The East Bay STEM Continuum

A REGIONAL STEM EDUCATION INITIATIVE & STEWARDSHIP COMMITMENT OF CALIFORNIA STATE UNIVERSITY, EAST BAY

Transforming Science, Technology, Engineering, and Mathematics Education to Meet Regional Workforce and Economic Development Needs
Mathematics and science are essential components of a liberal education, the backbone of logic and analytic thinking from early childhood through the most advanced levels of learning across the academic disciplines. Science, technology, engineering, and mathematics enable us to understand the natural world, the built environment, systems of society, and the interactions among them that will determine the future of our nation and planet.

The Opportunity Equation
Institute for Advanced Study
Commission on Mathematics and Science Education
Facing The 21st Century STEM Education Challenge

At the dawn of the 21st century, our nation and state — and the region we call “home” — face a dramatically changing world. An increasingly technological global economy is challenging American predominance. Our colleges and universities no longer produce enough technically competent graduates to meet the needs of business and industry. California’s students are falling behind national standards — especially in science and math — with fewer each year prepared for college and career success. As a result, we are losing ground in innovation, productivity, and competitiveness. At risk are the prosperity, social cohesion, and access to opportunity that have characterized our society for the past half-century.

Technological progress and innovation powered up to half of postwar economic growth in the U.S. California built its position as the world’s eighth-largest economy with a highly educated and skilled workforce — the product of a visionary state system of higher education. And, the San Francisco Bay Area achieved its preeminence as home to technology and employment leaders in computing, networking, Web services, biotechnology, and energy with workforce recognized one of the nation’s best educated and most technical.

Today, with a distinctly knowledge-based economy, the Bay Area’s economic and social health relies heavily upon a skilled professional workforce. The need for college-educated, technologically proficient employees in the East Bay — Alameda and Contra Costa counties — and the surrounding region is especially high. But despite the demand, there is a mounting shortage of college graduates with competence in science, technology, engineering, and mathematics — the critical “STEM” disciplines.

The Public Policy Institute of California (PPIC) has projected a shortage of one million college graduates by 2025 to fill jobs requiring at least a bachelor’s degree in this state alone. Identifying key causes of the shortfall, the PPIC pointed to the state’s inability to move through college enough of its fastest-growing minorities — highlighting the increasing criticality of access and diversity in higher education.

Without college-bound students ready to study STEM, or teachers to educate them, or graduates ready to fill critical technical positions, regional employers will be forced to increase outsourcing, hire workers from out of state or with H1B visas, or move from the area entirely. As a result, jobs and opportunity will be lost not only to a recession, but also to outsourcing and offshoring, undermining the plans and aspirations of generations to come.

Today, our entire society finds itself at a critical and historic juncture. As the Carnegie Corporation’s Institute for Advanced Study Commission on Mathematics and Science Education noted in its 2009 report, The Opportunity Equation, “The nation’s capacity to innovate for economic growth and the ability of America workers to thrive in the global economy depend on a broad foundation of math and science learning, as do our hopes for preserving a vibrant democracy and the promise of social
mobility for young people that lie at the heart of the American dream.”

We have already seen the early effects. The future of this nation and our region is being shaped and defined by the STEM disciplines. The need for skilled scientists, technicians, and professionals — as well as for an educational system capable of preparing teachers who can successfully meet the needs of students for intensive and effective STEM education — is pressing and expected to grow rapidly in the next decade. Unless the growing shortage of technically skilled, college-educated workers is reversed, the challenges we face as a society threaten to overwhelm our opportunities.

The failure of our educational system to keep pace with the global talent race — together with the daunting social and economic consequences we now face — has become the focus of significant national attention. Colleges and universities across the U.S. and throughout the state are exploring and introducing STEM initiatives. With its legacy of regional stewardship, history as one of the state’s leading producers of teaching and education professionals, and hallmark commitment to educational access, excellence, and student success, California State University, East Bay is uniquely qualified and in a unique position to take on this challenge locally.

As a regional, urban-serving university, Cal State East Bay is by nature and mission a steward of the area’s social and economic health. More than two-thirds of its students are from the region; an estimated 85 percent of its more than 100,000 graduates live and work here. It is among the region’s foremost producers of teachers, business professionals and entrepreneurs, public administrators, literary and performing artists, and science and math graduates. And it leads the 23-campus California State University system in producing credentialed math and science teachers. At the same time, the University has forged strategic partnerships with business, industry, government, and schools aimed at addressing the economic and workforce development needs of the region.

