated Algebra II proficiency rates two to three times higher (Figure 9).

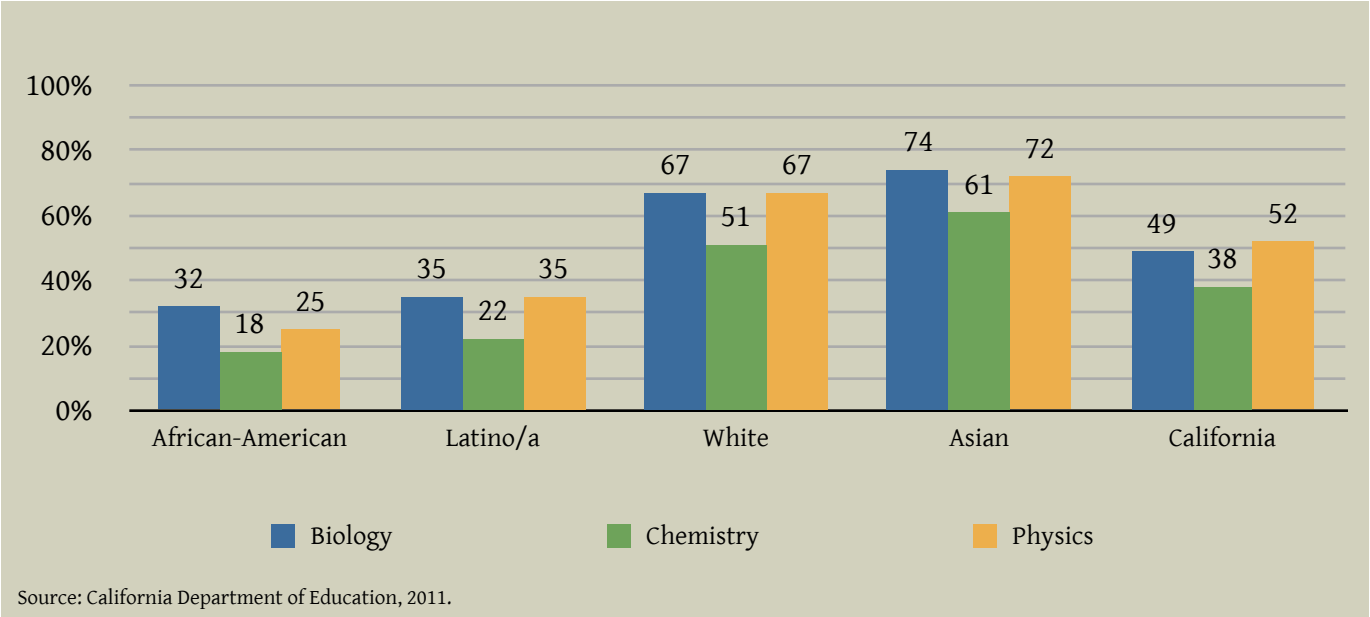
In science, students must complete two years of lab science (in biology, chemistry, and/or physics) to meet UC/CSU requirements to attend public universities in California. Yet, three to four years of science is recommended for students to be competitive to enter in the UC and/or CSU system within a STEM discipline. Students of color struggle to achieve proficiency across the science disciplines (Figure 10).

- 32% of African-American and 35% of Latino students reached proficiency in biology in 2011. This is an increase of three to four percentage points for each group. However, substantial gaps of over 40 percentage points persist.

- Less than two in 10 African-American students reached proficiency in chemistry in 2011.

- Of the students who go on to take physics, just 25% of African-American and 35% of Latino students reached proficient levels of performance.

Figure 10: CST Biology, Chemistry & Physics Proficiency Rates, by Race/Ethnicity (2011)



Source: California Department of Education, 2011.

How Does California Compare to the Rest of the Nation?

According to the results of the National Assessment for Educational Progress (NAEP) Mathematics (2011) and Science (2009) Assessment:

- In 8th grade mathematics, African-American students in 19 states and Latino students in 34 states scored significantly higher than their same-race peers in California.
- African-American students in nine states scored significantly higher than African-American students in California in 8th grade science, and Latino students in 35 states scored significantly higher on the 2011 NAEP mathematics and 2009 8th grade science assessment than Latino students in California.

How Does the U.S. Compare to Other Countries?

According to the most recent Program for International Student Assessment (PISA, 2009) conducted with 15-year-olds across OECD countries:

- 15-year olds in 17 countries significantly outperformed U.S. 15-year-olds in mathematics.
- In science, 15-year olds in the United States are significantly outperformed by 12 countries.
- These countries include Korea, Finland, Japan, Switzerland and New Zealand (See Appendix 5).

Advanced Coursework and College Prep

In high school, low proficiency rates among African-American and Latino students across math and science courses indicate that only a very small percentage of these students matriculate through high school achieving basic levels of proficiency in STEM studies.

