

PROJECT SUMMARY

Building Capacity for the *STEM Teachers for Justice, Community, and Leadership Program* at Saint Mary's College of California

Overview.

Saint Mary's College of California (SMC) submits this Capacity-Building proposal to the NSF Robert Noyce Teacher Scholarship Program for the *STEM Teachers for Justice, Community, and Leadership Program*, which will involve SMC's Kalmanovitz School of Education, School of Science, and the Mt. Diablo Unified School District, a high-need local educational agency. Presently at SMC, the undergraduate major Justice, Community, and Leadership (JCL) in SOLA serves as the pathway for students to become multiple subject and special education teachers. This proposal seeks to build and extend collaborations among SMC's Kalmanovitz School of Education (KSOE), the School of Science (SOS), and the School of Liberal Arts (SOLA) as well as between SMC and the Mount Diablo Unified School District (MDUSD) to design an undergraduate STEM teacher preparation program that combines robust STEM training, innovative teaching pedagogy and social justice focus to prepare students to teach in high-need diverse urban public schools. This project is informed by educational research and STEM disciplinary research on ambitious and equitable STEM teaching practices and teacher education curricula and pedagogy that foster such practices. This undertaking is also timely because in 2017 the state of California approved higher education institutions to grant a teaching credential alongside an undergraduate degree.

The proposed Noyce Capacity grant has five specific aims: 1) Conduct a needs assessment of STEM teaching and learning by engaging youth and their teachers in MDUSD partner schools as well as current STEM and JCL undergraduate majors and faculty at SMC in surveys and focus groups to better understand the gaps and challenges in STEM teacher preparation; 2) Deepen existing partnerships with five MDUSD Title I middle and high schools; 3) Develop a robust undergraduate STEM teacher curricular pathway, with partners from the School of Science; Teacher Education; and Justice, Community, and Leadership, to leverage and synergize existing programs at SMC; 4) Enhance institutional knowledge of recruiting, preparing, and sustaining diverse STEM teachers; and 5) Establish a mechanism for long-term sustainability and evaluation of the program, including an advisory board of SMC and district partner stakeholders, to identify and reflect on strengths, areas of improvement, and visions for the future. Data collected will include observations, surveys, focus groups, and student reflections.

Intellectual Merit

This project will contribute to the STEM education field by generating new knowledge on the possibility for convergence of programming that brings together science disciplinary, single subject. The proposed undergraduate STEM teacher preparation program will address the dire shortage of STEM teachers in Title I MDUSD schools, seeking to support new teachers not only to enter the profession but to persist in it as transformative change agents committed to justice, community, and leadership. pedagogy, and justice-oriented frameworks. The data acquired during this capacity grant period through design-based research will allow us to engage in cycles of improvement beginning at the capacity building stage.

Broader Impacts

The broader impacts will 1) improve ambitious, equitable, justice-oriented, and culturally sustaining STEM teaching in urban schools that serve predominantly Students of Color and economically marginalized students, who are often pushed to the margins in STEM, 2) recruit a more diverse STEM teaching force, 3) develop a model for professional learning communities for STEM teachers, and 4) increase STEM teacher retention through rigorous preparation and ongoing community building in high teacher turn-over schools.

PROJECT DESCRIPTION

1. Introduction

The Building Capacity for the *STEM Teachers for Justice, Community, and Leadership Program* at Saint Mary's College of California's (SMC) proposal seeks to build and extend collaborations – among SMC's Kalmanovitz School of Education and its Schools of Science and Liberal Arts as well as between SMC and the Mount Diablo Unified School District (MDUSD) – to design an ambitious, evidence-based, equity and social justice-driven undergraduate STEM teacher preparation program that will prepare diverse students to teach in high-need, urban public schools. Undertaking this program capacity building and devising strategies to recruit students to this program, will position SMC to establish the infrastructure necessary for implementing a future Track 1 Noyce project.

This undertaking is timely because in 2017 the state of California approved higher education institutions to grant a teaching credential alongside an undergraduate degree; prior to this, teacher education students were required to seek a credential after completing a baccalaureate major (Teacher Credentialing, Assembly Bill No. 170, O'Donnell, Chapter 123, 2017). SMC is well-positioned to respond to this legislation, to grow and enhance existing graduate teacher education programming into undergraduate teacher pathways.

In particular, there is fertile ground for developing a robust undergraduate STEM teacher preparation program at SMC:

- First, SMC's School of Science, which awards bachelors degree in allied health sciences, biology, biochemistry, chemistry, earth and environmental science, mathematics and computer science, physics and astronomy, and psychology, provides a range of resources to students, including a long-established summer research program; hands-on training in cutting-edge STEM technique; and a new STEM center that offers tutoring, supplemental instruction, and career guidance. The School of Science has implemented a number of initiatives to attract and retain students from underrepresented minority groups and those who are Pell-grant recipients.
- Second, the Single Subject Teacher Education (SSTE) program in the KSOE presently grants preliminary secondary teaching credentials to graduate credential students who are STEM teacher candidates. This mission of the SSTE program is to prepare teachers to teach in local, high-need urban public schools by supporting students to develop understandings of educational (in)justice contexts, foster a humanizing classroom community, design critical and culturally sustaining curriculum and assessments, engage in critical praxis to reflect and improve teaching, and learn from and build on students' and families' cultural wealth. STEM teaching methods courses emphasize ambitious, equitable instruction connected to the Next Generation Science Standards and Common Core Mathematics Standards.
- Third, the undergraduate Justice, Community, and Leadership (JCL) major in the School of Liberal Arts has been established at SMC as the 4-year baccalaureate and credential pathway for undergraduate teacher education in elementary and special education. The JCL programming supports students to understand the social, political, historical, and cultural dimensions of schooling and, through coursework and community engagement, understand the role of teachers as transformative change agents.

It is at the nexus of this programming -- in STEM disciplines; secondary teacher education; and justice, community, and leadership studies -- that we envision the design of the innovative, nationally groundbreaking *STEM Teachers for Justice, Community, and Leadership Program*. We seek to support new STEM teachers from diverse backgrounds not only to enter the profession but to persist in it as transformative change agents committed to justice, community, and leadership.

