LEVEL PLAYING FIELD INSTITUTE:

IMPROVING STEM OUTCOMES FOR STUDENTS OF COLOR IN CALIFORNIA

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LEVEL PLAYING FIELD

Presentation Overview

- Examine STEM Underrepresentation and Achievement in California
- Present LPFI's Two STEM Intervention Programs for Underrepresented Middle and High School Students
 - SMASH Academy (9-12)
 - SMASH: Prep Academy (6-8)
- Examine the research outcomes of the SMASH Academy and SMASH: Prep Academy
- Discuss Recommendations for Increasing STEM Achievement among Underrepresented Groups in CA



Why focus on Science, Technology, Engineering, and Mathematics?

□ Nationwide:

- STEM occupations have grown 8% in the last 10 years and are expected to grow twice as fast in the next 10 years.
- 16 of the 25 highest-paying jobs in the U.S. require STEM preparation, and STEM workers earn 26% more than their non-STEM peers.

In California:

- There will be a demand for 1.1 Million STEM jobs by 2018, with 49% of the STEM jobs being in Computer Occupations (Computer programmers, technicians, scientists)
- California is currently producing too few skilled STEM workers to meet the increasing demand for a STEM-educated workforce.

Sources: Georgetown University Center for Education and the Workforce STEM State Level Analysis; National Science Foundation, National Center for Science and Engineering Statistics, special tabulations of U.S. Department of Education Integrated Postsecondary Education Data System Completions Survey, 2010; Offstein & Shulock, 2009.

Underrepresentation of Latinos and African-Americans in STEM

Across the nation:

- African-American and Latino students comprise just 15% of all AP Math and Science exam takers
- African Americans and Latinos combined earn just 11% of all science and engineering degrees across the country
- Only 9% of the entire science and engineering workforce are African American or Latino; African American and Latina women combined represent just 2% of the science and engineering workforce

In California:

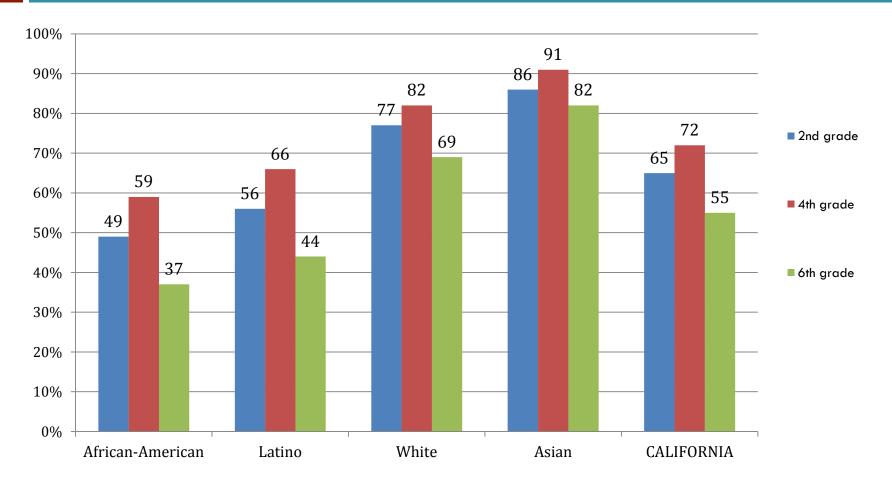
- African American and Latino students combined comprise just 20% of all AP Math and Science testtakers across California
- Across UC/CSU, only 3% of all STEM majors are African American and 18% are Latino