Figure 11: AP Calculus & Statistics, % of Test-Takers by Race/Ethnicity

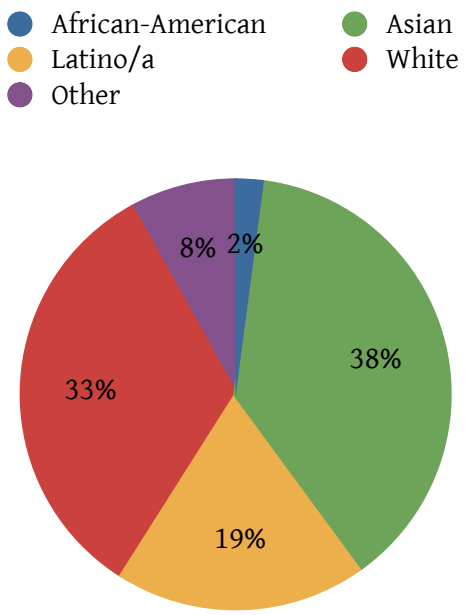
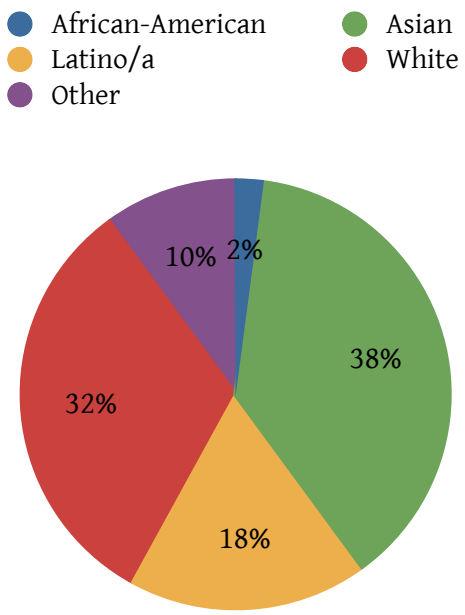
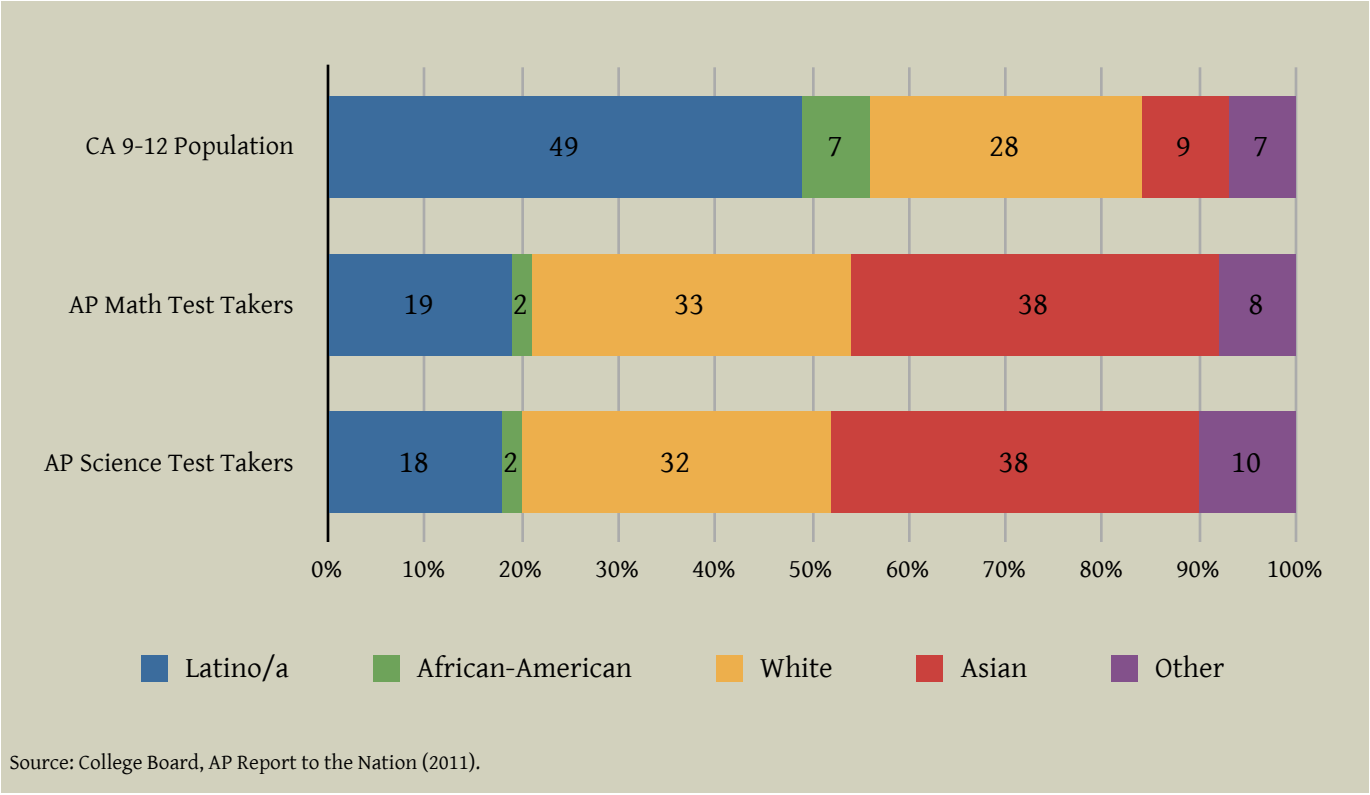


Figure 12: AP Science, % of Test-Takers by Race/Ethnicity



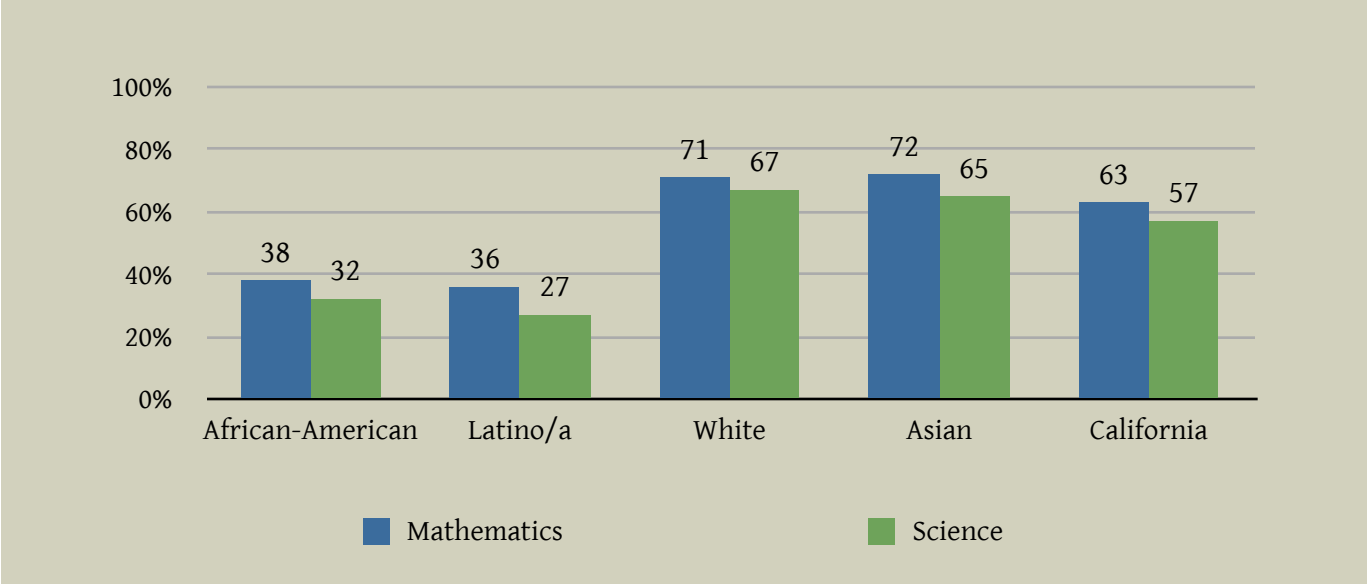
Source: College Board AP Report to the Nation (2011); Native American students constitute only 0.3% of all AP test-takers; Science courses include: biology, chemistry, computer science, environmental science, physics.

Figure 13: The Underrepresentation of Students of Color in AP STEM Courses in CA (2011)



Source: College Board, AP Report to the Nation (2011).

Figure 14: Percent of Students Passing AP Exams with a Score of 3 or Higher, by Race/Ethnicity (2011)



Source: College Board, AP Report to the Nation, 2011.

Even more troubling, achieving proficiency in math and science courses is only one limited measure of preparation in math and science, and to be truly "ready" for success in college, students must access and excel in rigorous curriculum and Advanced Placement (AP) courses. Students taking AP courses have access to rigorous curriculum designed to be equivalent to college-level course content. Low rates of access and success in AP courses, coupled with low proficiency rates in standard math and science courses, leads to dismal college readiness rates and low performance on college entry exams, putting underrepresented students of color at an even further disadvantage for entering college and completing degrees in STEM fields.

