# Building a STEM Pathway:
## Xavier University of Louisiana's Summer Science Academy

ALLIANCE FOR EXCELLENT EDUCATION

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CASE STUDY

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# Acknowledgements

*This paper was written by* ***Mariana Haynes, PhD,*** *a senior fellow at the Alliance for Excellent Education.*

*The* ***Alliance for Excellent Education*** *is a Washington, DC–based national policy and advocacy organization dedicated to ensuring that all students, particularly those traditionally underserved, graduate from high school ready for success in college, work, and citizenship.* ***www.all4ed.org***

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# Introduction

Click here to watch the overview video.

**For most of the last sixty years, the United States has labored to provide equitable educational opportunities for all children, regardless of their race or socioeconomic status. Today, more than ever, America's competitiveness and innovation depend on developing the talents and minds of *all* Americans. In a nation where students of color now constitute the majority of public school enrollees, increasing the diversity of the United States's science, technology, engineering, and mathematics (STEM) workforce is vital to maintaining the nation's scientific and technological leadership.[1]**

Diverse racial and ethnic groups are the most rapidly growing segment of the public school student population.[2] Since 2000, however, the share of natural science and engineering bachelor degrees earned by underrepresented student groups (USGs) has remained flat and their participation in mathematics has decreased.[3] For example, African Americans and Hispanics earn only about 15 percent of U.S. bachelor's degrees awarded in the natural sciences and engineering even though they now constitute more than one third of the nation's eighteen- to twenty-four-year-olds.[4] White young adults, who make up 56 percent of this age cohort, earn 64 percent of the bachelor's degrees in these fields.[5]

Students of color aspire to major in STEM in college at the same rates as their white and Asian American peers, according to the Higher Education Research Institute at the University of California–Los Angeles.[6] Nevertheless, African Americans, Hispanics, and Native Americans at all income levels remain underrepresented among the nation's highest achieving students.[7] The differential loss of students in the pipeline as they advance up the academic ladder accounts for the discrepancies in degree attainment in science and engineering.[8]

## Xavier University of Louisiana's STEM Program

In order to attract and retain USGs who aspire to major in STEM fields, educators recognize that science and math instruction must improve and also develop students' non-cognitive and social-emotional skills. Foremost in that effort is Xavier University of Louisiana, a historically black and Catholic university located in the heart of New Orleans. Throughout the past thirty years, Xavier compiled an extraordinary record as a top producer of African Americans who receive bachelor's degrees in biology, chemistry, and physics. Although Xavier enrolls only approximately 3,000 students, at least 70 percent are African American of whom about 65 percent major in science and mathematics, stated Dr. Loren Blanchard, provost and senior vice president for academic affairs at Xavier.[9]

Xavier continues to rank first nationally in the number of African American students who earn degrees in biological/life sciences, according to the U.S. Department of Education.[10] Similarly, Xavier ranks first nationally for the number of African American graduates who ultimately complete medical school. The College of Pharmacy, one of only two pharmacy schools in Louisiana, is third in the nation in producing African American doctor of pharmacy degree recipients. In addition, Xavier ranks fifth in the number of African American graduates who go on to earn a doctor of philosophy degree in science and mathematics.[11]

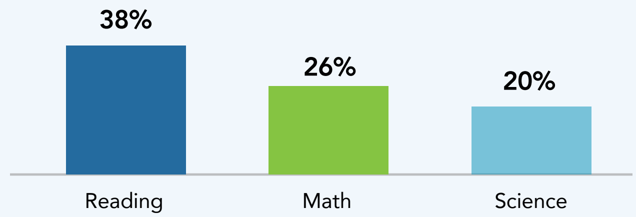
More than two decades ago, Xavier's institutional leadership committed to increasing the proportion of college students who complete undergraduate STEM degree programs. To that end, Xavier began its Summer Science Academy, a series of bridge or pre-college programs focused on preparing high school students to enter college and complete a STEM degree program. Dr. Norman Francis, president of Xavier since 1968, commissioned the design of these innovative programs for middle and high school students from New Orleans and other parishes within Louisiana. Ongoing program evaluation and refinement have perfected a dynamic model for accelerating students' math and science learning while at the same time reducing barriers to their long-term success.

