

## Participants

<u>Participant's Name(s)</u>	<u>Project Role(s)</u>	<u>Institution</u>
Mark S. Filowitz	Principal Investigator	CSUF
Martin V. Bonsangue	Co-Principal Investigator	CSUF
Larry Redinger	Co-Principal Investigator	Mt. SAC
Rochelle Woods	Co-Principal Investigator	CSUF
Carol Comeau	Co-Principal Investigator	SAC
Barbara Laguna	Senior personnel	CSUF
Nicole Infante	Senior personnel	CSUF
Todd Cadwalladerosker	Senior personnel	CSUF
Sean E. Walker	Senior personnel	CSUF
Asha Cyrs	Undergraduate peer advisor	CSUF
Crystal Lo	Undergraduate peer advisor	CSUF
Jesus Noland	Undergraduate peer advisor	CSUF
Robin Zafra	Undergraduate peer advisor	CSUF
Kurosh Jozavi	Undergraduate peer advisor	CSUF
Kathy M. Takahashi	Community college faculty	SAC
Iraj Nejad	Community college faculty	Mt. SAC
Jorge E. Lopez	Community college faculty	SAC
Cher Carrera	Community college faculty	SAC
Tammy Camacho	Community college faculty	SAC
Cathy Fernandez-Weston	Technician, programmer	CSUF
Ricardo Lopez	Technician, programmer	CSUF
Oscar Flores	Technician, programmer	Mt. SAC
Joel Sheldon	Technician, programmer	SAC
Shannon K. Gilmartin	External Evaluator	External

Various Undergraduates (45 in F10, 57 in SP 11)	Supplemental Instruction(SI) Peer Leaders/Undergraduates	CSUF, SAC, Mt. SAC (74 CSUF, 16 SAC, 12 Mt SAC)
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## Project Activities and Findings

TEST:UP is a collaborative program, initiated in fall 2008, among three Hispanic Serving Institutions—California State University, Fullerton (CSUF), a four-year, comprehensive university, and Mt. San Antonio College (Mt. SAC) and Santa Ana College (SAC), two of CSUF's feeder two-year community colleges. All three campuses are located within 23 miles of each other and have diverse student bodies with enrollments exceeding 27,000 students. Through TEST:UP, our collaborative program seeks to: 1) increase the recruitment and retention of STEM majors at Mt. SAC and SAC; 2) produce more STEM associate degrees and STEM transfers to four-year schools; 3) improve the retention and persistence of transfers and entering freshmen majoring in STEM fields at CSUF; 4) increase the number of students obtaining baccalaureate degrees in STEM disciplines at CSUF and other four-year institutions; and 5) improve mentoring and teaching skills of CSUF graduate students seeking community college teaching careers.

TEST:UP programs are impacting hundreds of students on each of our campuses by: significantly improving STEM learning environments; improving STEM academic advisement at our partnering two year colleges; and facilitating the transfer of two-year STEM students from Mt. SAC, SAC and other community colleges to CSUF or other four-year institutions. Our ultimate vision is that TEST:UP will result in a collaborative and replicable model of cooperation between two- and four-year institutions that results in the production of more STEM students and graduates.

Like other projects in the National Science Foundation's STEP program, TEST:UP has two overarching goals: 1) To increase the number of STEM transfer students to four-year universities and colleges and, 2) To increase the number of AA degrees and baccalaureates earned in STEM majors. The activities described herein are all aimed at achieving these goals.

More specifically, in our program we aim to increase by ca. 5% annually the number of new STEM majors at our partner community colleges (20 to 40 students per college for a total of 40 to 80 students annually) and to increase by 25 annually (50 at the two institutions) the number of students at those colleges who complete their associate degrees (or requirements) or who transfer to four-year institutions (including but not limited to CSUF) in any STEM major. At CSUF, we projected that TEST-UP will increase by 40 students annually the number of transfer students who eventually earn STEM baccalaureate degrees.

We are meeting our goals on increasing declared STEM transfers from and STEM degrees awarded at the community colleges. Improved retention rates for STEM freshmen reflect the impact of all retention efforts. STEM transfer retention in the College of Computer Science and Engineering (ECS) has improved since program start, and the College of Natural Sciences and Mathematics (NSM) retention has improved over the past five years and in 2009-2010 versus previous year but not yet since the baseline year of 2007-2008. Overall, we are encouraged that the retention rates for STEM transfers are up since the baseline year. It is too soon to assess STEM transfer graduation rate impact as only ~20% of STEM students historically graduate within 3 years of transfer to CSUF. We are close to meeting goals on CSUF graduate student instructors at the community colleges. We have observed much improved passing rates and GPA with SI at all three institutions, but more work is needed to isolate the role of student self-selection.