African-American and Latino students are considerably underrepresented in AP coursework in math and science. According to the most recent AP Report to the Nation (2011; Figure 11, 12, 13)[xlv]:

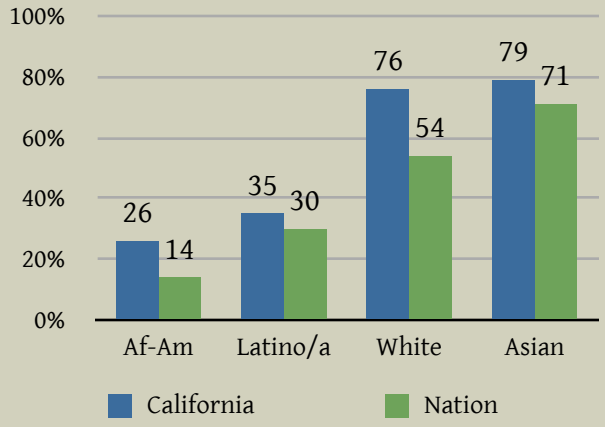
- Latino students represent just 18% of AP science and 19% of AP math test-takers, although they represent 49% of the high-school aged population in California.
- African-American students represent only 2% of the AP math and science test takers in California, roughly a third of their percentage within the high-school aged population.
- Since 2009, the percentage of AP math and science test-takers from Latino backgrounds has increased by two percentage points.

While the underrepresentation of students of color in AP STEM courses is concerning, it is also important to examine the success rates of the students who do enroll in these courses.[xlvi] In 2011, White and Asian students roughly doubled the AP science passage rates of African-American and Latino students (Figure 14).

- A little more than one-third of the AP math exams taken by African-American and Latino students earned scores of three or higher (38% and 36%, respectively).
- 32% of the AP science exams taken by African-American and 27% of the AP science exams taken by Latino students were passed.
- By comparison, passage rates for White and Asian students ranged from 67% to 72% on AP math and science exams.

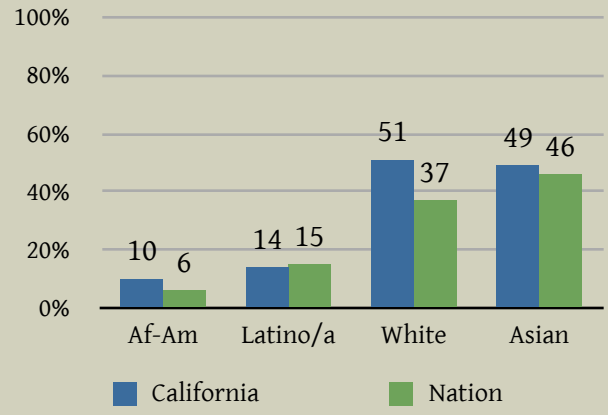
Given the low rates of proficiency in math and science courses and the low participation and success rates in

Figure 15: ACT Math: Percent Meeting College Readiness Benchmarks by Race/Ethnicity (2011)



Source: ACT, 2011.

Figure 16: ACT Science: Percent Meeting College Readiness Benchmarks by Race/Ethnicity (2011)



Source: ACT, 2011.

rigorous, college preparatory classes (e.g., Advanced Placement), underrepresented students of color complete high school less prepared for college, less likely to gain admission to college, and less likely to be academically successful in their first year of college than their peers.

The Early Assessment Program (EAP)[xlvii] provides an indicator of how well 11th graders in California have been prepared for college-level math.[xlviii] In 2011, only 5% of African-American and 7% of Latino students demonstrated college readiness on the EAP math assessment, while higher rates were demonstrated among White and Asian students (18% and 37%, respectively). This amounts to a total of only 5,600 Latino and African-American 11th graders across California who were prepared to take general mathematics at the college level.

The ACT exam provides another indicator of college readiness and an assessment of the knowledge and skills a student needs to enroll and succeed in first-year courses at postsecondary institutions without remediation (Figure 15 and 16).[xlixl]

- Across California, students demonstrate much higher levels of college readiness in math than in science.
- 26% of African-American students and 35% of Latino students in California met the ACT math college readiness benchmarks. Science readiness among these students was much lower—10% and 14%, respectively.
- Stark differences exist between underrepresented students of color and their peers, with roughly 40-50 percentage points separating African-American and Latino students from their White and Asian peers.
- Higher ACT scores are directly associated with more rigorous course sequences in math, where 77% of students taking Algebra I through Calculus met college readiness benchmark in mathematics.

After examining disparities in outcomes through elementary, middle, and high school, it is not surprising that the culminating exam used to assess knowledge, predict success in higher education, and factor into admissions decisions at many universities (the Scholastic Aptitude Test-SAT)[li] also demonstrates significant disparities between racial subgroups.

Among college-bound seniors in 2011,

- African-American students trail their White and Asian peers by over 115 points on the SAT

Figure 17: STEM Enrollment: UC and CSU (2010)

	UC TOTAL	CSU TOTAL	SYSTEMWIDE TOTAL
African-American	1,628 (2%)	2,777 (3%)	4,405 (3%)
Latino	9,179 (13%)	18,252 (23%)	27,431 (18%)
White	21,059 (29%)	26,606 (33%)	47,665 (31%)
American Indian/Alaskan Native	364 (0.5%)	349 (.04%)	713 (0.04%)
Asian/Pacific Islander	25,610 (35%)	14,598 (18%)	40,208 (26%)
Non-Resident/Alien	6,981 (10%)	6,530 (8%)	13,511 (9%)
TOTAL Note: Total includes "Filipino" "Other" and "No response."	**72,252**	**80,391**	**152,643**

mathematics section. Latinos are outperformed by slightly fewer points (roughly 90).

- To enter STEM majors, African-American and Latino students must compete with students with much higher scores. For example, the average SAT score for a student intending to major in Engineering was 584, a full 150 points higher than the average score for all African-American students.

How Does California Compare to the Rest of the Nation?

According to the results of the 2011 ACT and SAT assessments:

- African-American, Latino, and White students in California outperform the national average on the SAT mathematics exam; The national average for Asian students is higher than the average for Asian students in California.
- In both mathematics and science readiness on the ACT exam, each subgroup of students in California outperforms the national average (with the exception of Latino students in science).