University leaders describe the rationale, design, and impact of Xavier's Summer Science Academy in response to the alarming national trends that show a declining number of African American students entering college, persisting, and earning a degree.

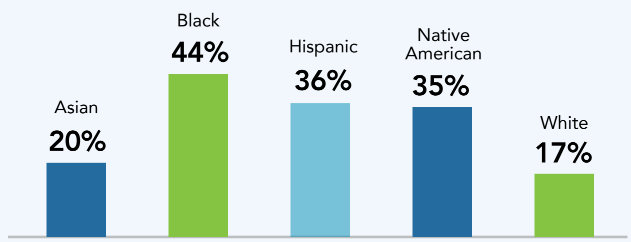

**Click here** to watch a video about assessing performance.

Nationally, for every 100 ninth graders, only fifty-three enroll in college and of these only thirty-one actually earn a degree within six years.[12] Of those thirty-one, only three will be African American.[13] In addition, assessments such as the National Assessment of Educational Progress (tables 1 and 2) and college-readiness assessments such as the ACT (table 3), reveal that large numbers of students, particularly students of color, are underprepared to effectively negotiate a college curriculum in the areas of mathematics, science, and literacy.

### TABLE 1: Percentage of Twelfth Graders Meeting or Exceeding Proficiency on the 2009 and 2013 National Assessment of Educational Progress[14]

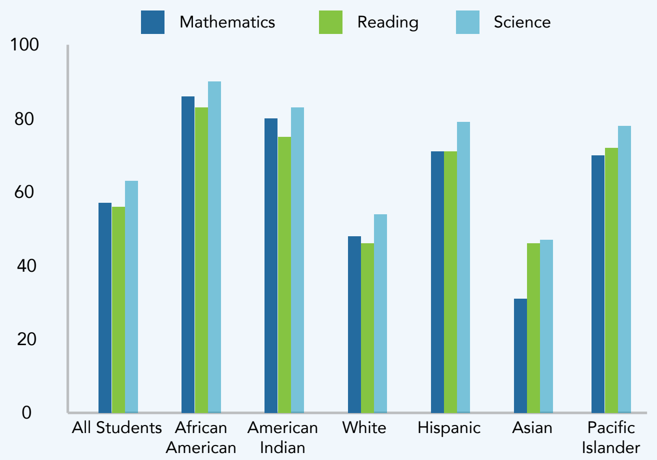



### TABLE 2: Percentage of Twelfth Graders Reading Below Basic on the 2013 National Assessment of Educational Progress[15]



"At Xavier, we have been asking ourselves about the underlying issues affecting the enrollment and graduation rates in STEM undergraduate education of Africans Americans. We continue to see an alarming amount of data showing that the majority of students are not prepared for college, particularly African Americans, Hispanics, and Native Americans," said Blanchard.[16] Xavier closely monitors the ACT scores of secondary school students who apply to Xavier against national ACT performance data. Of the U.S. students who took the ACT in 2013, 33 percent of white students and 43 percent of Asian American students achieved all four college readiness benchmarks; for African American students, only 5 percent met all four benchmarks.[17]

**TABLE 3: Percentage of 2010–14 ACT-Tested High School Graduates Not Meeting ACT College-Readiness Benchmarks[18]**




Click here to watch a video about vocabulary development.

Xavier administrators noted that too many students from local school districts—primarily low-income students and students of color—have fewer opportunities for advanced course work and experiences to develop their critical thinking, problem-solving, and communication skills. National data bears this out. Only 57 percent of African American high school students, 67 percent of Hispanic high school students, and less than 50 percent of Native American high school students have access to the full range of math and science courses.[19] In comparison, 81 percent of Asian American high school students and 71 percent of white high school students have access to high-level course work.[20]

Early on Xavier faculty, led by Dr. J.W. Carmichael, professor of chemistry and director of pre-medical programs, began tackling the underlying reasons for the enormous preparation gap, particularly among the growing number of minorities. They recognized the need to develop a dual focus on developing secondary school students along with their math and science teachers. Instituting more rigorous academic course work in high schools in and of itself would not change the picture of college and career readiness among students.[21] Effective teaching begins with a teacher's understanding of the subject area and how to teach it. Despite substantial evidence that various cognitive competencies, such as analytical thinking and reasoning, are teachable and learnable within a specific discipline, this type of instruction remains rare in U.S. classrooms.[22] Furthermore, while the number of mathematics and science teachers has steadily increased, students in high-minority schools remain disadvantaged by the distribution of the teacher pool and disparities in the quality of STEM teaching.[23]