Sources: CDE, 2012; CPEC, 2011; College Board, 2012; NSF, 2010, 2011, 2012



DISPARITIES IN STEM ACHIEVEMENT IN CALIFORNIA'S PUBLIC SCHOOLS

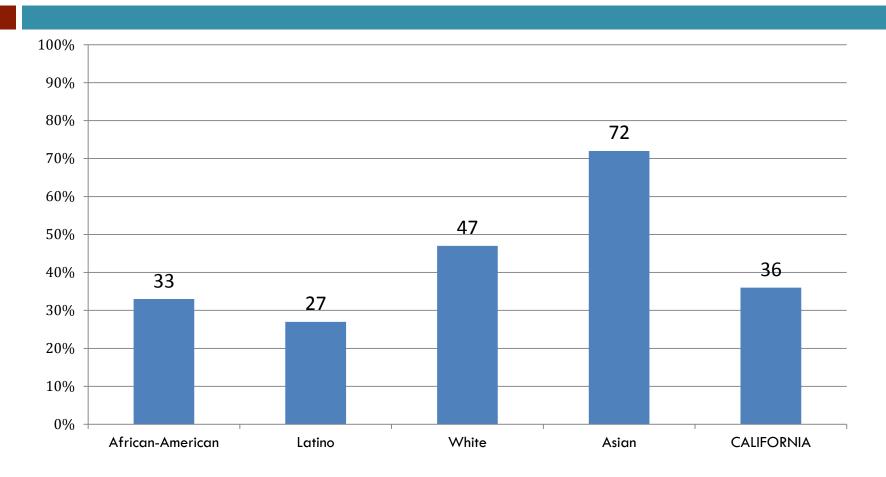
2013 CST Mathematics: 2nd, 4th and 6th Grade Proficiency Rates, by Race/Ethnicity





Source: California Department of Education, 2013

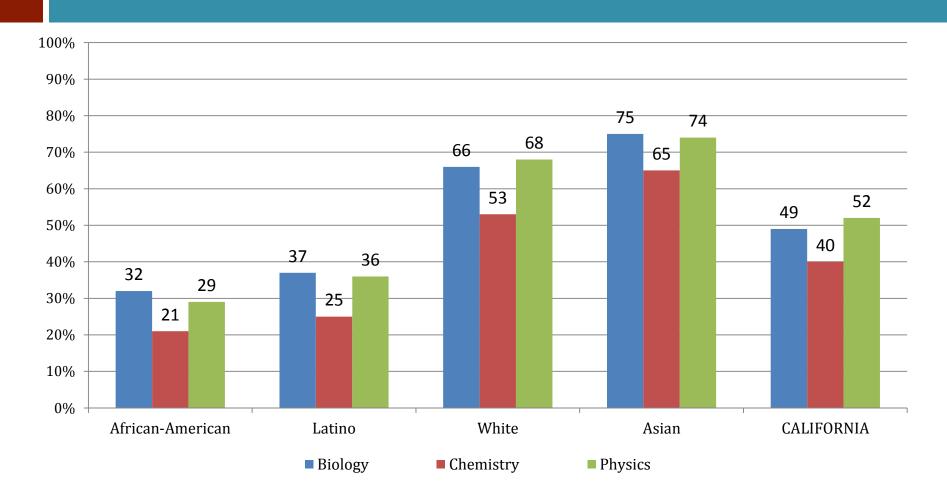
2013 CST 8th Grade Algebra I Proficiency Rates, by Race/Ethnicity





Source: California Department of Education, 2013

2013 CST Biology, Chemistry, and Physics Proficiency Rates, by Ethnicity





Source: California Department of Education, 2013

Participation in STEM Advanced Placement (AP) Coursework

- According to the 2012 College Board AP Report to the Nation:
 - African American and Latino students comprise just 20% of all AP STEM test takers in California
 - While they make up 57% of the high-school aged population in California, African-American and Latino students comprise just 9% of AP Computer Science exam takers
 - In real numbers, just 45 African Americans and 314 Latinos across California took the AP Computer Science exam in 2012



Barriers Facing Students of Color in California STEM Education

- Disparities in outcomes between Latino and African-American students and their White and Asian can be linked to inequity in K-12 STEM education in California:
 - Teacher quality
 - Access to rigorous STEM coursework
 - Access to labs, textbooks, resources
 - Lack of STEM role models
 - Lack of exposure to STEM careers and opportunities
- □ At the undergraduate level:
 - Few connections to STEM peers of color and faculty of color
 - Lack of STEM role models



LPFI's Mission and Vision

Mission:

Level Playing Field Institute is committed to eliminating the barriers faced by underrepresented people of color in science, technology, engineering and mathematics and fostering their untapped talent for the advancement of our nation.