The proposed undergraduate STEM teacher preparation program will address the dire shortage and high teacher turnover rate of STEM teachers in Title I MDUSD schools. SMC, particularly the Kalmanovitz School of Education, has multiple partnerships in place with the MDUSD, and currently most graduate credential students in the SSTE program are placed for student teaching in the district with

skilled Cooperating Teachers at Title I schools. There is opportunity and great enthusiasm from SMC and MDUSD leadership, faculty, and staff alike to deepen the SMC and MDUSD partnership around STEM education and social justice, particularly around diversifying the STEM teaching profession and preparing and supporting teachers to enact ambitious, equitable instruction that is culturally responsive and connected to the greatest STEM challenges of our times.

To establish the *STEM Teachers for Justice, Community, and Leadership Program* that prepares undergraduate students to ultimately teach in the MDUSD, the proposed Noyce Capacity grant has five specific aims: 1) Conduct a needs assessment of STEM teaching and learning by engaging youth and their teachers in MDUSD partner schools as well as current STEM and JCL undergraduate majors and faculty at SMC in surveys and focus groups to better understand the gaps and challenges in STEM teacher preparation; 2) Deepen existing partnerships with five MDUSD Title I middle and high schools; 3) Develop a robust undergraduate STEM teacher curricular pathway, with partners from the School of Science; Teacher Education; and Justice, Community, and Leadership, to leverage and synergize existing programs at SMC; 4) Enhance institutional knowledge of recruiting, preparing, and sustaining diverse STEM teachers; and 5) Establish a mechanism for long-term sustainability and evaluation of the program, including an advisory board of SMC and district partner stakeholders, to identify and reflect on strengths, areas of improvement, and visions for the future.

[Paragraph on what problems in Teacher Ed and STEM teaching, regionally and nationally, this work addresses.]

[Paragraph on research we’re drawing on to address aforementioned problems and how we’ll use it to proactively address the problems.]

2. Infrastructure

Saint Mary’s College of California: SMC is a private, comprehensive university located in Moraga, California in the diverse, urban metropolitan San Francisco Bay Area. SMC is guided by the Lasallian Core Principles, which include Respect for All Persons, Inclusive Community, Quality Education, and Social Justice. It serves 2,795 undergraduates and 1,086 graduate and professional students, offers 40 undergraduate programs in liberal arts, science, and business leading to a B.A. or B.S. degree, and ## education programs leading to a teaching credential, certificate, M.A. or Ed.D. degree. Undergraduate programs operate on a 4–1–4 schedule: fall (4 courses) – January term (1 course) – spring (4 courses), and teacher education programs operate year-round. The undergraduate student-to-faculty ratio is 11:1 and average class size is 19. SMC has been designated as a Hispanic Serving Institution (HSI) since 2015. The undergraduate student profile is:

Women or women-identified	57.4%	Students of color	52.8%
First-generation students	30%	Low-income (Pell grant-eligible)	21.5%
Hispanic/Latinx	28.9%	Traditional undergraduates (ages 19-24)	99%

The Kalmanovitz School of Education (KSOE) prepares over 600 students annually for certificates, credentials and degrees across three departments: Counseling, Leadership and Teacher Education. The KSOE emphasizes active collaborative learning, community engagement, and empowers students to lead change according to the principles of social justice and the common good. KSOE. It is conveniently located near many of the Bay Area’s largest public school districts, colleges and universities, and community-based agencies, providing students enrolled in KSOE programs opportunities to apply their knowledge and new understandings in real classrooms and community settings in both private and public sectors.

The Teacher Education Department is dedicated to preparing educators to teach and lead in schools that represent the linguistically, socially, and economically diverse population of the state of California. We offer credential programs for elementary, secondary, and special education teachers, all of which have 100% completion rates. There are X full-time faculty, Y staff, and the department serves approximately Z

students across the three credential programs each school year. Additionally, we offer a Master's of Education and Masters in the Art of Teaching, which enrolls approximately 90 students per year; the majority of students across the Master's programs completed credential work at SMC and are returning. The department has long-time partnerships with local districts. Twice per school year, the department holds a Credential Advisory Board meeting, in which district and school partners are invited to share their insights and expertise as they identify strengths and areas of improvement for the department's programs.

Beginning in Fall 2017, the Single Subject Teacher Education (SSTE) secondary teacher education program embarked on a program re-design to explicitly prepare teachers to teach in local, high-need urban schools. We strive to support teacher candidates learn how to: develop understandings of educational (in)justice contexts, foster a humanizing classroom community, design critical and culturally sustaining curriculum and assessments, engage in critical praxis to reflect and improve teaching, and learn from and build on students' and families' cultural wealth. While Saint Mary's is located in an affluent community with well-funded public and private schools, the program identified great need for well-prepared teachers in all secondary content areas in our bordering communities, such as in the city of Concord, which the MDUSD serves. All teacher candidates are placed in MDUSD or another local, high-need urban district, for year-long student teaching field placements, where they come to not only learn deeply about and from the class communities they student teach within, but they are also supported through program activities and assignments to learn about the strengths and needs of the school community and broader community, to understand how to build on these as a teacher. The Cooperating Teachers who mentor our students have a shared commitment to education as a vehicle for social justice, and a growing number of them are SSTE program alumni. Our College Supervisors observe students six times per semester and provide detailed feedback for improvement along the California Teacher Performance Expectations; they are long-time teachers in the community committed to continuing to serve local, high-need urban schools. Many students go on to secure teaching positions at their student teaching school sites or within the district where they student teach. The SSTE program is designed to be completed in a year if done full-time and offers both a summer and winter start, with every program class offered every semester, making our classes accessible to traditional credential students and undergraduate students alike. Courses are taught not only by full-time faculty members with field expertise but also by adjunct professors who are current secondary urban school teacher leaders who are up-to-date with implementing and innovating social justice teaching pedagogies.