With support from the National Institutes of Health (NIH) and the National Science Foundation (NSF), Xavier designed innovative models and approaches in STEM teaching and learning. NIH and NSF funding priorities require programs to use evidence-based instructional practices, support a high school outreach component, and document the impact of these programs on improving the preparation and success of candidates for STEM fields.[24] The Xavier programs deploy an array of effective strategies for targeting students' deeper learning and developing their scientific and mathematics proficiencies.

## Summer Science Academy

Click here to watch a video about metacognitive approaches.

In partnership with local feeder high schools, Xavier designed pipeline programs for middle and high school students beginning as early as the seventh and eighth grades. The goal was to expose students to disciplined study in math and science and integrate strategies to reduce barriers these students face to persistence and completion in college. The Summer Science Academy provides a range of programs across STEM areas and grade levels to ensure students receive adequate preparation, mentoring, and academic and peer support. (See Appendix for a full listing of Xavier's summer bridge programs.) Throughout the program, students receive advisement and information about STEM fields and how to navigate their requirements and opportunities. To encourage and support secondary school students' participation, Xavier offers students financial assistance, tutoring services, and research opportunities.

The nine STEM bridge programs, which serve 550 to 650 secondary school students each summer, are designed to (1) strengthen students' mastery of knowledge and skills in mathematics, science, and literacy; (2) develop their non-cognitive competencies[25] or "habits of mind;" (3) provide students opportunities to put new skills into practice within collaborative study groups and authentic laboratory settings; and (4) develop students' sense of self-efficacy and belonging with individuals who share the same career goals. Each program serves as many as eighty students and is designed to help students with demonstrated academic potential attain the high academic performance levels necessary to achieve a career in the biomedical sciences.

Instructors from local middle and high schools serve as facilitators for peer-to-peer learning, collaborative study groups, laboratory investigations, tutoring, and mentoring. Integrating reflection on one's own learning within discipline-based studies enhances student achievement and the ability to learn independently.[26] Considerable evidence exists for the remarkably strong effects of these types of psychological and social support systems on students' engagement and commitment as well as on their grade point averages and test scores.[27] According to Blanchard, "Roughly 75 percent of the students who participate in the summer programs are eligible for entry into college and universities because of their improved performance in their course work and on the ACT and/or SAT."[28]

The power of the Xavier model is two-fold. It engages students in complex tasks that tap their interests and intellect and uses a "metacognitive" approach to instruction, essentially "thinking about thinking," that enables students to control their learning.[29] This is at the core of the bridge programs' design—developing students' abilities to self regulate and their sense of efficacy and belonging through carefully structured social processes.

Three of the programs—MathSTAR, BioSTAR, and ChemSTAR—introduce students to the fundamental concepts of a mathematics or science area before they take the respective Algebra I, biology, or chemistry high school course the following school year. A fourth program, Stress on Analytical Reasoning (SOAR), is for rising seniors who have finished chemistry and are interested in science- and health-related careers. In particular, the inquiry and problem-based practices central to STEM course work require an explicit focus on conceptual understanding and the use of scientific language and literacy. National analyses of ACT scores reveal a close relationship between students' abilities to read and understand complex text, their completion of high school course work, ACT math and science scores, and their performance in credit-bearing college courses.[30] SOAR focuses on verbal and quantitative reasoning; analytical reading, writing, and thinking; conducting scientific inquiry; and expressing scientifically informed positions.

Click here to watch a video about analytical thinking and literacy.