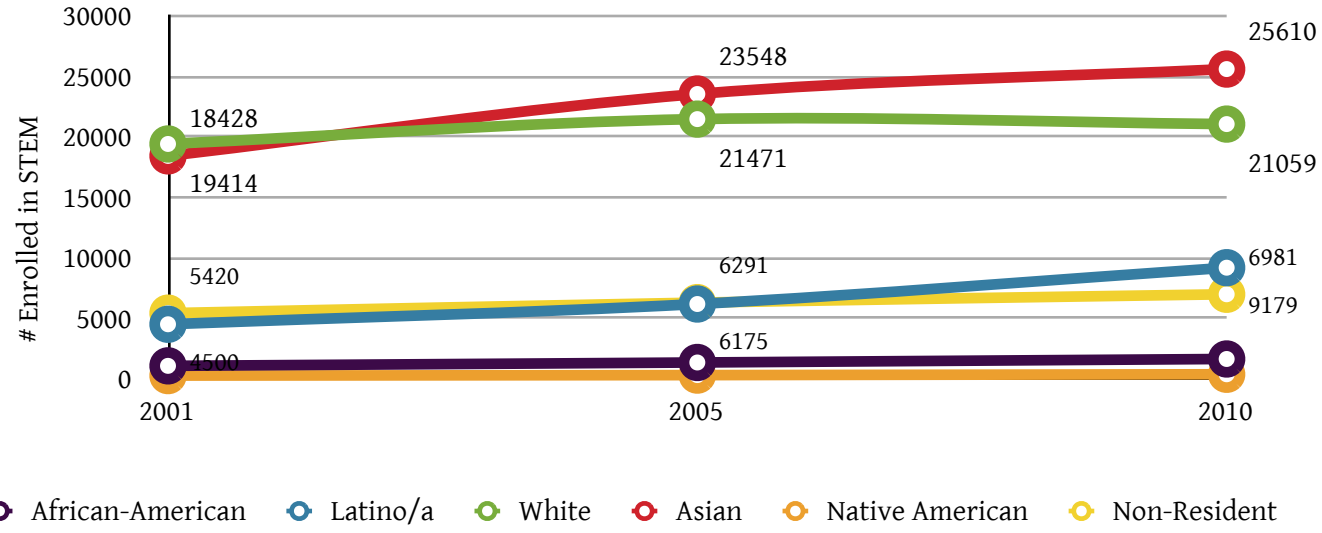
STEM Enrollment, Persistence, and Retention in Higher Education

The results of the college readiness examinations highlight the complex issues facing underrepresented students in STEM preparation throughout the STEM pipeline. Students face significant barriers and gaps in achievement by the end of elementary school, and these gaps grow wider as students progress through middle and high school. The lack of access to rigorous course sequences (and highly-qualified and engaging instruction) and lack of success within their courses creates a snowball effect, where they face significant deficits by the end of high school that seriously undermine their opportunity to attend college and successfully navigate college-level STEM coursework.

In 2010, a total of 152,643 undergraduates and graduates were enrolled in STEM majors across the University of California (UC) and California State University (CSU) systems, accounting for 24% of the total student population at UC/CSU. Yet, African-American and Latino students were severely underrepresented in STEM disciplines across both systems, both in comparison to other subgroups and when compared to their statewide population. According to the most recent data from the California Postsecondary Education Commission (2010; Figure 17):[lii]

- There were only 4,405 African-American students enrolled in STEM disciplines across both systems (3% of the population).

Figure 18: Trends in UC STEM Enrollment, by Race/Ethnicity (2001-2010)



Source: California Postsecondary Education Commission, 2010.

Figure 19: STEM Enrollment: University of California and California State University

STEM Enrollment: University of California							
STEM CATEGORY	**TOTAL**	**African-American**	**Latino/a**	**White**	**American Indian/ Alaskan Native**	**Asian**	**Non-Resident/ Alien**
Life Science	28,612	874	4,328	7,714	184	11,427	932
Engineering	25,015	430	2,849	6,778	98	8,874	3,517
Physical Science	10,076	179	1,046	3,930	54	2,916	927
Computer Science	4,650	72	335	1,299	10	1,419	1,065
Math	3,817	73	616	1,296	18	950	538
Other	82	0	5	42	0	24	2
UC TOTAL	**72,252**	**1,628**	**9,179**	**21,059**	**364**	**25,610**	**6,981**
STEM Enrollment: California State University							
STEM CATEGORY	**TOTAL**	**African-American**	**Latino/a**	**White**	**American Indian/ Alaskan Native**	**Asian**	**Non-Resident/ Alien**
Life Science	27,693	1,190	6,805	9,398	151	5,074	896
Engineering	30,369	813	6,687	9,693	97	5,589	3,636
Physical Science	5,587	186	1,135	2,148	31	882	243
Computer Science	9,389	388	1,542	2,666	24	2,027	1,462
Math	4,990	145	1,429	1,663	26	763	230
Technology	2,363	55	654	1,040	20	263	63
CSU TOTAL Total includes "Filipino" "Other" and "No response."	**80,391**	**2,777**	**18,252**	**26,608**	**349**	**14,598**	**6,530**

Source: California Postsecondary Education Commission, 2011; Enrollment includes undergraduate- and graduate-level students.

Figure 20: STEM Graduation Rates for Underrepresented Groups Attending UC (2003-2009)

	AFRICAN-AMERICAN			LATINO/A		
	# of Freshman Declaring STEM Major	6-year Graduation Rate	Estimated # of Students (Graduating in 6 years)	# of Freshman Declaring STEM Major	6-year Graduation Rate	Estimated # of Students (Graduating in 6 years)
Computer and Information Sciences	19	63%	12	103	62%	64
Engineering	69	68%	47	352	62%	218
Biological and Biomedical Sciences	198	74%	147	741	68%	504
Mathematics and Statistics	20	65%	13	116	77%	89
Physical Sciences	43	74%	32	157	66%	104

Source: University of California Office of the President, 2010. 2003-2009 is the most recent cohort with available data. Estimated number of students graduating within six years was calculated using the total number multiplied by the six-year graduation rate for the same cohort.

Figure 21: STEM Graduation Rates at CSU, By Race/Ethnicity (2004-2010)

	# Freshman Declaring STEM Major (2004)	4-year Graduation Rate	6-year Graduation Rate	Estimated # of Students (Graduating in 6 years)
African-American	438	3%	13%	57
Latino	1,823	4%	22%	401
White	3,266	9%	39%	1,274
Asian/Pacific Islander	2,010	6%	31%	623
Non-Resident Alien	169	6%	30%	51

Source: California State University, Consortium for Student Retention Data Exchange (CSRDE), 2010. 2004-2010 is the most recent cohort with available data. Estimated number of students graduating within 6 years was calculated using the total number multiplied by the 6-year graduation rate for the same cohort.

- While there were twice as many Latino STEM majors at CSU than at UC, Latinos accounted for only 18% of the STEM majors across both systems.
- There were only slightly more Latino students majoring in STEM at UC (9,179) than there were non-U.S. residents enrolled in UC's STEM programs (6,981).

In examining trends in UC STEM enrollment over the past 10 years, some progress has been made in increasing the numbers of Latino students enrolled in STEM; the numbers have increased by roughly 4,600 since 2001. Yet, the gaps between groups haven't closed since the pace of growth for Asian students has been even greater; their numbers have increased by approximately 7,000 during the same period of time. The group with the least amount of growth has been African-American students, whose numbers have only increased by roughly 550 in 10 years (Figure 18).