Teacher candidates take two teaching methods courses in their content area, one each semester. In these courses, STEM teacher candidates learn about ambitious, equitable instruction through the Next Generation Science Standards and Common Core Math standards as well as learning about gate-keepers in STEM education (e.g. tracking) and how teachers can challenge inequity in their classrooms and as transformative education leaders. Most classes in the SSTE program are offered to students from across content areas; this design offers many opportunities for cross-disciplinary collaboration. The credential program graduates approximately 6-10 STEM teachers per school year.

SMC's School of Science at SMC awards bachelor's degree in allied health sciences; biology; biochemistry; chemistry; earth and environmental science; mathematics and computer science; physics and astronomy; and psychology. The school has 53 full-time and 22 part-time faculty, and it has a wide range of resources to provide students with hands-on training in cutting-edge STEM techniques. (Please see the Facilities, Equipment, and Other Resources section for detail.)

Science faculty are committed to teaching excellence. With small class sizes (16- 32 students) and classrooms that are equipped with SMART boards, clickers and other technological resources, faculty strive to improve the interactive nature of the courses and enhance student engagement. A number of STEM faculty have participated in workshops focused on inquiry-based active learning strategies in the classroom, implementation of classroom-based research experiences, developing assessment practices and strategies to improve classroom equity and diversity in STEM in an effort to improve student learning in STEM courses. Following these workshops, faculty in the introductory STEM courses have implemented active learning strategies such as "flipped classroom," "clickers," and research projects. They have also incorporated discussions on race and equity in STEM through exercises such as "scientist spotlight" that

showcase stories of scientists from diverse backgrounds and through discussions on societal and ethical implications of scientific discoveries.

Science faculty regularly involve students in their research projects. In 2018-19, science faculty published 14 peer-reviewed articles; 12 students were co-authors on 4 of the published articles. Our Summer Research Program funds 15-20 projects per summer, with 10-12 faculty serving as research mentors for the students awarded funding, following which students present their research at local, regional or international conferences.

SMC is committed to the success of STEM students from diverse backgrounds. We have implemented a number of initiatives to attract and retain students from underrepresented minority and Pell-grant recipient students in the Sciences through an NSF-funded Mentored Access to Programs in Science program and through Caminos a Las Ciencias (CALC), funded in 2016 via a \$2.7 million U.S. Department of Education HSI STEM and Articulation grant. The NSF S-STEM grant has enabled us to support students with financial need through their bachelor’s degree in the sciences. The funding through the CALC grant has helped us develop support resources for students such as a STEM center for group study and tutoring, supplemental instruction for introductory courses and help with career planning through career panels and guest speakers. In addition, the CALC grant has provided support for faculty by funding implementation of innovative pedagogy to engage diverse students in STEM and funding for travel to pedagogical and equity workshops and conferences. All these efforts demonstrate the commitment and motivation of the School of Science to provide a rigorous and engaging STEM education for all students in our classrooms.

The Justice, Community, and Leadership (JCL) major is a program in which students learn how to analyze and engage in some of the most pressing social, educational, and environmental justice issues of our times. Through training in critical theory, leadership studies, policy, and education, and an emphasis on humility and self-reflection, students are prepared to participate in and lead collective endeavors to make the world a better place. Currently, the Justice, Community and Leadership major houses two of our undergraduate integrated teacher education pathways - Multiple Subject (elementary teaching) and Special Education; since 2016, the undergraduate teacher pathway population has grown by nearly 40%, and we anticipate attracting further interest with the addition of a 4-year secondary teaching pathway. While we recognize that future secondary teachers will not major in JCL as presently designed because they must gain deep understandings of (and often seek to major in the content area they will teach), we will develop a unique program for future secondary teachers that includes taking a combination of substantial STEM disciplinary, Single Subject (secondary teaching), and JCL coursework. SMC does not currently have a pathway that spans these three areas, yet we know all three are essential to becoming effective STEM teachers in urban schools. This program will be unique nationally due to the integration of the JCL component. Presently, undergraduates at SMC interested in becoming STEM teachers major in a STEM field and then, separately, take an additional year of SSTE classes.

The **Mt. Diablo Unified School District** (MDUSD) is a K-12 public school district located in Contra Costa County in the San Francisco East Bay Area of California. The district serves more than 31,000 students and includes 1,768 teachers at more than 50 school sites, including 9 middle schools and 5 comprehensive high schools. As part of a richly diverse community, MDUSD families represent numerous ethnic communities, speaking nearly 50 different languages and dialects. The MDUSD is a high-need local educational agency, with 3 of the middle schools and 2 of the comprehensive high schools consisting of far more than 50 percent of enrolled students eligible for participation in the free and reduced-price meal program. The following schools, all with Title I designation, are included in the table below. The schools serve mostly Students of Color, have between 23-47% of English learners, and all have a majority of students not meeting the standard on the California Assessment of Student Performance and Progress mathematics test. The percent of Teachers of Color at these five schools ranges from 11-37%.

School	Grades	Title I	% Eligible	%	%	%	High	% Students Not
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			Free/ Reduced- Priced Meals	English Learners	Students of Color	Teachers of Color	School Grad. Rate	Met Standard on CAASPP Math Test
Riverview Middle	6-8	Yes	88%	37%	97%	19%		67%
El Dorado Middle	6-8	Yes	63%	23%	77%	11%		62%
Oak Grove Middle	6-8	Yes	92%	47%	97%	29%		71%
Mt. Diablo High	9-12	Yes	76%	34%	92%	37%	83%	59%
Ygnacio Valley High	9-12	Yes	73%	30%	89%	37%	91%	64%

Table based on 2017-2018 school year data from the California Department of Education's Ed-Data website. CAASPP is the California Assessment of Student Performance and Progress

3. Entities and Processes

3.a. Entities

3.a.1. Kalmanovitz School of Education, School of Science, and School of Liberal Arts Key Faculty Staff, and Administrators

Dr. Mary Raygoza (PI), Asst. Prof. and Program Director, Single Subject Teacher Education, teaches courses for secondary teacher candidates, including Foundations of Urban Secondary Education, Teaching for Social Justice, and Humanizing Mathematics Methods. She also teaches within the undergraduate Justice, Community, and Leadership program and advises students obtaining Master's degrees in Education. She will lead the overall project and direct the needs assessment research as well as internal (within SMC) and external (between SMC and the MDUSD) collaborative partnership building.