<u>Strategy/Activity</u>	<u>2007-2008</u> <u>Baseline Yr</u>	<u>2008-2009</u> <u>Year 1</u>	<u>2009-2010</u> <u>Year 2</u>	<u>2010-2011</u> <u>Year 3</u>
		Goal/Actual	Goal/Actual	Goal/Actual
<b>New CC Declared STEM majors (+20-40/yr)</b>				
SAC	1099	1119-1139/1185	1139-1159/1022‡	1159-1179/1359
Mt SAC	632	652-672/676	672-692/714	692-712/809
<b>Total</b>	<b>1731</b>	<b>1771-1811/1861</b>	<b>1811-1851/1736‡</b>	<b>1851-1891/2168</b>

**Increase STEM 4yr  
transfers and AA  
Degrees Awarded <sup>1,2</sup>  
(+25/yr)**

SAC	226	251/246	276/204‡	301/NA
Mt SAC	465	490/510	515/591	540/NA
<b>Total</b>	<b>691</b>	<b>741/756</b>	<b>791/795‡</b>	<b>841/NA</b>

**CSUF STEM Year to Year  
Retention-% of  
First time freshmen<sup>3</sup>**

NSM	52.4%	59.0%	68.4%	NA
ECS	52.3%	50.8%	67.8%	NA

**CSUF STEM Year to Year  
Retention-% of  
STEM transfers<sup>4</sup>**

NSM	71.0%	67.6%	70.8%	NA
ECS	62.0%	59.8%	71.4%	NA
<b>All STEM</b>	<b>67.5%</b>	<b>64.3%</b>	<b>71.1%</b>	<b>NA</b>

**CSUF Graduate  
Students Teaching At CC**                    **0**                    **4/0**                    **4/1**                    **4/3**

**Appendix Notes:**

‡ Computer system change in 2009-2010 at SAC may have caused missing count in AA degrees/ 4 yr transfers and declared STEM majors, but see corrected trend upwards in STEM majors in 2010 to meet and exceed targets.

1. Many students at community colleges do not get an AA degree prior to transfer. In fact, we are finding that AA degree and transfer trends differ at different community colleges, an area for exploration in additional research.
2. Overall targets achieved despite negative impacts of 10% enrollment reductions, almost no spring transfers in 2009 or 2010 , plus impaction effect on Mt.SAC where out of service area transfers required GPA of 3.7 or higher.
3. Impact on retention of first time freshmen STEM majors is an intermediate indicator of total retention efforts in STEM.
4. Five year trends in STEM transfer student retention rates (2005-2006 to 2009-2010) in NSM are 63.8%, 65.0%, 71.0%, 67.6%, 70.8% and in ECS are 66.2%, 64.5%, 62.0%, 59.8%, 71.4%. Composite trend (2005-2006 to 2009-2010) is are 64.7%, 67.3%, 67.5%, 64.3%, 71.1%.

To accomplish the goals of TEST-UP, we have developed four strategies. These are to: 1) improve counseling, guidance, and mentoring opportunities and improve information and knowledge of STEM careers for Mt. SAC and SAC STEM and potential STEM students, 2) develop support networks, including facilities and programs to develop learning communities, and facilitate the transfer of STEM students to CSUF, 3) improve student learning (and therefore student success) in pivotal math and science introductory discipline courses by instituting supplemental instruction (SI) programs, and 4) develop a teaching intern/mentoring program to improve the pedagogical and mentoring skills of CSUF graduate students interested seeking two-year college teaching careers.

A total of \$149,295 in funds allocated to Mt. SAC were not spent in years 1 and 2. After consultation with the Program Director, these funds were re-allocated to Santa Ana College and CSUF to support programs associated with the grant. SAC used re-purposed funds to further support their successful supplemental instruction (SI) program by adding 15 more SI sections to assist students in mathematics and biology courses. In addition, SAC is using these funds to augment their presentation and instructional resources supporting STEM courses. In year 3 CSUF is using re-purposed funds support 39 SI sections in math, biology, computer science and chemistry in spring 2011. In addition, funds are being used to support a one-year year appointment for a STEM Student Success Coordinator who is: evaluating five years of historical and current transcripts of STEM transfer students to assess transfer-student preparedness for a four-year STEM degree program; administering and analyzing pre- and post- transfer surveys developed specifically for this program; piloting an on-line early warning system; and running a STEM student retention campaign on the CSUF campus. The transcript and survey activities will provide increased capacity to evaluate the success of our advisement program and point out needs for change. We are piloting a new program in spring 2011 that places five transfer students in STEM research groups or research-themed learning communities as soon as they come to the CSUF campus. We are adding this last element, which will involve transfer students in undergraduate research, as an offshoot of our highly successful Howard Hughes Medical Institute (HHMI), NSF Research Experiences for Undergraduates (REU), and US Department of Education funded projects that have brought community college students to CSUF to engage in undergraduate research in the past.