## SOAR

In classroom discussions of texts, such as *The Immortal Life of Henrietta Lacks*, the SOAR instructor draws from the students' background knowledge and experiences to illuminate what they know, what they may find confusing, and how they can deepen their understanding of the text. For example, the reading of this story—about a poor African American woman from Baltimore, whose cells were taken from her unknowingly in 1951 and continue to be used for research today—prompts students to reflect on the moral and ethical decisions that impact scientists and medical professionals. Students annotate the text, evaluate multiple perspectives, and draw inferences using specific references to support their arguments and interpretations. "STEM curriculum is challenging for many high school students because it stresses analytical reasoning," noted Dr. Mario Garner, president and chief executive officer of New Orleans East Hospital and a SOAR alumnus. "That is the beauty of the SOAR program. It enabled me to read and think analytically so that when I took the ACT and SAT during my senior year, I achieved phenomenally beyond what I was able to accomplish as a sophomore or junior."[31]

SOAR also engages students in inquiry-based learning that encourages doing with understanding rather than focusing on broad content coverage and recall of discrete facts. Xavier's science labs, for example, offer students opportunities for collaborative hands-on investigation. They receive minimal directions and rely on peer-to-peer interactions to solve problems and experiment, share their observations, and explain their findings. Students report that laboratory experiences sharpen their interest and motivation to pursue scientific study. One SOAR student commented, "What excites me about science is the breakdown. You get to see more of what is underneath than just what is on the surface. You learn about what makes up science and how areas of science are different and how they are similar."[32]

**Click here** to watch a video about the application of knowledge.

Not only does the mix of learning experiences expose students to disciplined study, it also nurtures and expands each student's sense of their own potential. Similar themes play out in group activities that tap students' creative and performance talents. "We have lots of students who love to perform and our goal is to play to all of those strengths. All students are expected to participate. You have to sort of find your place in the skit," explained Justin Mack, director of SOAR and director of student affairs for Joseph A. Craig Charter School.[33] The activities help fashion a social connection among students while also enabling them to expand their knowledge of themselves in relationship to others. Program staff encourage students to evaluate their strengths and weaknesses as vital to ensuring their future success and their ability to make good choices for themselves and others.

**Click here** to watch a video about the social context for learning.

## ChemSTAR

ChemSTAR is designed to enable students to succeed in high school chemistry so that they ultimately succeed in college-level chemistry. "Our goal was to get them through the first grading period equipped with the essential concepts and strategies to continue learning at an advanced level," stated chemistry teacher Kendal McManus-Thomas, director of the ChemSTAR program and the science department chairman at Warren Eastern Charter High School in New Orleans.[34]

How well students do in their chemistry course depends not only on their understanding of core concepts and skills, but on non-cognitive attributes such as conscientiousness, discipline, and persistence. These academic mindsets involve students' emotions and feelings and are intertwined in students' cognitive development and learning. In order to integrate social and academic learning, the Xavier programs develop powerful learning communities that attend as much to students' deep engagement with peers, teachers, and mentors as they do


Click here to watch a video about peer-to-peer learning.

to accelerating students' acquisition of STEM content.[35] This community-centered approach cultivates norms for how students learn as well as connections to the outside world that support core learning values.[36]

The instructor's job is to ensure that students know precisely what they have to do to succeed and that they view themselves as capable of mastering STEM course work. Through explicit instruction, modeling, guided practice, group problem solving, and discussion, the ChemSTAR instructor carefully guides students through the thinking processes essential to solving complex problems. Students work in small groups to calculate chemistry equations requiring an understanding of core concepts. They collaborate with their peers to solve problems by explaining their thinking, asking questions to clarify understanding, and suggesting avenues to move the group toward its goal. McManus-Thomas noted the use of "learn one, teach one," which, in essence, asks students to demonstrate mastery of a core concept by teaching it to a classmate. "They work together with their peers and are responsible for ensuring that the person sitting next to him or her also understands the concept or algorithm and can solve the problem," McManus-Thomas explained.[37]

The program directors design an array of learning experiences to provide students with ample opportunities to practice and receive feedback on how well they apply new knowledge and skills. Peer-to-peer learning in small groups enables students to deepen their understanding of concepts and improve their abilities to think through problems. Daily quizzes clarify learning goals and provide feedback to improve student learning. The instructors use data for formative purposes to show students where they are progressing, identify gaps and missing skills, and adjust instruction. "When students achieve a series of small successes, they see that achievement is not pre-ordained, but results from effort. They become more invested in learning, which will encourage them to go farther and achieve at even higher levels," said McManus-Thomas.[38]

## Staffing the Summer Science Academy

Xavier administrators and faculty noted that many secondary school STEM teachers report the need and desire to improve their math and science teaching.[39] To sustain students' learning trajectory throughout the school year, Xavier offers local secondary school teachers professional learning opportunities through the university's middle/high school math and science program and workshops. Secondary school teachers collaborate with Xavier faculty to design curriculum and enact new pedagogical approaches in math and science education.