As part of its historic role in, and commitment to, building healthy communities, Cal State East Bay
recognizes that regional social, physical, and economic health are inseparable. University President Mohammad Qayoumi echoed this sentiment when he said, “We recognize that we have a responsibility — and an opportunity— to play a central role in helping meet the needs of our region, from employment and work force preparation to education, economic opportunity, and multicultural inclusion.”

Cal State East Bay’s strategic plan calls for an ambitious expansion of both enrollment and programs over the next decade to deliver on its robust regional stewardship commitment. Its new academic plan, adopted in February 2008, identifies STEM as an area of critical need, a program of distinction — and a key academic priority for the future. Together, these plan calls for CSUEB to be recognized regionally and nationally as a major hub of activity for STEM education, innovation, and transformative learning models for educational reform.

At the center of this vision is an innovative and uniquely integrated, systemic, hands-on approach to STEM education. Its goal is for CSUEB, by 2020 —with a significantly increased enrollment of up to 20,000 or more — to be a regional leader in developing and graduating the next-generation technical workforce, preparing teachers of STEM, and working with partners in business and education to ready students in the P-12 schools (preschool through 12th grade) for STEM education and careers that are the future of the region.

Cal State East Bay’s mission, vision, and values all stress a deep commitment to a diverse academic environment, making broad student access to educational excellence a hallmark and an institutional priority. While private and other universities strive for excellence through exclusivity, CSUEB achieves its excellence through inclusion. Thus, President Qayoumi’s vision and the CSUEB strategic plan for the coming decade together emphasize access alongside the commitment to STEM education. This recognizes that the vitality of the region and the success of the University’s STEM initiative depend upon students of all backgrounds having the opportunity to attain a relevant and high quality college education. For this reason, Cal State East Bay has committed itself to addressing the achievement gap in STEM disciplines for underserved communities as a holistic element of its overall STEM commitment and strategy.

“These plans call for CSUEB to be recognized regionally and nationally as a major hub of activity for STEM education, innovation, and transformative learning models for educational reform.”
Cal State East Bay anticipates a future that will see a dramatic increase in careers in STEM fields, a world in which all graduates — regardless of major and degree — must be technologically proficient. Commenting on this megatrend, President Qayoumi has stated that “The future economic and social vibrancy of our region and our nation depend on an increasingly well-educated and technologically skilled workforce. Cal State East Bay has accepted the challenge to become a university that is a major regional resource and hub for science, technology, engineering, and math education.”

The University recognizes that the deficiencies of national and state STEM education and the shortage of STEM-skilled graduates together represent a complex problem that must be addressed on multiple fronts to gain ground now and into the future. Every course of study at CSUEB — regardless of major — must be infused and enhanced with STEM content and methodology, qualifying all graduates for success in the increasingly technological workplace of today and tomorrow. Existing technical fields of study must be updated and expanded. Curricular and academic programming gaps must be bridged. And a far higher level of interdisciplinary integration and cooperation is required.

The University understands, however, that it will not be enough simply to focus on educating tomorrow’s scientists and technical professionals. Cal State East Bay must also respond to the growing need for qualified math and science teachers, from preschool through high school. And it must work with the region’s stakeholders to create a pipeline of students interested and engaged in STEM — and fully prepared to continue their studies at a college level. In sum, the University recognizes that leading the way in addressing the STEM challenge requires far more than providing excellent higher education opportunities. It demands a continuum of school programs from preschool through graduate school, together with outreach and advocacy for the underserved, as well as partnerships with business, industry, and government, and education.