Looking more closely at STEM enrollment by discipline, the following statistics further demonstrate the underrepresentation of African-American and Latino students in STEM majors and these low numbers

represent a significant barrier to preparing the future generation of STEM professionals in California (Figure 19).

- Only 72 African-American students were enrolled in computer science and 73 were enrolled in math across the UC system.
- There were roughly 7,000 more Asian students in life sciences at UC than Latino students (11,427 compared to 4,238).
- The CSU system enrolled roughly 2.5 times more Latino students than the UC system; CSU also enrolled five times as many computer science majors.

While the enrollment figures for underrepresented students of color majoring in STEM across UC and CSU campuses are dismal, even more disheartening are the persistence and graduation rates for the students who do enter college in California enrolled in a STEM major. Although the UC system admits and retains far fewer students from underrepresented background in STEM majors than CSU, graduation rates at UC are two to four times higher (Figures 20 & 21). According to the most recent persistence/retention data from UC and CSU[liii liv]:

- Among first-time freshman entering the University of California system in 2004, six-year graduation rates for African-American and Latino students are approximately 62-77% across STEM disciplines.
- Using estimates, the approximate number of African-American and Latino students who graduate within six years in STEM from UC is a total of 76 in computer science and a total of 60 in physical sciences, and 265 in engineering (groups combined).
- Among first-time freshman entering the CSU system in 2004, only 13% of African-American and 22% of Latino students graduated with a degree in STEM within six years (See Figure 16). Meanwhile, 39% of White students entering CSU in 2002 graduated by 2008 with a STEM degree.
- Further, the four-year graduation rates across all groups at the CSU system are below 10%, with African-American students the lowest at 3%.
- Using estimates, the total number of underrepresented students of color who graduated from UC and CSU with a degree in a STEM discipline in 2008 was 1,688.

How Does California Compare to the Rest of the Nation?

- California ranks 5th in percentage of science and engineering degrees conferred (3%).
- Vermont, D.C., Maryland and Wyoming lead the country in percentage of science and engineering degrees conferred.

How Does the U.S. Compare to Other Countries?

- The U.S. graduates a lower percentage of college students with degrees in life and physical sciences, math, computer science and engineering than the average for all OECD countries.
- Only 3.6% of college graduates in the U.S. have degrees in math or computer science.
- Only 6% have degrees in engineering, which is half the average for all other OECD countries (12%).

CRITICAL CHANGES ARE NEEDED TO IMPROVE STEM PREPARATION FOR UNDERREPRESENTED STUDENTS OF COLOR IN CALIFORNIA

Underrepresented students of color make up 59 percent of California's K-12 student population (with Latino students as a group comprising 51% alone), yet disparities in funding, quality teaching, course offerings, technology, and resources/facilities based on race and socioeconomic status create massive achievement gaps in

STEM outcomes. As early as elementary school, the impact of these disparities within the K-12 pipeline are readily apparent. African-American and Latino students demonstrate much lower levels of proficiency in math and science when compared to their White and Asian peers. By eighth grade, math and science proficiency levels decrease, achievement gaps widen, and disparities in rigorous coursetaking between groups result in African-American and Latino students being less likely to enroll in Algebra I in eighth grade, more likely to take lower-level math courses, and less likely to reach proficiency across math and science courses than their peers.

By the end of high school, only 21% of Latino students and 16% of African-American students reach proficiency in Algebra II, students of color are vastly under-represented in AP courses, and ultimately 40-50 percentage points separate African-American and Latino students from their White and Asian peers in college readiness benchmarks in math and science.

The dismal college readiness rates clearly demonstrate the impact of disparities throughout the K-12 educational pipeline, and affect the number of African-American and Latino students enrolling in and completing degrees across the UC and CSU systems. Only 31,800 African-American and Latino students were enrolled in STEM fields across the UC and CSU system in 2011, and persistence and graduation rates are low (especially within the CSU system), reducing the number of STEM graduates from underrepresented backgrounds even further. For example, based on estimates of six-year graduation rates, just 1,688 underrepresented students of color graduated from UC and CSU with a degree in a STEM discipline in 2008.

Recommendations

Coordinated and systematic efforts across sectors are needed to reverse these trends and re-invest in STEM education, particularly for underrepresented students of color in California. To address inequities in STEM education and increase the STEM outcomes of students of color, we highlight promising statewide and nationwide practices and initiatives and suggest the following recommendations:

1 Increase training and professional development opportunities for teachers within science and mathematics from pre-service to career, to ensure that teachers are prepared with both content knowledge and pedagogical skills to deliver effective instruction to all students.

2 Expand programs that develop early interest and counteract psychological barriers to STEM among underrepresented groups, especially through the promotion of hands-on instruction in the early grades, extracurricular activities in middle and high school, and mentorship programs.

3 Increase access to rigorous and Advanced Placement courses in mathematics and science to ensure underrepresented students of color enroll in larger numbers in the courses necessary to prepare for college-level work.

4 Expand STEM acceleration and pre-college bridge programs to ensure students who have demonstrated interests in STEM fields complete high school with the skills needed to persist and graduate with degrees in STEM.

5 Expand higher education programs that recruit and retain scholars of color in STEM fields and ensure their completion of STEM degrees (through mentorship, financial assistance, peer and faculty networks).

California is producing too few graduates to meet the projected increase in demand for STEM graduates to fill the fast-growing STEM occupations that are critical to the economy of the state.[lv] Despite the fact that California is a major source of innovation in science and technology and educates roughly one-eighth of all students in the United States, the STEM outcomes for

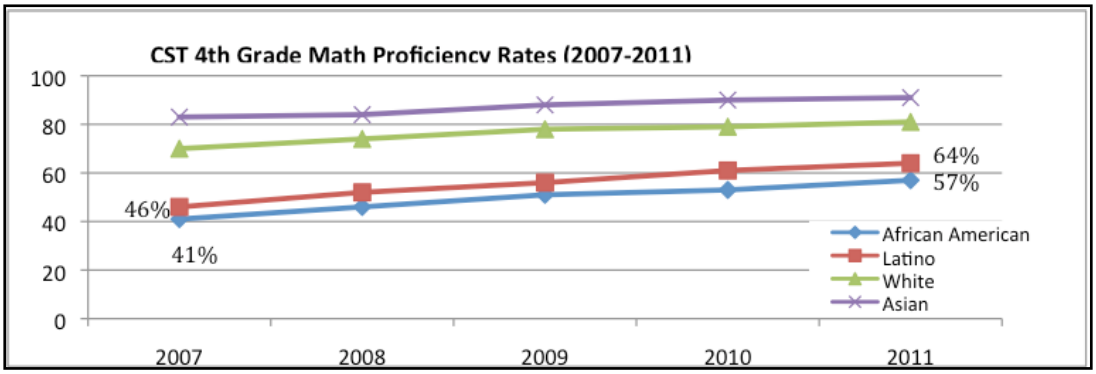
diverse groups in California are dismal. The vast disparities in STEM preparation existing between underrepresented students of color and their peers in California are problematic in both the limited future opportunities afforded to these students and the significant loss of a large pool of talent for the state.