Dr. Vidya Chandrasekaran (Co-PI), Assoc. Prof. of Biology teaches lower division and upper division Biology courses and has mentored more than 50 SMC undergraduates on independent and course-based research projects. She has been engaged in active learning approaches and is a co-author on four science education publications in CBE-Life Sciences. In 2016-17, she was Interim Director for the NSF S-STEM grant (award #) (2014-19) to provide tuition support for academically talented financially needy students majoring in STEM disciplines and is a Co-PI on a Dept. of Education HSI-STEM grant (2016-21) to implement strategies aimed at improving the retention and success of students from underrepresented minorities in STEM. As a Co-PI for this Noyce grant, Dr. Chandrasekaran will be actively involved in facilitating the discussion among SMC faculty to develop a curricular map that integrates STEM education, teacher preparation and social justice. She will also assist Dr. Mary Raygoza with the design and execution of the needs assessment.

As described in section 3.b. Activity 3, the PI and Co-PI will lead a core group of 9 associate faculty in STEM, liberal arts, and education strengthen collaborations and develop curricular pathways for a STEM-focused SSTE program

Education Faculty Associates

Dr. Peter Alter, Professor and Chair, Teacher Education

Dr. Raina León, Assoc. Prof., Teacher Education and Incoming Single Subject Teacher Education Program Director

Dr. Tamara Spencer, Assoc. Dean and Assoc. Professor of Teacher Education

Liberal Arts Faculty Associate

Dr. Manisha Anantharaman, Asst. Prof. of Justice, Community, and Leadership,

STEM Faculty Associates

Dr. Alice Baldrige, Assoc. Prof., Environmental and Earth Science teaches Earth Science courses for both majors and non-majors and has advised and supervised the research projects of undergraduates who are interested to pursue science education. Baldrige prepares her students to communicate science and is committed to social justice in science classrooms. She is a Senior Research

Scientist at the Planetary Science Institute and has participated in a variety of NASA-funded projects over the past 10 years including Project WISER (Workshops in Science Education and Resources) and Laurel Clark Earth Camp for Educators.

Dr. Steven Bachofer, Prof. of Chemistry, has worked informally on STEM education projects impacting K12 students for the past 15 years. Building on the knowledge from his involvement in the NSF-supported SENCER (Science Education for New Civic Engagements and Responsibilities) project, he has offered education lab experiences with Sequoia Middle School students and teachers regularly for the past decade. He has also received a SENCER-ISE (Informal Science Education) 2013 subaward to coordinate STEM outreach to Lindsay Wildlife Experience which assists the Mt. Diablo Unified School District for K5 STEM education.

Dr. Jessica Coyle, Asst. Prof. of Biology, teaches Ecology, a required writing course for majors. She is interested in fostering scientific ways of thinking through authentic classroom research experiences and in developing and assessing activities that teach quantitative and analytical skills. She is keen to build a curriculum that enhances the capacity of future secondary science teachers to teach quantitative science skills and problem solving in ways that are effective and feasible in public schools.

Dr. Andrew Conner, Assoc. Prof. of Mathematics and Computer Science, has been teaching college mathematics courses for over 15 years, mostly to students who are, or intend to be, STEM majors. His primary interest lies in building capacity in secondary-level math programs by placing good teachers *with strong math skills and knowledge* (roughly commensurate with a B.S. in mathematics) in districts that desperately need them. He is interested in developing the mathematical repertoires of students who want to teach math, and recruiting strong math students into education programs.

Dr. Zuleikha Kurji, Asst. Prof. of Chemistry

Key Staff

Chris Junsay, Coordinator of Field Experience and Admissions, Single Subject Teacher Education

Isabella Navarro, Undergraduate Teacher Education Coordinator, supports all undergraduate teacher education concentrations - monitoring and documenting undergraduate teacher candidates' progression through programs from admission to timely completion of BA and teaching credential. In 2017 Isabella was brought on to support the development and implementation of the INSTEP grant, awarded by the state of California, allowing the JCL program to transition our successful 5-year Teachers For Tomorrow program into an integrated undergraduate pathway for students to receive a preliminary teaching credential in Special Education (SPED) along with their BA in just four years. Shortly after, in coordination with the Graduate School of Education and JCL, another integrated program was developed for Multiple Subject Teacher Education candidates in which Isabella also played a key role.

Junsay and Navarro will participate in designing and implementing the needs assessment research. Their experiences of working closely with MDUSD secondary teachers (including program alumni teaching within the district) and all SMC undergraduates on a teaching pathway, respectively, offer essential insight for this work. While site partner work, student advising, curricular mapping, and serving on the advisory board would fall under their duties, conducting mixed methods research is beyond their institutional responsibilities.

Ms. Jerrie Zee, KSOE Data Specialist, will support the project by analyzing data on SSTE STEM teacher candidate enrollment trends over the last five years, specifically student demographics (e.g. race, gender).

A **Graduate Student Assistant** (specific individual TBD), reporting to the PI, will support data gathering, data analysis, communications, logistics and coordination for faculty collaborations at SMC and for the partnership with MDUSD, and other project activities.

Key Administrators

Gittens

Wensley

Hassell Hughes

3.a.2. District Partners

Jennifer Sachs, Executive Director of Instructional Support for the Mt. Diablo Unified School District (MDUSD), has worked in education for over 25 years. Prior to coming to Mt. Diablo, she worked in several districts as Director of Educational Services, Assistant Director of Curriculum & Instruction, site principal, teacher, and instructional assistant. Jennifer has experience partnering with K-12 and community college systems and has served on a multitude of committees with community partners to support the enrichment of educational programs for underserved students. In her current role, she supports elementary through high school principals with district/school initiatives through coaching and mentoring and counsels administrators on how to leverage state/federal program funds and data analysis cycles to design coherent school-wide programs. Jennifer supervises the Teacher Induction and Support Program (TISP) in MDUSD focused on creating innovative, job-embedded teaching and training opportunities (i.e. study lab classrooms), and works collaboratively with the Human Resource Department and institutions of higher education to broaden the participation of groups underrepresented in STEM.