To address this challenge and deliver on its visionary commitment, Cal State East Bay has a uniquely systemic, three-part strategy that addresses interdependent STEM-related needs and opportunities creatively, comprehensively, and sustainably. Each of the three prongs of Cal State East Bay’s STEM education initiative, listed below, expands and enhances the institution’s recognized strengths and builds upon its successes and momentum in these areas.
CSUEB STEM Education Continuum Strategy

- Teach STEM for the 21st Century
- Develop a New Generation of STEM Teachers
- Partner to Build a Robust School-to-Career STEM pipeline

Together, the three thrusts of Cal State East Bay’s STEM education initiative call for meeting regional technical workforce needs by significantly expanding, leveraging, and further integrating the University’s existing, foundational work, as follows:

1 Teaching STEM for the 21st Century

In the coming decades, growth rates for STEM careers are projected to exceed those of other areas, outstripping the supply of qualified graduates. Yet this is where the opportunities for California’s next generation of workers and citizens are. Cal State East Bay therefore commits to ensuring that students ready to enter the college-to-career path are supported with state-of-the-art STEM instruction, together with extensive advising and mentoring. The University will:

— Ensure that existing programs remain current and keep pace with rapid developments in STEM fields
— Enhance and expand curricular offerings to reflect changing technological developments and workforce needs
— Reinforce its emphasis on pragmatic, hands-on, applied learning, particularly as related to STEM
— Employ an increasingly interdisciplinary curriculum to support the broadest and most integrative approach to STEM education.

With a rigorously targeted, applied, and pragmatic curriculum, training with the latest methods and equipment, and a comprehensive education in complementary subjects, Cal State East Bay will ensure that all of its graduates are qualified to meet immediate needs for skilled workers in the region. In doing so, it will produce the STEM workforce needed.
today and lay the groundwork for the STEM workforce of tomorrow. Setting itself apart from other STEM initiatives in higher education, the University plans a unique, pioneering collaboration — with national implications — between its award-winning College of Education and Allied Studies and distinguished College of Science in teaching and learning for a more technical world.

2 Developing a New Generation of STEM Teachers

A lack of skilled math and science teachers at the P-12 levels (preschool through 12th grade) has led to declining interest and lower test scores among students who are unfamiliar with and uninspired by math and science. The California Council on Science and Technology has reported that the state is falling far short of producing sufficient skilled and knowledgeable math and science teachers, undermining the chance of poor and minority students in particular to compete successfully for higher paying jobs in the science and technology sectors of the economy. Clearly, the economic health of the state and future of our region depend upon an educational system capable of preparing teachers who can not only inspire students, but also respond to their needs for intensive and effective educational programs in science and math.

Cal State East Bay, already a statewide leader in graduating P-12 teachers, will address this by increasing the number of graduates who go on to be P-12 teachers of STEM disciplines, with an emphasis on recruitment and placement in underserved communities. And to assist those teachers already in the field, the University will help provide additional training and sponsor research into best practices in STEM teaching nationwide. To reach these goals, CSUEB will

— Create new pathways into mathematics and science teaching while increasing teacher recruitment efforts

— Develop new cross-disciplinary programs and approaches to train STEM teachers

— Partner with schools and districts to improve STEM-related education in P-12 schools through professional and curriculum development

— Support faculty research and programs development to enhance the quality of STEM education in the University and P-12 schools
Building a Robust School-to-Career STEM Pipeline

Even those students aspiring to higher education are often unprepared for the demands of college-level math and science coursework, requiring remedial classes or a change of focus altogether. Thus, creating a skilled workforce, especially in science and technology, must begin long before college.

Cal State East Bay operates a number of partnership programs designed to stimulate learning and support access and success, especially in STEM fields, at different stages of the educational process. These include 20 initiatives in more than 34 elementary and high school districts in five counties throughout the Bay Area region. This is in addition to partnerships with community college districts, county agencies such the Alameda and Contra Costa county offices of education, as well as national research agencies including NASA Ames, Lawrence Berkeley and Lawrence Livermore National Laboratories, and Sandia Labs — all focused on stimulating interest in and supporting STEM education from an early age.

Building upon this impressive foundation, Cal State East Bay will work with a growing base of regional industry, government, and philanthropic partners who recognize what’s at stake and have made a priority of investing in a solution. Together, they will

— Establish deeper ties with local P-12 school districts and schools
— Develop innovative partnerships with regional business, industry, and community organizations, as well as government research agencies and local and national foundations, to support and promote outreach and early STEM education
— Increase collaboration with community colleges to create seamless pathways to STEM-related majors, including teaching
— Expand mentoring and college-bridge and preparation programs to inspire and assist underprepared students for success in studying STEM in college
Combined, these strategies will create a robust school-to-career pipeline of students, graduates, and professionals ready for the challenges and opportunities of a growing knowledge economy. With the support of its partners, Cal State East Bay will not only become a hub of regional STEM education, research, and collaboration, but also a national demonstration site for best practices in STEM teaching and a knowledge center for those seeking to join the commitment to STEM.