In addition, the Summer Science Academy employs STEM teachers from middle and high schools in New Orleans and adjacent school districts. Program administrators develop organizational structures to build teachers' individual and collective efficacy for advancing students' learning and development. "The Summer Science Academy provides opportunities for Xavier faculty members and K–12 teachers to learn more about themselves, both in relation to their mastery of math and science content and their ability to teach effectively," said Blanchard.[40]

In order to standardize the content and strategies for teaching math and science, Xavier STEM and college education faculty provide bridge program staff with extensive coaching and feedback on effective pedagogies. Instructors become more adept at clearly presenting math and science concepts, managing different types of discourse, and organizing groups for learning. Through this apprenticeship, teachers acquire an array of strategies to understand and respond to students' learning status. They learn to probe and diagnose student understanding, ask students to explain and elaborate their thinking, and provide feedback to help students develop more sophisticated reasoning skills.[41] "We know that Xavier has been recognized for its mathematics and science graduates, especially those who go on into medical school and complete their medical school training. But you can't get those good students without good teachers," said Dr. Rosalind Pijeaux-Hale, a professor within the Division of Education and Counseling.[42]

Click here to watch a video about professional development.

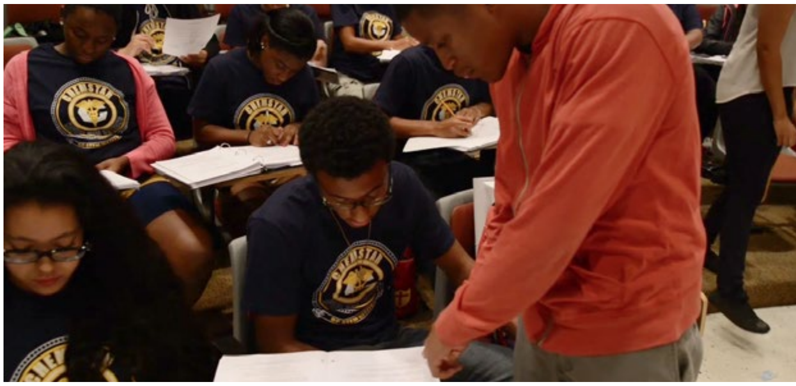
## Improving STEM Teaching at Scale

Xavier has designed a set of powerful student-centered learning environments to strengthen students' academic competencies and self-efficacy in pursuit of STEM careers. These programs continue to evolve and succeed in strategic ways. Their design stands in stark contrast to the caliber of math and science instruction in many secondary schools. Multiple indicators show a pattern of unequal access to rigorous course work and the most qualified and effective teachers, especially in schools serving low-income students and students of color.[43] Significant work remains to eliminate these disparities that deny students critical resources and opportunities and perpetuate achievement gaps.

National data shows that a significant number of schools each year report serious problems filling their teaching openings in math and science, despite successful national efforts to produce more math and science teachers.[44] The reasons for shortages are complex and varied. STEM shortages result from an annual reshuffling of a significant number of math and science teachers from poor to non-poor schools and from high-minority to low-minority schools.[45] In particular, disadvantaged public schools have among the highest rates of math and science teacher turnover, mostly due to poor working conditions rather than to student demographics. Increasing educational opportunities and resilience among disadvantaged students requires a school culture focused on improving teaching and learning as a collective, rather than individual, enterprise.[46] (For more information, see the Alliance publication, *On the Path to Equity: Improving the Effectiveness of Beginning Teachers*.)