To provide advice and to guide TEST:UP, we have formed functioning internal advisory committees and an external advisory committee that provides advice on the entire collaborative program. These internal advisory committees are meeting regularly as is our external advisory committee to learn about TEST:UP programs and progress and provide advice on program elements.

*1) Improve counseling, guidance, and mentoring opportunities and improve information and knowledge of STEM careers for Mt. SAC and SAC STEM and potential STEM students.*

We hired one full-time Coordinator for STEM Transfer Student Services at CSUF and two half-time STEM Counselors and Advisors at Mt. SAC and SAC in 2008. Suitable space was made available for these personnel on all three campuses and STEM advising and counseling activities are on-going. Gina Garcia, CSUF's full-time Coordinator for STEM Transfer Student Services resigned in summer 2009 to enroll in a Ph.D. program at UCLA where she will be performing dissertation work on topics related to our STEP grant. A successful search was completed to replace Gina with Cathy Fernandez-Weston who came to CSUF from Virginia Tech. Cathy assumed this position in August 2009. As the CSUF Coordinator for STEM Transfer Student Services, Cathy continues to meet twice per week and collaborate with Tammy Camacho at SAC and Oscar Flores at Mt. SAC who continued as the incumbent half-time STEM Advisors. The advisement activities of the two half-time STEM Advisors have been accepted by SAC and Mt. SAC counseling centers and are meeting with students regularly after significant initial barriers of acceptance that have been overcome with time and the support from the SAC and Mt. SAC Deans. This program is working to improve STEM advisement on the two-year campuses.

Existing systems in place on the two-year campuses required students to make appointments to see campus counselors and did not offer drop-in, targeted STEM advisement. Often, students need to wait for two weeks or more to meet with a counselor. Our NSF program has now greatly increased student access to STEM academic advisors. Drop-in STEM advisement is available and there has been an increase in student awareness of the need to get advice if a STEM degree is being sought. This is particularly important for STEM majors where hierarchical curricula are the rule and is very important for students with little knowledge of college programs, as is the case with first-generation college students and for many who belong to traditionally underrepresented minority groups. In addition, the STEM advisors are assisting students with the CSU application process, which is highly important given the current constraints on two-year admissions to CSUF and other CSU campuses resulting from budget cuts.

TEST: UP has assisted 448 students on the Mt. SAC (207) and SAC (241) campuses with developing academic plans for transfer. Mt. SAC and SAC advisors have recruited participants in the TEST: UP program on their respective campus through class visits, information tables, career day fairs and STEM week events.

The CSUF Coordinator for STEM Transfer Student Services and her STEM Peer Advisors have advised 389 of the 1139 STEM transfer students since the program started in 2008. The STEM Advisors at SAC presented information to almost 400 students in math, biology and chemistry courses on STEM careers, student success in STEM, pathways to STEM majors, and showed a SAC STEM recruitment DVD that addresses academic progression and STEM career options. The DVD video is under revision and will be close-captioned once completed.

An on-line early warning system was developed in 2010 to identify at-risk students in NSM and ECS within their first semester at CSUF. The system requests that faculty respond to four simple questions for all new CSUF STEM students (transfers and first time freshmen) within the first 3 to 4 weeks of the semester on indicators such as attendance, quizzes and homework assignments. Students identified as being at-risk are individually contacted and invited/encouraged to see the CSUF Coordinator for STEM Transfer Student Services to make plans to improve their time management and performance in class. Initial data indicate that transfer students are less likely to take advantage of intrusive interventions as compared with first time freshmen. They are not accustomed to unsolicited assistance and think that they already know how to succeed in the four year university based on their community college experience.

SAC underwent a major student information system conversion in 2009 that involved all aspects of college data processing. Information retrieval became increasingly difficult as we moved further into 2009-2010. The data comparing 2009-2010 to the previous year is therefore not likely to be accurate. However, data in 2010-2011 indicate that we are on track for production of STEM AA degrees and four year institution transfers.