The University Of Possibilities — Delivering The STEM Vision

President Qayoumi has made it clear that reinventing STEM education for the 21st century is integral to the University’s mission and central to its role and commitments as a regional steward — as well as fundamental to the health of our region. As such, he has pledged that no matter what CSUEB students major in — the arts, humanities, social or natural sciences — STEM knowledge, skills, and competencies will be central to their ability to succeed, to pursue meaningful careers, and to become socially responsible contributors to their communities both locally and globally.

The University’s commitment to transforming education to meet the regional needs is not only evidenced by its strategic vision and academic planning, but also by its plans and priorities for philanthropic support. As such, the University launched the planning and leadership phase of its first fundraising campaign in July 2009. President Qayoumi has declared this campaign as the means by which “California State University, East Bay will become ‘The University of Possibilities,’ where all students will major in solutions for tomorrow.”

In addition to providing foundation capital for a truly innovative future, this campaign also will help build a permanent endowment to sustain the University’s vision into the future. Most importantly, it will allow Cal State East Bay to be both creative and rigorous in pursuit of its ambitious plan to move to the vanguard of educational innovation. Thus, the goal of The University of Possibilities campaign is not only to enhance the quality of the University’s academic offerings and to ensure student access and success, but also to ensure the relevance of its programs in meeting critical regional needs. Of the various regional commitments that this campaign embodies, the University’s inclusive, wide-ranging STEM educational initiative is therefore central and preeminent.
The STEM focus of Cal State East Bay’s *The University of Possibilities* campaign comprises five keystone support priorities — opportunities for those who share our values to support the transformative vision that they represent — listed and described below:

### CSUEB STEM Initiative Campaign-Support Opportunities

- Center for STEM Education
- STEM Academic Programming
- STEM Learning Technology
- STEM Gateway Learning Complex
- STEM Student Scholarships & Fellowships

### Center for STEM Education

To plan, coordinate, and support CSUEB’s comprehensive STEM education initiative strategically and efficiently, the University will develop a Center for STEM Education. The Center will enhance and coordinate the existing STEM education activities at CSUEB, and provide a platform from which the University can expand its efforts in STEM education in the future.

The CSUEB Center for STEM Education will:

- Develop new programs to recruit, support and train science teachers
- Build partnerships with P-12 schools and districts to improve STEM related education in P-12 schools through professional development, and curriculum development
- Increase collaboration with community colleges to create seamless pathways
- Improve recruitment of students for STEM learning and teaching, targeting underserved populations
- Support faculty conducting research and developing programs to enhance the quality of STEM education in the University and P-12 schools
- Provide support and resources for STEM education scholars, teachers, researchers, and students to support and sustain these efforts
Although the Center is expected to be self-supporting within five years, estimated start-up costs, including a director, support staff, and faculty release time and resources, are $500,000.

STEM Academic Programs

The academic colleges, departments, and programs of Cal State East Bay must not only be prepared for a long-term increase in STEM-related enrollment, but also must anticipate and meet rapidly evolving employer-workplace standards, technological skill requirements, and student needs. This requires the resources and capabilities to respond nimbly to the demands of the new economy — expanding and modifying existing programs, exploring new concentrations and options, and developing and offering entirely new majors in emerging areas as needed.

These changes will not be limited to the departments in the University’s College of Science. Because STEM must play a role in every student’s college experience, this will extend to the College of Education and Allied Studies — with its central role in teacher development — as well as to departments of business, economics, the social sciences, and the arts. Nor will these developments be limited to the classroom. Extracurricular and interdisciplinary programs, such as the University’s acclaimed Freshman Learning Communities, blending science with liberal arts and social sciences, will also play an increasingly important role in extending STEM education to the campus as a whole. And, reflecting the University’s distinctly hands-on, applied approach to teaching and learning, expanded research opportunities will be available to undergraduates in the STEM disciplines and beyond.