School District Champion, Specific Individual TBD. MDUSD Champion - . to support this needs assessment to happen and coordinate collaborative meetings; the point person
Recognize how time-demanding working in schools is; critical to have this point person

3.b. Processes

The long-term goal of this project is to address the STEM teacher shortage and need for culturally responsive teachers in high needs diverse school districts in the San Francisco Bay Area through the development of a SSTE STEM teacher education pipeline at SMC. To achieve this long-term goal, here are the four main objectives:

Objective 1: Provide STEM teacher candidates with robust integrated STEM knowledge and STEM students with a better understanding of STEM teaching pedagogies

Objective 2: Develop culturally responsive STEM teacher candidates to teach in diverse school districts.

Objective 3: Attract STEM students from diverse backgrounds to STEM teaching

Objective 4: Deepen existing partnerships with local school districts.

To meet these long-term objectives, we propose the following activities as part of the capacity building grant: 1) Conduct a needs assessment of STEM teaching by engaging youth and their teachers in partner schools as well as current STEM/JCL/SSTE majors at SMC through surveys and focus groups to better understand the gaps and challenges in STEM teacher preparation; 2) Deepen existing partnership with MDUSD middle and high schools; 3) Develop a robust undergraduate STEM- single subject teacher preparation program; 4) Learn from and build collaborations with STEM education organizations and fellow teacher preparation programs with social justice commitments; and 5) Set up a mechanism for long-term sustainability and evaluation of the program.

Activity 1: Needs assessment

To inform the submission of a future Track 1 Noyce proposal, we intend to utilize the capacity grant to design and implement a needs assessment of STEM teaching and learning at both SMC and MDUSD, recognizing that educator and student voice at the college and secondary level will shed light on the programming and support needed to develop and sustain the *STEM Teachers for Justice, Community, and Leadership* program. The following overarching research questions will guide the needs assessment: A) To what extent are SMC students energized and informed about becoming STEM teachers, and what can SMC do to generate more interest among STEM majors becoming STEM teachers?; and B) How can SMC's STEM teacher preparation best meet the STEM education needs of the MDUSD and create a

pipeline of SMC STEM teachers into the MDUSD? A mixed methods approach of quantitative and qualitative data collection will allow for nuanced understanding of the state of STEM teaching and learning at SMC and the MDUSD. Prior to the start of the grant project, the PI and Co-PI will seek Institutional Review Board approval from SMC and the MDUSD. The data collection and analysis procedures as well as how data will be stored and shared will be specified in the IRB protocol.

Question A) To what extent are SMC students energized and informed about becoming STEM teachers, and what can SMC do to generate more interest in STEM majors becoming STEM teachers?

To address this question, we seek to learn from current SMC students as well as SMC faculty.

i) First, we will analyze data on SSTE STEM teacher candidate (graduate credential student) enrollment trends over the last five years, specifically focusing on student demographics (e.g. race, gender).

ii) To more deeply understand SMC undergraduate student interest, we will conduct a survey of current undergraduate STEM students and JCL Single Subject students, followed up by a focus group. The survey will inquire about their interest in teaching. If they are already intending to become a teacher, they will be prompted to share what drew them to teaching, what is helping them to persevere, and what they feel they need more of. If they are STEM majors not on a teaching path, we will ask them to rank their interest in learning more about becoming a teacher, share how much information or advising they have presently received about how to become a teacher and social justice-oriented STEM teaching, and to share rationales for why they are not presently interested; this will assist in identifying common themes of deterrence into STEM teaching so that we may be aware of and address those areas in recruitment. If they are JCL Single Subject students, we will inquire if they have taken STEM-intensive coursework and why they have or have not considered teaching STEM. We will also ask questions to all participants about their ideas for recruitment, as they are most intimately familiar with student discourse on potential career trajectory and the kinds of outreach that generate student enthusiasm.

iii) To understand the SMC faculty and staff perspective on generating student interest and being prepared to inform STEM majors about becoming teachers, we will design a survey and administer it to STEM and Teacher Education faculty and staff, including those faculty who serve in advisory roles for student course and career planning and staff who serve in roles for underrepresented students to succeed in STEM. We will inquire about the extent to which and how they have heard students discuss becoming STEM teachers and their perspectives on what would generate more student enthusiasm as well as concerns. Furthermore, we would ask them to identify what they would need to know to recruit and advise students well.

Question B) How can SMC's STEM teacher preparation best meet the STEM education needs of the MDUSD and create a pipeline of SMC STEM teachers into the MDUSD?

To address this question, we seek to learn from MDUSD leadership, teachers, and students.

i) First, we must learn about the STEM teacher shortage areas (i.e. the MDUSD is in need of mathematics as well as all levels of science teachers each school year, yet there may be particular grade levels or courses or schools with higher need), as well as STEM teacher turn-over rates- which we will review for overall trends as well as specifically looking into the persistence of SMC alumni STEM teachers in MDUSD. We will request information on the demographics of STEM teachers to understand the extent to which the ethnic and gender backgrounds of teachers represent student backgrounds. And we will analyze district assessment data from STEM classes (e.g. standardized tests, common assessments). The MDUSD champion will support us to secure these descriptive statistics from the MDUSD.

ii) STEM teachers in the MDUSD, both more veteran and newer to the profession, can speak to their present realities persisting as STEM teachers, what sustains them and what they need more support with, which will be important lessons for the development of our programming. We seek to understand their perspectives on what is necessary for strong STEM teacher preparation and transition to full-time teaching, in relation to the unique strengths and needs of the MDUSD students; they can speak to the current landscape of STEM education in the MDUSD most directly, which will support us in understanding the assets and challenges our teacher candidates will likely experience as they student teach

and ultimately secure teaching jobs in the MDUSD. We will survey 30 MDUSD STEM teachers and conduct a follow up focus group of 6-12 teachers. In particular for the focus group, we will seek to invite SMC alumni who are current MDUSD STEM teachers (this will first require identifying them and reconnecting with them), and ask them to speak to areas the program prepared them well for and areas it could grow. We will also seek to invite mathematics and science department chairs, as teachers leaders at the schools. We will explore if STEM teachers feel they are equipped with content and pedagogical knowledge and knowledge about STEM education policy and reform? We will zoom in on adoption of the Common Core Standards in Mathematics and the Next Generation Science Standards. We will consider the implications of what we find for our program development. We will also ask teachers' perspectives on how we can create a stronger pipeline into the district from SMC.