In hard-to-staff schools, twice as many minority students as white students are assigned teachers who lack the qualifications to teach mathematics.[47] In Louisiana, where Xavier is located, more than 35 percent of core secondary school classes are taught by teachers with neither an academic major nor certification in the subject, according to Schools and Staffing Survey data on teacher assignments.[48] University of Pennsylvania Professor Richard Ingersoll reports that "[t]he largest differences in math and science teacher hiring problems are not between regions or states, but between different schools, even within the same school district."[49] The unevenness in teaching quality matters greatly. "About 70 percent of the students are not prepared well enough to handle an introductory college math course. Connected to that is a lack of mathematical esteem. Students feel intimidated and have a sense that they can't measure up in the area of mathematics," reported Blanchard.[50]

National Research Council reports issued a decade apart document powerful pedagogies and design principles for improving students' learning and higher-order thinking.[51] Although substantial evidence indicates that important twenty-first-century cognitive competencies are teachable and learnable, instruction based on an understanding of how people learn is not the norm in secondary school classrooms.[52] Most teachers, for example, are unfamiliar with the kind of practices the Xavier STEM programs use, such as metacognitive approaches and formative assessment.[53] Ingersoll and his colleagues find that incoming mathematics and science teachers have even less pedagogical and methodological preparation than other teachers, based on recent analyses of the Schools and Staffing Survey and the Teacher Follow-up Survey.[54] Math and science teachers with more formal training in teaching and pedagogical methods—knowing how to teach—were far less likely to leave teaching after their first year on the job.[55]



Click here to watch a video about formative assessment.

Improving STEM teaching requires substantial reforms to upend disjointed teacher development and credentialing policies and address root causes for math and science staffing problems. In contrast to many preparation programs that Pijeaux-Hale described as "generating" rather than "preparing" teachers, Xavier provides teacher candidates with strong STEM content and expertise in adolescent development, learning, and subject-specific pedagogy.[56] The university partners with secondary schools to provide STEM education majors with quality clinical experiences and expert supervision. "The science of learning is applied not only to how young people learn and develop but to the adults [who] teach them as well," said Pijeaux-Hale.[57] Teachers need to understand why, when, where, and how to apply new strategies and routines along with opportunities to practice and receive feedback. "Before they go out on their own, we make sure that [prospective STEM teachers] have the essential knowledge and that they teach in a place where they want to be and with students with whom they want to work," said Pijeaux-Hale.[58]

Xavier is the only university in Louisiana and the only historically black college/university nationally in the 100Kin10 Network, a partnership of more than 200 organizations committed to the goal of preparing 100,000 excellent STEM teachers by 2021.[59] During this time period, Xavier will prepare 110 new STEM teachers who will be trained to work with students in urban high-needs schools and districts. In addition, Xavier will provide hands-on professional learning for 225 STEM teachers through workshops conducted on campus or by other partnering STEM organizations, such as NASA or the National Science Teachers Association.[60] Xavier faculty and STEM consultants also will work on site in classrooms to mentor and coach STEM teachers.

"STEM literacy and the importance of ensuring that our nation is fully prepared to address the current STEM shortage is a national priority and one that Xavier stands ready to address," stated Francis.[61] The university plans on working with 100Kin10 Network partners to share its STEM successes in educating minority youth and broaden its repertoire of innovative STEM practices. In addition, Xavier is building a pipeline of STEM teachers through the recent launch of a summer bridge program for middle and high school students interested in STEM teaching.[62]

## Policy Implications and Recommendations

Members of the congressionally-commissioned Rising Above the Gathering Storm Committee, under the direction of the National Academies, have urged aggressive action to ensure all students have access to vastly improved K–12 mathematics and science education.[63] Socioeconomic disadvantage continues to impact student performance in the United States, and since 2000, the percentage of Americans attaining or exceeding the level of education reached by their parents has declined.[64]

The committee emphasized the need to broaden participation of USGs in the nation's STEM workforce. Moreover, the members concluded that all job seekers must possess basic mathematics and general science proficiency increasingly demanded in a global technologically dominated marketplace. "Education can lift people out of poverty and social exclusion," states Organisation for Economic Co-operation and Development Secretary-General Angel Gurria, "but to do so we need to break the link between social background and educational opportunity."[65]

Xavier has perfected a model for successfully guiding and educating minority STEM students. This vibrant program offers powerful strategies that other educators can distill, adapt, and scale to improve students' proficiency in math and science. The program reinforces the importance of providing students with academic support and social integration. Learning environments that can satisfy students' needs for competence, autonomy, and relatedness are essential to ensuring equitable access and opportunities to pursue a STEM education. These strategies apply equally to students in STEM fields regardless of their racial or ethnic background, but such learning experiences are even more critical for USGs.[66]