Strategic Vision:

To improve access and opportunity for underrepresented students of color in STEM, LPFI:

- (1) Operates STEM-Focused Education Programs,
- (2) Executes Innovative Computer Science Initiatives,
- (3) Conducts **Research on STEM Equity and Opportunity**.

THE SMASH ACADEMY

Summer Math and Science Honors Academy

<u>GOAL</u>: "To alleviate the barriers facing underrepresented high school students of color in STEM by providing a rigorous, college preparatory summer academy to prepare students demonstrating interest and aptitude in studying STEM subjects to enter and persist in STEM studies at 4-year universities."

<u>PROGRAM</u>: 5-week, 3-year STEM-focused summer enrichment program for high school students of color





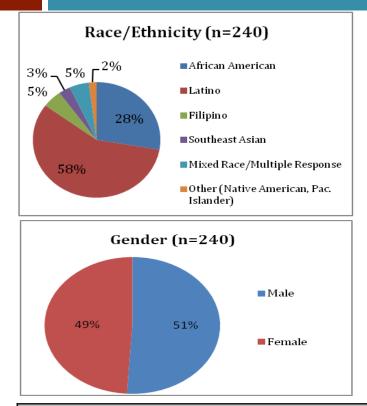


SMASH: History & Context

- The SMASH Academy began in 2004, has been operating for 9 years
- LPFI currently operates SMASH sites across CA located at UC Berkeley, Stanford, USC, and UCLA
- Each site contains 3 cohorts, including rising 10th, 11th, and 12th graders and incoming 10th graders commit to 3 summers of participation



SMASH Academy: Student Demographics



- n=240 students attended SMASH in 2013
- 178 SMASH alumni, currently in college or other post-secondary endeavor
- □ 58% Latino, 28% African American
- 83% FRPL-eligible, 81% first-generation college
- □ 93% attend California public schools

Academic Data	
Average Current Math Grade	B+/A-
Average GPA	3.64
Socioeconomic Indicators	
Free/Reduced Price Lunch Eligibility	83%
Average Household Income	\$51,495
Average Household Headcount	4.6
First Generation College	81%
Both FRPL & First Generation	73%

SMASH Programming and Curriculum

SMASH Curriculum

- Core mathematics (Algebra II, Pre-Calculus, Calculus) and science (Biology, Chemistry, Physics) enrichment courses
- 3-year AP Computer Science preparatory sequence of courses (CS1, CS2, CS3)
- College success classes (e.g., college applications), youth development curriculum (e.g., leadership, public speaking)
- Curriculum integrates project-based learning, culturally relevant pedagogy, and technology
- Role Models, Mentors, STEM Peer Networks
 - Exposure to diverse STEM role models through weekly "Speaker's Series"
 - Facilitation of community-building and support networks among peers
 - Field trips and guest lectures during the academic year

Youth Development Curriculum

- Activities focused on cultural competence, social justice orientation, leadership and critical thinking skills
- Workshops (e.g., SAT prep) during the academic year

2013 Evaluation of SMASH Impact

- Evaluation procedures included: (a) Pre- and Post-SMASH academic assessments, (b) Pre-Post student surveys, (c)
 Academic year transcripts, and (d) Alumni surveys.
- Highlights include:
 - In science, 78% of SMASH students demonstrated gains in assessment scores, with an average increase of 16%; 91% of students in Biology increased in knowledge from pre-post SMASH
 - **70%** of **Algebra II** students demonstrated improvement in proficiency over the 5-week program
 - Across 12 computer science skills and concepts, a large and statistically significant increase from pre-post SMASH (Mean=1.87 to 2.86) was demonstrated, with huge gains in using variables in Scratch (24% to 81%), creating stories in Scratch (31% to 81%), and familiarity with algorithms (20% to 58%).
 - Students increased significantly in access to networks of STEM peers and role models, specifically in access to role models of color (57% to 72%), and access to female STEM role models (46% to 60%).
 - Scholars demonstrated significant increases in leadership skills, social justice orientation, and a decrease in the endorsement of negative racial and gender stereotypes.
 - A significant increase in positive attitudes towards science and computer science, identification with the fields of science and computer science, and self-efficacy in science were reported from pre- to post-SMASH
 - STEM college aspirations (Mean=4.30 to 4.48), STEM career aspirations (Mean=4.40 to 4.52), and aspirations to pursue computer science in college and career (Mean=2.96 to 3.11) all increased significantly from pre-post; by the end of the program, 89% indicated their plans to declare a STEM major in college