In addition to its undergraduate and graduate-level STEM offerings, the University also recognizes the critical foundational roles of college pathway and bridge programs — an inseparable part of this initiative. With California students — particularly those from underserved communities and ethnic minorities — underperforming in math as early as 4th grade, investing in supplementary P-12 programs will be critical to ensure the strength of the pipeline. In response, the University will also expand its college pathway programs and bridge programs, such as the University’s Summer Algebra Academies, to reinforce the development of skills required for education and career advancement.
Six million dollars of financial support for new and expanded STEM and related interdisciplinary programming is included in the campaign’s $17 million combined funding objective for foundational investments in STEM technology, equipment, and facilities. Campaign funding goals also include an additional $2 million for college pathway programs and bridge programs.

**STEM Learning Technology**

An effective applied education in the sciences depends on first-hand, immediate exposure to and familiarity with modern scientific tools. Centralized facilities are the most efficient way to make these expensive and highly specialized tools available. Cal State East Bay is able to provide much of this equipment and technology in its current laboratory and SciCore computing facilities. But a comprehensive STEM education plan must address equipment and learning technology needs that are changing and evolving as rapidly as science itself.

Existing labs, already in need of upgrades, will be inadequate when faced with the increased demand brought on by a focus on cutting-edge STEM education and anticipated enrollment increases. Teaching and research spaces housing this equipment must also be renovated and modernized as CSUEB pushes ahead with its STEM education initiative.

The University must also expand the quantity and quality of tools available to meet demand. This is especially critical at a high access institution like Cal State East Bay, which serves so many promising, high potential students who otherwise might not have the opportunity to use advanced technology and instrumentation. The University’s STEM education initiative — and the campaign designed to support it — therefore make learning technology and equipment enhancements and upgrades a priority.

Assisting the University’s STEM-related programs to acquire necessary cutting-edge technology not only ensures that every student gets the hands-on time they need to excel, but also accelerates the institution’s progress on its STEM education trajectory. Up to $1.5 million of the total campaign goal is to support this objective.
STEM Gateway Learning Complex

While Cal State East Bay’s STEM education initiative will begin in current facilities, the scope of this effort is so great that programs will quickly outgrow what is now available to house this expansive, multidisciplinary effort. And although this initiative is neither focused nor reliant upon a capital project, the realities of teaching and learning such highly technical subjects make this proposed major investment in infrastructure an essential one for the future. Ultimately, through refurbishment and expansion of existing buildings and the addition of a proposed new structure, Cal State East Bay’s commitment to STEM education will be embodied in an advanced complex on the Hayward Campus, designed expressly to meet the requirements of a rigorous 21st century technical education.

Technology and scholarship will evolve in the future even more rapidly than in the past — and a well-designed building must have the ability to evolve with them. Thus, this complex will be designed and engineered for maximum flexibility and continuously evolving teaching-learning pedagogy. It will offer tomorrow’s students modern classrooms and sophisticated labs with tools readily available on demand — from high-speed computing, analytical, and modeling applications to sophisticated, state-of-the-art testing instrumentation.

Drawing on synergy between the College of Science and the College of Education and Allied Studies, the STEM Gateway Learning Complex will be a national center for innovation in training tomorrow’s teachers, as well as the teaching and learning of STEM disciplines. The center will also house a growing P-12 education outreach partnership program. As home to innovative approaches to STEM teaching, new interdisciplinary STEM programs and majors, and pioneering teacher development collaboration, the center will be a gateway to the future in the broadest sense of the term — for students and educators alike.

Preliminary estimates of the need for such state-of-the-art space including advanced classrooms, labs, and equipment call for approximately 132,000 square feet of assignable space at an estimated cost of $80 million. The campaign’s $17 million STEM-support goal includes an increment designed to leverage and allow CSUEB to qualify for future California State University system and other public funding to build this complex.
Among the hurdles looming especially large for aspiring college students is cost. And for students who may be the first in their families to consider college, or returning adult students and transfer students, many of whom work full or part time, this barrier to access is often magnified. Any solution for making a quality STEM education more widely available — and indeed a college degree in general — must therefore address this serious barrier.

Cal State East Bay is, by mission and practice, the most affordable, inclusive, and flexible university in the region. The cost of attendance is among the lowest in the nation for schools of comparable quality. Yet even with this high level of access, far too many promising and qualified students simply cannot afford a college education without outside help. In fact, more than 50 percent of Cal State East Bay’s current students rely on some form of financial aid. Clearly, the University must expand the range of financial aid available to students — including essential need-based scholarships as well as awards recognizing academic achievement — to provide increased access.