iii) Finally, we will explore what inspires MDUSD students to be engaged and feel empowered in STEM by asking MDUSD students themselves. What kinds of teaching practices and classroom opportunities support students to see themselves in STEM, see themselves continuing to take STEM classes, and perhaps considering STEM-intensive majors? We will form a focus group of 6-12 high school seniors, a mix of students intending to do STEM-intensive majors in college and students who do not. Given that our programming seeks to be culturally responsive, it is critical to understand from students themselves what qualities they identify as important for an engaging, ambitious STEM teacher. Research on positive mathematics identity will inform the focus group protocol.

Activity 2: Deepen existing partnership with MDUSD middle and high schools

We aim to deepen existing partnerships with MDUSD middle and high schools. This will be accomplished through the needs assessment detailed above, as we identify and meet regularly with an MDUSD champion as well as with MDUSD teachers and students. While the SMC Teacher Education Department has a long-standing relationship with the MDUSD, including teaching pathways in special education and elementary education, SMC secondary teacher education does not have an official pathway for student teaching and becoming a teacher within the MDUSD. The SSTE program presently has a relationship with administrators and teachers at several MDUSD high needs schools, where SSTE teacher candidates student teach. Through the capacity grant, we would continue to identify potential Cooperating Teachers at these high needs schools, particularly Cooperating Teachers who share SSTE program perspectives and pedagogies on STEM for equity and social justice, to push back on teacher candidates having incongruous experiences learning about teaching in their coursework and in the field. Additionally, we will learn if there are other high needs secondary schools within the district (that serve majority economically marginalized Students of Color, emergent bi/multilingual students, and students with special needs) that we do not already partner with and explore these new school partnerships. In designing the undergraduate single subject STEM teacher program, we do so from the perspective of reciprocal learning-- that secondary students, college students, secondary teachers, and college professors alike have much to learn from one another. We will enter this partnership building bringing our expertise and experiences and also a sense of humility to learn from teachers and students "on the ground" in MDUSD schools every day.

Activity 3: Developing a robust undergraduate STEM- single subject teacher preparation program

The main focus of this activity is to develop pathways for integrating undergraduate STEM learning and STEM teaching with an overarching emphasis on enhancing cultural responsiveness of teachers to teach in diverse high need school districts. Studies have shown that preservice teachers may have stereotypical beliefs or minimal awareness of race-related discrimination and about equity-related issues in the classroom. This is especially true of teachers who are STEM majors as undergraduates due to their limited exposure to conversations regarding justice and equity issues as part of their STEM curriculum. Also, studies have shown that culturally responsive teaching can enhance student success and retention in diverse school districts (). Therefore, having a STEM teacher preparation major that includes courses that discuss race and equity related issues and strategies for navigating a diverse classroom are crucial to teacher retention and success. On the other hand, we find that there are teacher preparation program such as our existing program where pre-service teachers have a strong background in pedagogical approaches

and capability to work in a diverse environment but take few science classes. This makes it challenging for new teachers to develop classroom approaches that take an integrated approach to science and Math, which is becoming popular in K-12 education. Therefore, we propose to explore three paths as part of this grant to combine STEM knowledge with training in STEM teaching and cultural competence.

A) Developing a curricular map and advising plan to better leverage existing programs at SMC.

We have a robust STEM curriculum with students taking core curriculum classes across the College. However, we have relatively few STEM majors that pursue a teacher education track at SMC. To increase the pipeline of diverse group of STEM undergraduates at SMC entering the STEM teacher profession, our goal for this activity is to streamline the current course offerings at SMC to enable students to complete the requirement for STEM and teacher education in their 4 years. As part of this activity, we plan to engage faculty members from the School of Education, Science and Liberal Arts to identify courses and pathways through the existing undergraduate curriculum that would enable a STEM major to acquire knowledge of STEM teaching strategies and equity issues in the classroom. This curricular map will also be informed by the data from our needs assessment to ensure that the changes to the curriculum do not adversely affect teacher preparation. This activity will strengthen existing collaborations between faculty in three schools and integrate the curriculum for preparation of STEM teachers. It will also enable us to advise current STEM undergraduates regarding teacher education pathway, with a focus to increase the number of STEM majors entering the teacher education programs at SMC.

B) Development of an Introductory STEM teaching for social justice course

Recent studies have shown that teachers find it difficult to discuss topics such as climate change and evolution which have a strong political/religious component (). Currently, we do not have a course for undergraduates in the teacher education program or for STEM majors interested in teaching that specifically delves into the complexities of teaching STEM topics within the framework of social justice. So, we propose to develop a course that would serve as a foundational course for students interested in STEM teaching.

Course development: The development of this course will be a collaboration between STEM faculty in Biology, Chemistry, Math and Physics, Education faculty in the Single Subject credential program and faculty from the Justice, Community and Leadership program. This course will be targeted towards first- and second-year students who have embarked on STEM-intensive coursework and are interested in learning more about STEM as it pertains to justice issues. This course will use the framework of the some of the important socially relevant topics in STEM such as climate change, data management, genetics for students to understand the scientific data underlying these topics, to discuss topics such as racial equity, ethics, sustainability and to provide an introduction to the development of classroom modules and pedagogical strategies to teach these topics in a diverse classroom. This course will also include a practical component in collaboration with MDUSD where students in this course will interact with the STEM teachers at MDUSD high schools to discuss their experiences in the classroom, observe them in class and teach one of the sessions to MDUSD students.

Learning goals/objectives for this course. Following completion of this course, students will:

- i) Develop an understanding of complex scientific topics and of the societal implications of STEM discoveries
- ii) Gain skills for teaching scientific topics in an accurate and culturally responsive manner.
- iii) Develop their ability to create lesson plans that involve active inquiry-based learning to stimulate student engagement.