* Percentages are % of students who strongly agree/agree with each item; % increases are differences in % of students who strongly agree/agree at post-SMASH vs. pre-SMASH

Longitudinal Outcomes of SMASH Students

n=178 SMASH alumni, 119 (67%) have been tracked using alumni surveys

High School Outcomes

- 100% of SMASH alumni graduated from high school
- 79% of alumni took an AP STEM course during high school

Higher Education Enrollment

- 84% of SMASH alumni are currently enrolled in a four-year university, with 7% currently enrolled in graduate school
- The most frequent colleges of attendance among alumni are U.C. Davis, U.C. Berkeley, and Stanford.

STEM Entry and Persistence in Higher Education

- 67% of SMASH alumni are currently declared STEM majors; the most common major reported by SMASH alumni is engineering.
- B2 % of alumni intended to major in STEM while in high school and 78% of those went on to declare a STEM major in Year 1 in college
- 88% of the alumni who declared STEM majors in Year 1 persisted through Year 2 with a STEM major



"In my classes, I improved my public speaking confidence and skills. In biology, I conducted many experiments, where as in school I don't conduct any. In Algebra 2, I learned different about functions and also conducted many experiments. Overall every class improved my skills and knowledge." -1st year SMASH Berkeley student



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Research Examining Barriers to STEM Participation

Perceived Barriers to STEM among High-Achieving Adolescents

- n=152 high-achieving HS students of color
- The most frequently perceived internal barriers included: feeling not as smart (46%) and not feeling prepared enough to succeed in STEM (41%). The most frequently perceived external barrier was the fear of being treated differently based on race (45%).
- Females reported significantly higher levels of perceived internal and external barriers than males (p<.05)
- Perceived internal barriers significantly predicted a decrease in STEM career aspirations and higher levels of perceived internal and external barriers predicted a decrease in confidence in achieving higher education aspirations (p<.05).</p>
- Endorsement of Negative Racial/Gender Stereotypes and Implications for STEM Outcomes
 - N=75 high-achieving, female HS students of color
 - Students were significantly more likely to endorse negative racial stereotypes than gender stereotypes
 - Endorsement of negative racial stereotypes was negatively related to STEM career aspirations
 - However, a significant decrease in endorsement of negative racial and gender stereotypes was demonstrated over the course of the 5-week SMASH program.

SMASH: PREP ACADEMY

Saturday Math and Science Honors Preparatory Academy

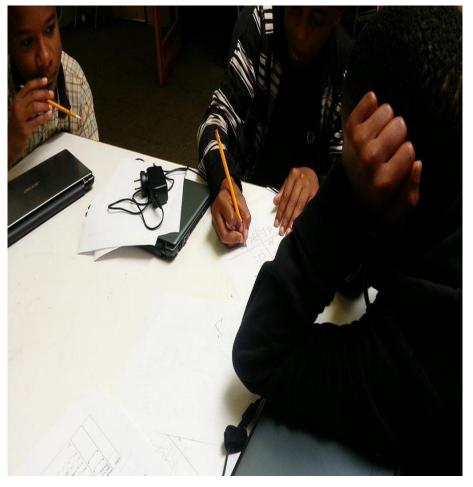
<u>GOAL</u>: "To develop a STEM educational pipeline for African-American males to combat systemic educational inequities and societal challenges faced by these students in their schools and communities and equip them with the skills and experiences necessary to improve their educational success and life opportunities."