Some of the most academically gifted students are from economically disadvantaged backgrounds; the addition of expanded merit awards to need-based aid resources will also help ensure that these students can pursue their dreams of a college degree. Together, scholarships and student fellowships will give opportunities to promising students who otherwise could not meet the financial obligations of a quality college education.

In recognizing needs and rewarding accomplishments, Cal State East Bay can attract the region’s most promising students. And in doing so, it will remove even more barriers to a quality STEM education — opening the door to a lifetime of individual achievement and productive citizenship while playing a central role in helping produce the region’s next-generation technical workforce. Up to $13 million of the campaign’s total goal is intended to support this crucial aspect of Cal State East Bay’s mission.
Without a strategic, integrated plan for educational reform, the declining performance of California’s children in mathematics and science will continue. The data demonstrate clearly that if we are not able to generate a larger number of high school students with proficiency in mathematics and science, we will not be able to increase the number of students who pursue college degrees, and especially degrees in the STEM disciplines. Considering the demographics of California’s growth, the problem is exacerbated by the performance deficiencies of underrepresented populations in math. Without improving or creating new educational resources, the number of graduates in STEM disciplines will continue to decline, leaving California unable to meet workforce needs required to ensure future economic vitality and competitiveness. California’s economy — and with it, that of our region — will be relegated to a state of perpetual stagnation and recession.

What is critically needed are systematic strategies such as public policies, school district strategies and leadership, teaching methods, and expectations that will significantly enhance student learning outcomes. The challenges that must be addressed — which Cal State East Bay proposes to spearhead in partnership with its closest friends, supporters, and partnership — are

- reducing the educational achievement gap
- increasing diversity in the STEM fields and education
- meeting industry demands for graduates in the STEM fields
- reforming science and mathematics pedagogy
- increasing the numbers of science and math educators
- providing teacher development and enrichment programs
- inspiring P-12 students to aspire to the STEM college-to-career pathway
- increasing science, mathematics, and technological literacy for all students and the public

To meet the challenges facing the region and the state, and increase the scientific literacy of our population, Cal State East Bay commits to a “cradle-to-career” STEM education.
1. Increase the number of CSUEB science, technology, engineering, and mathematics graduates capable of meeting workforce needs by up to 300 percent — from approximately 660 per year to almost 2,000 per year.

2. Increase the numbers of teachers trained and certified by CSUEB to teach science and mathematics in the P-12 schools by up to 400 percent — from approximately 120 per year to more than 800.

3. Ensure that 100 percent of CSUEB graduates — regardless of major — possess technical fluency, including essential computational skills, software proficiency, technical Web abilities, scientific methodology, and basic physical, biological, and chemical mechanics.

4. Grow regional college-going rates through P-12 outreach partnerships with business, industry, government, P-12 schools, and national research laboratories with an emphasis cultivating and encouraging future STEM students.

5. Improve the success of transfer students at CSUEB, particularly in STEM fields, through enhanced regional community college partnerships and more robust pathways such as dual admissions.

A Joint Venture & Investment in Tomorrow

Financing this ambitious agenda will require far more than public funding can provide. This is especially true in an environment in which state funding — once the source of nearly all the University’s operating costs but now only about two thirds — is projected to continue to decline to a third or less in coming years. Although state funding will provide a foundation for University operations, it will fall increasingly short of the vision and plans for the future forged with our partners and friends. Thus, this University’s vision and plans for a sweeping continuum of STEM educational reform — like the all of the University’s campaign priorities — will rely upon a combination of private and public support.

If Cal State East Bay and its partners in economic and social vibrancy are to reform and reinvent STEM education for tomorrow, our work must begin today. The University of Possibilities campaign is our call to action, a prospectus for tomorrow, an opportunity to invest in and underwrite our region’s most promising venture — the workforce of tomorrow.
Knowledge and skills from science, technology, engineering, and mathematics — the so-called STEM fields — are crucial to virtually every endeavor of individual and community life. All young Americans should be educated to be “STEM-capable,” no matter where they live, what education path they pursue, or in which field they choose to work.