Assessment of course effectiveness. To study the effectiveness of this course, students will be surveyed before and after completion of the course to assess their scientific content knowledge, their understanding of pedagogical strategies for communicating scientific content in an equity-oriented manner and their enthusiasm for careers in education.

C) Development of a new undergraduate major that focuses on integrated STEM education for justice, community and leadership.

To alleviate the shortage of STEM teachers in California, it is crucial to attract students who are excited about STEM to explore options in STEM education early in college. Therefore, in addition to developing clear pathways for STEM majors to complete their STEM teaching credential, we would like to explore the potential for creating a STEM/SSTE major with an emphasis on social justice. The development of this program will engage faculty associates from School of Education and School of Science to review existing undergraduate STEM education programs, identify potential STEM courses essential for a STEM teacher candidate to gain proficiency in STEM concepts necessary for high school teaching, determine courses in the teacher education program that are critical for understanding the pedagogical frameworks and explore course in our Justice, Community and Leadership program that will enable the development of culturally responsive teachers. The faculty group will also examine the possibility of a capstone research or teaching and research course that will help the potential students in this program gain more hands-on lab experience and develop scientific investigation modules for classroom implementation. Since every student at SMC has to take number of Core curriculum courses, the faculty group will also examine the intersection of the Core curriculum courses with the courses for the major to ensure that students can complete the STEM education major in 4 years. If the resulting new major appears feasible, the faculty associates will facilitate conversations with the rest of the faculty in the School of Science and Education to get approval for the new major so it can provide the basis for a Noyce Track 1 grant application to provide stipends for undergraduate students to enroll into the program.

D) Coordinating activities across the College to create an infrastructure for student recruitment and curriculum implementation

As part of the curriculum development, we plan to have meetings once a month for curriculum design and planning involving the PIs and faculty associates. Once we have a framework of the curriculum map, the PIs will have meetings with our first year advisers, coaches and faculty to disseminate the information for leveraging the existing curricular pathways to increase the number of STEM students entering the SSTE program.

As part of our feasibility study for developing a new STEM/SSTE with Social justice track, the PIs will have meetings at least 2-3 meetings involving all the entities on campus that are involved in recruiting students and in financial aid including Admissions, enrollment, intercultural center, diversity office, student life and financial aid. These meetings will enable us to develop strategies for recruiting students from diverse backgrounds, especially students from underrepresented minority groups and/or first generation College students into STEM teacher education track of the STEM major.

Activity 4: Learning through collaborations with STEM teaching organizations

We seek to enhance our knowledge of recruiting and sustaining diverse (first generation college-going, Students of Color, women) STEM teachers. The PIs will attend conferences and workshops to learn from research, policy, and practice of social justice-oriented undergraduate STEM teacher preparation at similar institutions to SMC (e.g. Liberal arts colleges, Lasallian colleges, colleges in our geographic region- the greater Silicon Valley region with an abundance of STEM professionals). Specifically, PIs and faculty associates across the disciplines will review conference proceedings and papers to more deeply explore the kinds of social justice-oriented STEM teaching professional development that effectively supports STEM faculty to participate in teacher education pathways as model pedagogues and informed advisors. Furthermore, a group of PIs and faculty associates will use internal funds available at SMC to attend at least one conference from the following professional organizations: American Educational Research Association- Research in Mathematics Education SIG, Science Teaching and Learning SIG, and Division K Section 6: Teaching and Teacher Education: Multicultural, Inclusive, and Social Justice Frameworks in PK–16+ Settings; California Council on Teacher Education; Association of Mathematics Teacher Educators; Association for Science Teacher Education; National Council of Teachers of Mathematics; National Science Teaching Association and Science education for new civic engagements and responsibilities (SENCER) Summer institute.

Activity 5: Setting up a mechanism for long-term sustainability and evaluation of the program

Beginning in the capacity grant year, we will embark on continuous assessment of the STEM Teachers for Justice, Community, and Leadership program. As part of this evaluation, we will create an advisory board of 8-12 members from SMC and district partner stakeholders to identify and reflect on assets, areas of improvement, and visions for the future. Together we will engage in cycles of critical praxis, to reflect and act as we move forward. In the capacity grant year, the advisory board will map out a long-term continuation and growth plan. The advisory board will consist of project Co-PIs, the district champion, one faculty member from the three schools, 1- 2 members of the leadership team at SMC and at MDUSD.

Spring/Summer 2020

Jan. 2020	IRB approval secured in time for NSF award, if offered	PI, Co-PI
May-June 2020	Project kick-off meeting logistics and coordination planning; hire graduate student assistant;	PI, Co-PI, Deans of Ed. & Sci.
June 2020	Kick-off meeting for all project participants	PI, Co-PI, partners

Activity	Fall 2020	Spring 2021	Who Implements
1) Needs assessment	Refine instruments, data collection	Data collection continued, data analysis	
2) Deepen existing partnership w/ MDUSD middle & high schools	District meeting with leadership	Meeting with continuing and new Cooperating Teachers	
3) Develop robust undergraduate STEM- single subject teacher preparation program	Campus meetings (once per month per topic) <ul style="list-style-type: none"> make curriculum map, new course, advising recruitment, admissions, financial aid, other topics 		PI, Co-PI + team members by topic
4) Learning through collaborations with STEM teaching organizations	Identify literature/conferences; review literature	Attend workshops/conferences	
5) Setting up a mechanism for long-term sustainability and evaluation of the program	Identify who is on board	One meeting - end of year	
Steps toward applying for a Track I Robert Noyce Teacher Scholarship Program		June-August: Prepare application to apply for Track 1 Noyce grant for submission in August 2021	PI, Co-PI, Project Team

4. Plans for Collecting Data

As discussed in section 3.b. Activity 1, the project team's processes are designed to gather a comprehensive set of data to determine the need, interest, and capacity for recruiting STEM majors to become STEM teachers at SMC and the STEM education needs in the MDUSD. The table below summarizes the types of data to be gathered (quantitative or qualitative), sources, instruments and strategies to be used in obtaining data, timing of data collection, and who will engage in the process. In Spring 2020, we will update our Institutional Review Board protocol with both SMC and the MDUSD in light of any proposed changes in the study that have developed since the original IRB approval.