<u>**PROGRAM</u></u>: SMASH: Prep is an out-of-school STEM enrichment program serving highachieving African American male middle school students from the East Bay, CA</u>**





SMASH Prep: Student Demographics



- n=34 students attended
 SMASH:Prep during the 2012-2013 school year
- 94% African-American, 6%
 Mixed Race
- □ 32% FRPL-eligible
- 88% attend California public schools
- □ Average GPA=3.20

SMASH Prep Programming and Curriculum

SMASH Prep Curriculum

- Mathematics, Communication Technologies, and Computing & Mobile Apps enrichment courses
- Youth development workshops (e.g., leadership, public speaking)
- Curriculum integrates project-based learning, culturally relevant pedagogy, and technology
- Parental Involvement
- Role Models, Mentors, STEM Peer Networks
 - Exposure to African-American male STEM role models (instructors and speakers)
 - Facilitation of community-building and support networks among peers
 - STEM-focused field trips

2013 Evaluation of SMASH Prep Impact

- Evaluation procedures included: (a) Pre- and Post-SMASH Prep academic assessments and concept inventories, (b) Pre-Post student surveys, (c) Academic year transcripts, (d) teacher ratings rubrics, and (e) Student focus groups.
- □ Highlights include:
 - 69% of students increased in mathematics achievement from pre- to post-program, an average of 5 items (a 47% increase) from pre- to post-SMASH Prep.
 - In Computing and Mobile Apps, students showed large gains in 12 core concepts. Increases ranged from 8 pct. points to 53 pct. points, with an average increase across skills of 26 pct. points.
 - In Communication Technologies, students showed large gains in knowledge and skills, with increases ranging from 5 pct. points to 36 pct. points, with an average increase of 18 pct. points.
 - Students' positive beliefs in the ability to be successful in computer science (self-efficacy) increased from pre- to post-SMASH Prep (M=3.85 to 4.09).
 - Students increased in identification with math (M= 4.6 to 4.85) and computer science (M=4.1 to 4.31).
 - Students also demonstrated an increase in their aspirations to take advanced math and science courses in high school (M=3.79 to 4.12) and their aspirations to pursue STEM in college (M=3.96 to 4.0).
 - There was a significant decrease in the perception of barriers that students might face in high school in studying STEM, as well as a decrease in endorsement of negative racial stereotypes from pre- to post-SMASH Prep.



"I learned how to connect social justice to mobile apps." —SMASH: Prep student



COMPUTER SCIENCE INITIATIVES

LPFI's Computer Science Initiatives

- LPFI also implements computer science initiatives designed to provide underrepresented students opportunities for exposure, engagement, and technical skill development within the field of computer science:
 - An NSF-Funded AP Computer Science preparatory sequence from 9-12th grade within the SMASH Academy
 - Computer science exposure courses at the middle school level through SMASH:Prep and CampCode
 - Hackathons to increase exposure and "Level the Coding Field" for 6-12th grade students.
- These initiatives provide access to critical, sequential coursework in computer science and integrate culturallyrelevant approaches to increase access, interest, engagement, attitudes, skill development, and aspirations for continued course-taking in computer science.

RECOMMENDATIONS

Recommendations for Improving STEM Outcomes among Underrepresented Students

□ Within K-12 schools

- Increase access and availability of rigorous and AP STEM coursework across California's schools to ensure students of color have opportunity to enroll in critical gatekeeper courses
- Increase training and professional development opportunities for teachers within science, mathematics, and computer science from pre-service to career
- Integrate aspects of project-based learning and culturally relevant pedagogy into teaching and curriculum to engage students from underrepresented backgrounds in STEM

In out-of-school settings

- Expand programs that develop early STEM interest through hands-on experiences and extracurricular activities
- Expand summer and afterschool programs to provide STEM enrichment to complement traditional STEM coursework
- Invest in STEM acceleration and pre-college bridge programs for students with demonstrated interest in STEM to ensure they gain skills necessary to pursue and persist in STEM
- Increase exposure to diverse STEM professionals, mentors, and role models to counteract stereotypes about STEM aptitude and ability and decrease psychological barriers to pursuing and persisting in STEM.
- □ Within higher education
 - Expand higher education programs that aim to recruit and retain students of color in STEM (and also faculty of color in STEM fields), through research and mentorship opportunities

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And many others!

THANK YOU



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