At each level in the STEM pipeline, significant numbers of underrepresented students are denied the opportunities to develop skills in science, math, engineering, and technology that will prepare them for careers in the fastest-growing and most lucrative occupations of the future.

Investing in the educational development of underrepresented students of color, who comprise the largest population in California and the fastest-growing population in the country, is of critical importance to California's future economy and to the continued growth, innovation, and technological advancement of the nation.

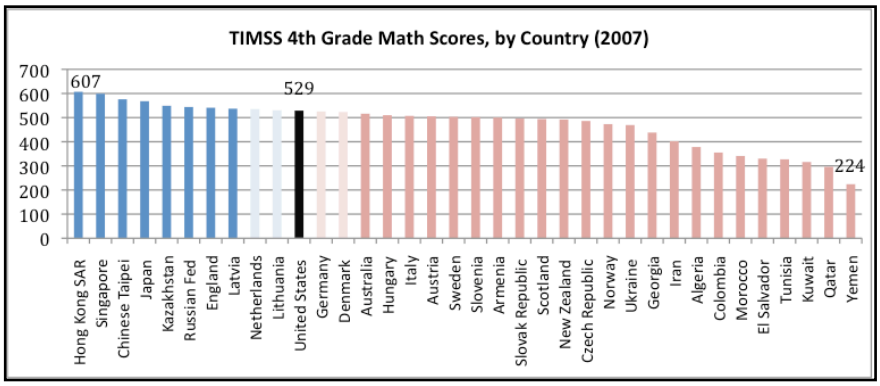
Appendix

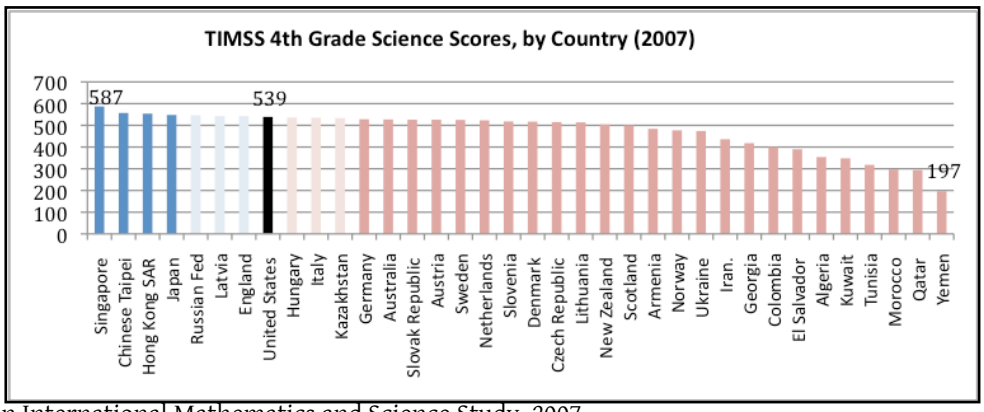
Appendix 1.



Source: California Department of Education, 2011

Appendix 2.





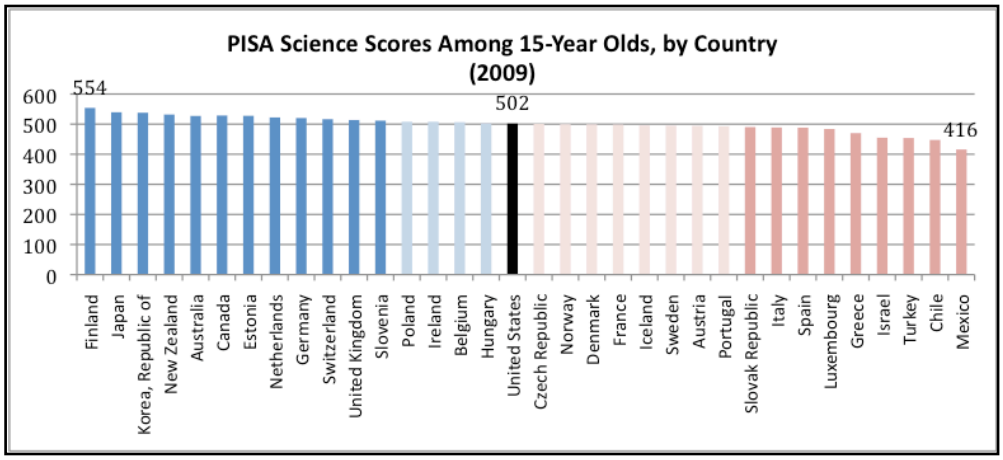
Source: Trends in International Mathematics and Science Study, 2007.

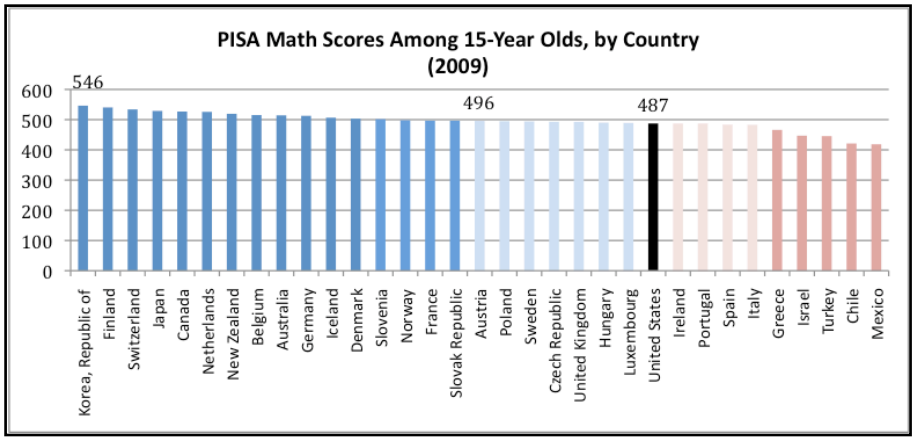
Appendix 3.

CA 11th Grade Mathematics Course Enrollment (2011)				
	African American	**Latino**	**Asian**	**White**
Total 11th Grade Enrollment	35,543	235,736	44,066	141,910
Algebra II	8836 (25%)	60,244 (26%)	9732 (22%)	36,396 (27%)
Geometry	6809 (19%)	46,425 (20%)	3525 (8%)	19,094 (13%)
Algebra I	4466 (13%)	32,792 (14%)	1569 (4%)	11,668 (8%)
Integrated 1, 2, 3	867 (2%)	4379 (2%)	501 (1%)	2662 (2%)
Remaining Course?	41%	38%	65%	50%

Source: California Department of Education, 2011

Appendix 4.