Needs Assessment Question	Source	Data Type	Instrument / Strategy	Timing	Who Gathers
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A) To what extent are SMC students energized and informed about becoming STEM teachers, and what can SMC do to generate more interest in STEM majors becoming STEM teachers?	SMC Teacher Education Department records	Quant.	Analysis from SMC Teacher Ed. Department on enrollment trends	Sum. 2020	PI, Co-PI, Data Specialist
	SMC students: Current undergrad. STEM students Current undergrad. JCL Single Subject students	Quant.	Survey	Fall 2020	PI, Co-PI, staff
		Qual.	Focus Group	Fall 2020	PI, Co-PI, staff
	SMC STEM and Teacher Education faculty and staff	Quant.	Survey	Fall 2020	PI, Co-PI
Question B) How can SMC's STEM teacher preparation best meet the STEM education needs of the MDUSD and create a pipeline of SMC STEM teachers into the MDUSD?	MDUSD records; Education Data Partnership website of the California Department of Education	Quant.	Descriptive statistics from MDUSD on STEM teacher shortage areas, turnover rates, demographics, STEM student assessment data	Fall 2020	PI, Co-PI, staff, MDUSD champion
		MDUSD STEM teachers			
		Qual.	Focus group	Spr. 2021	
	MDUSD high sch. seniors	Qual.	Focus group	Spr. 2021	

5. Potential Outcomes

The main focus of this proposal to build the capacity of SMC to offer a robust STEM- SSTE program with a social justice focus. The proposed activities in this project will result in the following outcomes, which will prepare SMC to apply for a Track 1 Noyce proposal:

- i) Through our needs assessment surveys and focus groups, we will generate data on the needs in the local high need district, the gaps in STEM teacher preparation and the challenges STEM teachers face as they transition to classroom STEM teaching during the early stages of their career. These data will allow us to shape the existing curriculum for STEM and STEM teacher education at SMC to make more effective in addressing these issues and challenges.
- ii) We anticipate that the needs assessment meetings with MDUSD will also result in strengthening our collaboration with the MDUSD by identifying potential areas where the resources present in the School of Science could be leveraged to enhance continued education and preparation of STEM teachers in the school district. In addition, these meetings will also be used to identify potential workshops, laboratories and research opportunities that use SMC SOS resources to enhance the science learning experience of middle school and high school students at MDUSD. By partnering with SMC School of Science, STEM teachers at MDUSD schools will have access to SMC scientists and resources that will enable them to bring innovative lesson plans to their curriculum and help them integrate various STEM disciplines.
- iii) The curriculum planning and development meetings will bring together experts in STEM, STEM education and Social Justice at SMC. The literature review and meeting discussions will enable faculty from these three areas to learn about advances in STEM, STEM education and strategies for improving students retention and engagement in STEM courses. Thus, these meeting will contribute to professional

development of faculty members at SMC and strengthen collaborations among the various schools to create an integrated and effective STEM teacher preparation program.

iv) One of the main outcomes of this project will be to develop a clear pipeline and program for STEM/SSTE interested students. As part of this project, we anticipate developing infrastructure for recruiting students into the program, potential curricular offerings and curricular map for students in the new program and connections with MDUSD for teacher placement, following the completion of the program.

v) The formation of the advisory board comprising of SMC and MDUSD members will foster further conversations and collaborations between SMC and MDUSD for continued assessment of the curricular offerings and improvements to STEM teacher preparation and retention in high-need school districts.

6. Intellectual Merit

This project will build capacity to ultimately contribute to the STEM education field by generating new knowledge on the possibility for convergence of programming that brings together science disciplinary, single subject pedagogy, and justice-oriented frameworks. Data collected will include observations, surveys, focus groups, and student reflections. Design-based research will allow us to engage in cycles of improvement beginning at the capacity building stage.

7. Broader Impacts

This project will create the capacity to affect the following broader impacts: 1) improve ambitious, equitable, justice-oriented, and culturally sustaining STEM teaching in urban schools that serve predominately Students of Color and economically marginalized students, who are often pushed to the margins in STEM, 2) recruit a more diverse STEM teaching force, 3) develop a model for professional learning communities for STEM teachers, and 4) increase STEM teacher retention through rigorous preparation and ongoing community building in high teacher turn-over schools.

8. Prior NSF Support

SMC has not received prior Noyce grant support.

From 2014-19, Vidya Chandrasekaran was a Co-PI on the NSF S-STEM grant, “Mentored Access to Programs in Science (MAPS)” for \$613,477 (Award #1354825). She was Interim MAPS Director in 2016-17. **Intellectual Merit:** The MAPS project supported 21 academically talented students from financially needy backgrounds through scholarships and student support. While the grant is closed, ## of the students supported by the project are still completing their SMC degrees. Of the students recruited into the program in its first two years (2014, 2015), 12 of 12 continued in the sciences, majoring in Mathematics, Physics, Chemistry and Biochemistry. All have maintained an average GPA of between 2.7 and 3.9 and are on target to graduate in four years. **Broader Impacts:** Roughly 50% of students in the MAPS cohort were from underrepresented minorities, # women; these factors contribute to increasing the diversity of the STEM workforce. The MAPS team worked with participants to develop internship and career training in partnership with SMC’s Career Center; this will ultimately benefit all STEM majors.

During 3 weeks of Summer 2019, Vidya Chandrasekaran received a stipend from the NSF S-STEM grant “Mentored Access to Programs in Science (MAPS)” for developing and teaching the first Summer Early Research Immersion Experience (SERIE) for incoming freshman MAPS scholars. **Intellectual Merit:** The involvement of early career College students in research has been shown to increase engagement and improve retention in science. All seven MAPS scholars participated in the research program. **Broader Impact:** The pilot SERIE, if successful, will be extended to all STEM students at SMC and disseminated

nationally. The MAPS program aims to recruit, educate, and graduate low-income academically talented students and provide an opportunity for these students to become effective leaders in the STEM field.