The strategies Xavier uses are not new. What is unique and paramount to Xavier's success is that the programs successfully implement many research-based strategies simultaneously. Policymakers often interpret recommendations individually rather than collectively. Programs that aim to increase minority participation in STEM fields should integrate *all* of the following strategies:

- **Improve academic outcomes for high-need students by setting high performance expectations for college and career readiness for all students.** States and districts should collaborate with postsecondary education to align performance expectations for successful entry into college-level STEM course work. Education leaders should expect educators to act on the belief that all students can attain high levels of learning and to encourage and support minority students in completing pre-college STEM programs, Advanced Placement (AP), International Baccalaureate (IB), and/or research and internship projects.

- **Increase collaboration and/or implement partnerships between K–12 and postsecondary education to improve student success in STEM degrees with critical attention to pathways and transition points.** All students can benefit from carefully designed learning experiences and academic and social support systems to improve their competencies, motivation, and self-efficacy. These opportunities are critical for students who have not had access to the information and experiences that facilitate movement along the STEM pathway. As a result, these students require more intensive efforts at the K–12 level to provide interventions, summer programs, seminars, mentoring, and activities for social and intellectual integration that align with the expectations of postsecondary education.[67]

- **Redesign learning environments based on research of human development and learning.** A strong mathematics and science curricula should include active, hands-on applied learning and research experiences that improve students' understanding of science and scientific processes. Many important ideas in science are crosscutting and learners should engage in practices across multiple scientific contexts. Effective learning environments are student-centered and attend as much to integrating social and academic learning as to students' mastery of knowledge and skills. Research shows that developing non-cognitive factors, or academic mindsets, that enable students to work collaboratively, reflect on their learning, and persevere through setbacks improves educational outcomes, regardless of students' racial or economic background.[68]

- **Build teacher capacity to develop secondary school students' deeper knowledge and skills in mathematics, science, and literacy.** Preparation and in-service learning for teachers should be grounded in strong content knowledge, subject-specific pedagogy, and knowledge of how adolescents learn. All teachers need extended opportunities to practice and receive feedback on teaching techniques essential to developing students' deeper content knowledge and ability to apply their knowledge and skills to novel problems. These techniques include explicit instruction with multiple representations, encouraging questioning and explanation, providing guidance and support for analytic reading and writing, using formative assessment, and motivating students to exert effort to learn.

  States and districts should develop coherent systems that encourage high-quality educator development and teaching in STEM courses using performance measures based on validated standards of teaching practice for initial and advanced licensure. Districts and schools should be responsible for increasing the percentage and equitable distribution of highly effective STEM educators, particularly for underrepresented minorities.

Improving STEM education requires coherent strategies across the federal, state, and local levels that are well informed and comprehensive in their design. Leadership at all levels will be critical to setting expectations, leveraging knowledge about effective STEM programs, and building supportive environments for collaboration and innovation. The federal government should

- **Sustain federal funding to scale up the most effective STEM programs with the goal of improving K–12 mathematics and science education for all students.** Efforts are needed to coordinate STEM education programs to broaden participation in the STEM workforce. Federal grant programs should promote broad dissemination of policies and practices that explain how students learn mathematics and science effectively, and how teacher preparation and professional learning can improve. In addition, funding programs should support coordination and strategic partnerships between K–12 and postsecondary education institutions that can make national and local efforts more effective and powerful. In addition, federal investments should target improving the preparedness of STEM teachers serving diverse students and ensure all students' have equitable access to high quality STEM teaching.

## Conclusion

In the twenty-first century, the nation's future will depend upon developing a vibrant STEM workforce and a scientifically, mathematically, and technologically literate populace. To meet the challenge, national, state, and local leaders must act aggressively to broaden the participation of underrepresented student groups in STEM courses and career pathways. They can capitalize on new understandings of how students learn and powerful examples of effective STEM programs, such as Xavier's Summer Science Academy.