Source: Program for International Student Assessment (2009)

End Notes

[i] U.S. Department of Labor, U.S. Bureau of Labor Statistics (BLS, 2009). *Employment Projections Program.* http://www.bls.gov/emp/ep_table_102.htm

[ii] U.S. Department of Commerce, Economics and Statistics Administration (ESA,2011). *STEM: Good Jobs Now and for the Future.* http://www.esa.doc.gov/sites/default/files/reports/documents/newstemljuly14.pdf

[iii] Georgetown University, Center for Education and the Workforce, *STEM State Level Analysis*

[iv] U.S. Department of Labor, U.S. Bureau of Labor Statistics (BLS, 2007). Occupational Outlook Quarterly: STEM Occupations. http://www.bls.gov/opub/ooq/2007/spring/art04.pdf.

[v] U.S. Department of Commerce, Economics and Statistics Administration (ESA,2011). *STEM: Good Jobs Now and for the Future.* http://www.esa.doc.gov/sites/default/files/reports/documents/newstemljuly14.pdf

[vi] World Economic Forum (2011). The Global Competitiveness Report 2010-2011. http://reports.weforum.org/global-competitiveness-2011-2012/.

[vii] Trends in International Mathematics and Science Study (TIMSS, 2007)

[viii] Organization for Economic Cooperation and Development (2009). *Education at a Glance 2009: OECD Indicators*; Table A-3.5.

[ix] Task Force on the Future of American Innovation (2006). *Measuring the Moment: Innovation, National Security, and Economic Competitiveness. http://futureofinnovation.org/PDF/BII-FINAL-HighRes-11-14-06_nocover.pdf* .

[x] National Science Foundation (NSF, 2011). Science and Engineering Doctorate Awards: 2007-08. http://www.nsf.gov/statistics/nsf11321/pdf/nsf11321.pdf

[xi] Georgetown University, Center for Education and the Workforce, *STEM State Level Analysis*

[xii] Higher Education Research Institute at UCLA (2010). Degrees of Success: Bachelor's Degree Completion Rates among Initial STEM majors. http://www.heri.ucla.edu/nih/downloads/2010%20-%20Hurtado,%20Eagan,%20Chang%20-%20Degrees%20of%20Success.pdf

[xiii] Ibid.

[xiv] National Science Foundation, National Center for Science and Engineering Statistics, special tabulations of U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey, 2001–09.

[xv] National Science Foundation (NSF, 2011). Science and Engineering Doctorate Awards: 2007-08. http://www.nsf.gov/statistics/nsf11321/pdf/nsf11321.pdf

[xvi] Ibid.

[xvii] National Science Foundation (2011). Women, Minorities, and Persons with Disabilities in Science and Engineering: 2011. http://www.nsf.gov/statistics/wmpd/pdf/nsf11309.pdf

[xviii] Black Enterprise Magazine (2011). The Digital Divide: Are African-Americans Being Left Behind? (May 18, 2011; Hajj Flemings) http://www.blackenterprise.com/2011/05/18/digital-divide/.

[xix] CSU Sacramento, Institute for Higher Education Leadership & Policy (2009). *Technical Difficulties: Meeting California's Workforce Needs in Science, Technology, Engineering, and Math (STEM) Fields*

[xx] McKinsey & Company (2009). The Economic Impact of Achievement Gaps in America's Schools. http://mckinseyonsociety.com/downloads/reports/Education/achievement_gap_report.pdf

[xxi] Center for Technology in Learning (2009). Some Economic Consequences of Improving Math Performance. https://zimbra.kei.com/service/home/~/CTL_economic_consquences_math_report_092009.pdf?auth=co&loc=en_US&id=22221&part=2

[xxii] Perna, L., Lundy-Wagner, V., Drezner, N. D., Gasman, M., Yoon, S., Bose, E., Gary, S. (2009). The contribution of HBCUs to the Preparation of African-American Women for STEM Careers: A Case Study. Research in Higher Education, 50(1), 1-23. https://www.education.umd.edu/Depts/EDHI/about/faculty_pages/ndrezner/The%20Contribution%20of%20HBCUS.pdf

[xxiii] EdTrust-West (2012). The Cruel Divide: How California's Education Finance System Shortchanges its Poorest School Districts. http://www.edtrust.org/sites/edtrust.org/files/ETW%20Cruel%20Divide%20Report.pdf

[xxiv] National Science Foundation (NSF, 2008). Science and Engineering Indicators: 2008. http://www.nsf.gov/statistics/seind08/c1/c1h.htm

[xxv] Darling-Hammond, L. (2004). Inequality and the right to learn: Access to qualified teachers in California's Public Schools. http://www.srnleads.org/data/pdfs/ldh_achievemen_gap_summit/inequality_TCR.pdf.

[xxvi] EdTrust (2010). Not Prepared for Class: High Poverty Schools Continue to Have Fewer In-Field Teachers. http://www.edtrust.org/sites/edtrust.org/files/ETW%20Cruel%20Divide%20Report.pdf

[xxvii] National Research Council (2010). Preparing Teachers: Building Evidence for Sound Policy. http://www.nap.edu/openbook.php?record_id=12882&page=103

[xxviii] WestEd Center for the Future of Teaching and Learning (2011). High Hopes-Few Opportunities: The Status of Elementary Science Education in California http://www.scribd.com/doc/70262940/High-Hopes-Few-Opportunities-by-Center-for-the-Future-of-Teaching-and-Learning-at-WestEd#archive

[xxix] Goode, J. (2010). Mind the Gap: The Digital Dimension of College Access http://geekyartistlibrarian.pbworks.com/f/Mind+the+gap+-+The+digital+dimension+of+college+access.pdf

[xxx] San Francisco County Superior Court (2000). Williams et al. v. State of California et al http://www.decentschools.org/court_papers.php Daniel v. California No. BC 214156

[xxxi] Oakes, J. (1985/2005). Keeping Track: How Schools Structure Inequality. Yale University Press;

[xxxii] Aronson, J., Steele, C. (1995). Stereotype Threat and the Intellectual Test Performance of African-Americans. http://www.aronsonresearch.com/pdfs/SandA1995.pdf

[xxxiii] Ibid.

[xxxiv] Price, J. (2010). The Effect of Instructor Race and Gender of Student Persistence in STEM Fields .

[xxxv] Higher Education Research Institution (2010). Degrees of Success: Bachelor's Degree Completion Rates among Initial STEM Majors. http://www.heri.ucla.edu/nih/downloads/2010%20-%20Hurtado,%20Eagan,%20Chang%20-%20Degrees%20of%20Success.pdf

[xxxvi] Ibid.