According to the President's Council of Advisors on Science and Technology, the nation must focus on two complimentary goals: (1) ensuring all students, particularly those underrepresented in STEM fields, are college and career ready; and (2) inspiring many of them to pursue a STEM career.[69] The Council writes, "STEM education will determine whether the United States will remain a leader among nations and whether we will be able to solve immense challenges in such areas as energy, health, environmental protection, and national security."[70]

# Endnotes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# Appendix

## Xavier University of Louisiana's Summer STEM Programs

### Summer Science Academy "STAR" Programs

**OBJECTIVE:** The Summer Science Academy offers three "STAR" programs for high school students who have an interest in science careers. Each program introduces a content area to students before the student takes the course in high school. The programs are MathSTAR—Algebra I; BioSTAR—biology; and ChemSTAR—chemistry.

### SOAR Program

**OBJECTIVE:** The Stress on Analytical Reasoning (SOAR) program prepares students in analytical reasoning and provides early exposure to science/health careers. A limited number of on-campus housing is available for SOAR participants living outside of the New Orleans metropolitan area.

### SuperScholar/EXCEL

**OBJECTIVE:** SuperScholar/EXCEL is an intensive three-week residential summer enrichment program geared toward students interested in pursuing college degrees in the arts, humanities, social sciences, and education. All participants learn test-taking strategies that will enhance their performance on standardized tests. Participants take non-credit courses in quantitative reasoning (math), critical thinking/writing, speech/debate, and African American history.

### CS: Exploring Computer Science at Xavier

**OBJECTIVE:** Xavier's computer science department continues to respond to the need to prepare more students for a technology career. Funded by BP America, Inc., CS: Exploring Computer Science at Xavier enriches the computation-specific studies of both college and high school students. Xavier undergraduate students receive instruction from Xavier faculty to teach and mentor high school students through hands-on learning challenges in the computation sciences. The college student mentors lead the high school students through computational problem-solving tasks.

### Louisiana Cancer Research Consortium's Summer Internship

**OBJECTIVE:** The Louisiana Cancer Research Consortium's (LCRC) mission is to promote education and conduct research in the diagnosis, detection, and treatment of cancer, while pursuing a National Cancer Institute designation. Through the internship program, students from select local high schools are exposed to science related careers, mentored by faculty, and conduct laboratory experiments designed to contribute to cancer research.

### STEM Scholars Summer Bridge Program

**OBJECTIVE:** The STEM Scholars Summer Bridge Program is a five-week program for highly motivated high school seniors who plan to major in the areas of computer science, physics, engineering, or mathematics at Xavier. Participants spend the summer session on Xavier's campus and can earn four hours of college credit in mathematics. The STEM Scholars Summer Bridge Program is sponsored by the National Science Foundation through the Historically Black Colleges and Universities–Undergraduate Program and Xavier.

### XUPharmPrep Program

**OBJECTIVE:** XUPharmPrep is a four-week program for incoming freshmen who intend to pursue a career in pharmacy. Program participants work with Xavier faculty from the departments of chemistry, mathematics, and communications who help prepare them for the academic challenges they will face in these key areas during their first year in Xavier's chemistry–pre-pharmacy program. Participants also interact with pharmacy professionals and learn more about career opportunities.

### Center of Excellence

**OBJECTIVE:** The Center of Excellence is a four-week session designed to grant a small group of high school students interested in pharmacy a broader perspective of the academic requirements and exposure to various career opportunities in pharmacy. The academic objective of the Center of Excellence is to reinforce math and science concepts learned throughout the school year and introduce new content material.

### LEAP Science Engineering/Summer Scholars Program

**OBJECTIVE:** The LEAP Science Engineering/Summer Scholars Program is a competitive and intensive four-week non-residential honors program for students entering the ninth, tenth, and eleventh grades in the fall. Students currently must be in the eighth, ninth, or tenth grade and have a minimum 2.30 (out of 4.00) grade-point average. The program is designed to improve the analytical reasoning and vocabulary skills of students who are considering a career in engineering, mathematics, or the sciences. Students must attend all classes in order to participate and are subject to dismissal if absent for more than three days.

### Future Mathematics and Science Teacher Academy

**OBJECTIVE:** The Future Mathematics and Science Teacher Academy (FMSTA) is a worldwide, hands-on, primary and secondary school-based science and education program. FMSTA's vision promotes and supports students, teachers, and scientists to collaborate on inquiry-based investigations of the environment and the earth system working in close partnership with NASA and the National Science Foundation.

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