[xxxvii] Chang, M., Eagan, M.K., Lin, M.H., Hurtado, S. (2009). Stereotype Threat: Undermining the Persistence of Racial Minority Freshmen in the Sciences. http://www.heri.ucla.edu/nih/downloads/AERA%202009%20-%20Chang,%20Eagan,%20Lin,%20Hurtado%20-%20Stereotype%20Threat.pdf

[xxxviii] Eagan, M. K., Jr., Hurtado, S., Chang, M. (2010). What Matters in STEM: Institutional Contexts that Influence STEM Bachelor's Degree Completion Rates. http://www.heri.ucla.edu/nih/downloads/ASHE%202010%20-%20Eagan,%20Hurtado,%20Chang%20-%20What%20matters%20for%20STEM%20Completion.pdf

[xxxix] Perna, L., Lundy-Wagner, V., Drezner, N. D., Gasman, M., Yoon, S., Bose, E., Gary, S. (2009). The contribution of HBCUs to the Preparation of African-American Women for STEM Careers: A Case Study. Research in Higher Education, 50(1), 1-23. https://www.education.umd.edu/Depts/EDHI/about/faculty_pages/ndrezner/The%20Contribution%20of%20HBCUS.pdf

[xl] California Department of Education (2011). Dataquest. www.cde.ca.gov

[xli] Stein, M. K., Kaufman, J. H., Sherman, M., Hillen, A. (2011). Algebra: A challenge at the crossroads of policy and practice. Review of Educational Research, 81 (4), 453-492.

[xlii] Paul, F.G. (2005). Grouping within Algebra I: A structural sieve with powerful effects for low-income, minority, and immigrant students. *Educational Policy,* 19, 262-282.

[xliii] National Center for Education Statistics (2011). Nation's Report Card http://nces.ed.gov/nationsreportcard/pdf/main2011/2012458.pdf

[xliv] Adelman, C. 1999. *Answers in the Tool Box: Academic Intensity, Attendance Patterns, and Bachelor's Degree Attainment*. Washington, DC: U.S. Department of Education http://www2.ed.gov/pubs/Toolbox/toolbox.html

[xlv] The College Board (2011). The 7th Annual AP Report to the Nation. http://apreport.collegeboard.org/

[xlvi] Students who perform successfully on AP exams (receive a score of 3+) gain access to the corresponding college course (instead of having to take placement test or prerequisite courses) and students who receive a score of 4 or 5 are eligible to receive college credit.

[xlvii] Early Assessment Program (2011). Test Results 2011. http://eap2011.ets.org/ViewReport.asp

[xlviii] EAP scores are utilized by the CSU system to determine college readiness among 11th graders; Students who are deemed to be "college-ready" can enroll directly in college-level coursework, students who are "college ready-conditional" must take and pass a senior year math course to enroll directly in college-level work, while students who do not demonstrate proficiency must enroll in remedial coursework in college (which receives no credit towards graduation).

[xlix] ACT (2011). The Condition of College and Career Readiness-2011. http://www.act.org/newsroom/data/2011/index.html

[l] The EAP is taken in 11th grade, the ACT can be taken anytime during high school, typically from 11th-12th grade.

[li] Scholastic Aptitude Test (2011). Total Group and State Reports-College Bond Seniors 2011 http://professionals.collegeboard.com/data-reports-research/sat/cb-seniors-2011

[lii] California Postsecondary Education Commission (2011). UC and CSU Enrollment by STEM Discipline. www.cpec.ca.gov

[liii] University of CA Office of the President (2010) "Persistence Rates in Year 1 and 2, Graduation Rates in Year 4, 5, 6 (2002-2008)

[liv] CA State University, Center for Student Retention Data Exchange (CSRDE) (2011). Retention and Graduation Rates Among Full-Time First-Time Freshman Declaring Majors in STEM.

Promising STEM Initiatives

TEACHER PREPARATION

- The National Math and Science Initiative's UTeach program, which began at the University of Texas at Austin , sponsors science and math undergraduate teacher recruitment and preparation programs at universities nationwide. The University of California system has CalTeach programs (the California affiliate of the UTeach initiative) at universities across California which works with current undergraduate math and science majors to recruit them into the STEM teaching profession and provides rigorous training in both content knowledge and pedagogy.

- President Obama's 2010 Educate to Innovate initiative brought together corporate partnership investments of $250 million for multiple STEM programs and initiatives, one of which seeks to prepare 10,000 new math and science teachers and to provide training to 100,000 current STEM teachers.

EARLY INTEREST, EXTRACURRICULAR ACTIVITIES, MENTORSHIP PROGRAMS

- The California Afterschool Network's STEM in Out-of-School Time Initiative works with over 250 programs throughout the state of California to provide STEM curricula, training, and professional development in order to increase high quality STEM opportunities for youth in after-school programs. This project is part of a broad effort to build innovative STEM programs for students in grades K-8 across California.

- Great Minds in STEM The mission of Great Minds is to inspire and motivate underserved students to pursue careers in STEM and to enlighten and engage families, educators, communities and employers to assist underserved students pursuing STEM careers. Two main programs are STEM Up and Viva Technology.

ADVANCED PLACEMENT COURSEWORK

- The National Math and Science Initiative's Advanced Placement Training and Incentive Program attempts to increase access to math and science AP courses for underrepresented students, and to transform school college-going culture and AP expectations. This program has had success in increasing the number of students taking and passing AP mathematics and science exams, particularly for underrepresented students.

- The United States Department of Education announced in August 2011 that it will award a total of $6.6 million for 12 new Advanced Placement Incentives Program grants, with Los Angeles Unified School District recently receiving $600,000 in funding under this initiative, in order to assist low-income students with increased access to and success in Advanced Placement STEM courses.

BRIDGE PROGRAMS

- The California STEM Service-Learning Initiative supports high school and university students across the state, and works to meet local community needs through service projects. Students work with teachers, university faculty, and STEM industry advisors as they utilize service-learning to teach STEM disciplines and explore STEM fields. The initiative particularly aims to increase the number of women and students of color studying STEM and entering STEM fields.

- Engineering the Future: Science, Technology, and the Design Process is a full-year course designed to introduce students to the world of technology and engineering, as a first step in becoming technologically literate citizens. The course isintended to help today's high school students understand the ways in which they will engineer the world of the future — whether or not they choose to pursue technical careers.

HIGHER EDUCATION PROGRAMS TO INCREASE RECRUITMENT AND RETENTION

- The California State University system is working to increase the number of graduates in STEM through their new Service Learning Transforming Educational Models in Science, Technology, Engineering, and Mathematics (STEM)[2] initiative. This program aims to increase the number of STEM majors and graduates, as well as the number of California State University graduates entering the STEM workplace. The program also works to prepare students to apply their STEM knowledge to service-learning projects in local communities.

- With funding from the National Science Foundation, the Model Replications Institution program provides three years of technical assistance to nine Historically Black Colleges and Universities, Hispanic Serving Institutions, and Tribal Colleges and Universities, to improve STEM initiatives and outcomes, in order to build STEM infrastructure components. These included faculty development, pre-college initiatives, student support,undergraduate research, laboratories & classrooms, graduate programs and science career initiatives, and curriculum development.

For further promising statewide and nationwide STEM initiatives to improve outcomes for underrepresented groups, click here.

LEVEL PLAYING FIELD
INSTITUTE
543 Howard St., 5th Floor
San Francisco, CA 94105
www.lpfi.org
(415) 946-3030