*2) Develop support networks, including facilities and programs to develop learning communities, and facilitate the transfer of STEM students to CSUF.*

A study campaign similar to the 25-35 empowerment campaign at CSUF (encourage students to study 25-35 hours per week outside of class time) has been implemented at SAC with the goal of increasing student study time in STEM courses. Students and their families often do not recognize that compared to high school, much more time is needed outside of the classroom to succeed in college. This is particularly

true for first generation college students. The College of NSM has also implemented and funds an NSM Day that takes place before the start of the fall semester at CSUF for both transfer students and first time freshmen. This is an outreach program that augments orientation activities by bringing in new students and their families to learn more about time management and requirements for success in STEM fields at no cost to participants. These bilingual NSM days typically attract ~150 participants. NSM has also instituted mandatory on-campus academic advisement for newly arriving transfer students beginning June, 2011. Registration is put on hold until they receive advisement by faculty at CSUF. This will help ensure that students are taking the right paths for initial placement in appropriate mathematics and science courses and shorten time to graduation.

NSF STEP funding has undoubtedly contributed to a positive impact on our ability to retain STEM majors at CSUF. The percentage of first time STEM freshmen students retained as majors in the College of NSM has increased from 59.0% to 68.4% since 2008 and at ECS retention has increased from 50.8% to 67.8%. The percentage of STEM transfer students retained as majors in the College of NSM has increased from 67.6% to 70.8% since 2008 but is virtually unchanged compared to 2007 while College of ECS retention has increased from 62.0% to 71.8% since 2007. Overall, STEM transfer retention has improved from 67.5% to 71.1% since 2007. These percentages compare the number of STEM majors from one academic year to the previous academic year.

At SAC, infrastructure for the faculty mentoring program was developed and the linking of SAC faculty and students is a key in recruiting new two-year college students to these difficult and complex majors. Through these linkages students were referred to resources which efficiently exposed them to academic programs and career options (e.g., through STEM panels and student/faculty socials).

A book voucher reward system was put into place at all three campuses to encourage STEM major participation in our programs. The book voucher system provided incentive to students to participate in activities which would be advantageous to their academic progression but would cost them valuable time. The program requires participation in 5 or more STEM outreach activities over the course of an academic year to qualify for the voucher. These activities include events, peer mentoring or counseling meetings, resume preparation, and club participation, based on campus.

A pre-transfer survey was developed in fall 2010 and administered in December to 594 students in STEM classes at SAC and 529 at Mt. SAC. The survey is aimed at assessing preparedness for transfer to a four-year institution, and identifying key stumbling blocks, both real and perceived, in the STEM transfer process. Preliminary raw findings indicate that: ~35% of SAC students and ~23% of Mt.SAC students are attending more than one community college; most (~95%) at both campuses do not intend to stop at an AA degree, ~20% intend to achieve a bachelor's degree, ~25% intend to achieve a master's level degree, and ~25% intend to go for a doctoral level degree; over 90% intend to transfer to a four year institution, 46% in STEM at SAC and 72% in STEM at Mt. SAC; 55% at SAC and 44% at Mt. SAC reported that English is not their first language; 43% at SAC and 30% at Mt. SAC reported that they would be the first in their families to attend a four year university; over 45% at both campuses are employed while attending college; and about 12% at both campuses are foreign nationals . We believe that some of the differences in response are due to whether the survey populations were STEM majors at Mt. SAC or student were s enrolled in science general education courses, like BIOL 109, at SAC. This is supported by the ethnicity and gender data on the survey participants. At SAC, the ethnicity and gender

of the surveyed students were very similar to the general population with about ~53% Latinos, ~20% Asians and ~10% Caucasians, and ~38% male, ~62% female. At Mt. SAC the ethnicity and gender of the survey population was not typical of the general population and more like what one might expect from a typical STEM population based on the literature, with ~25% Latinos, ~42% Asians, and ~9% Caucasians and ~57% male and ~43% female. We can separate the self-proclaimed STEM majors to look more closely at that population, but the number of surveys is much smaller. We are continuing analyses to determine robustness of conclusions and considering another survey that targets STEM major courses only. The services of an outside consultant were contracted to code the data.

A post-transfer survey has been developed for administration to STEM transfers who come to CSUF, and is being administered on-line in spring 2011. We estimate that we need over 200 responses to draw statistically valid conclusions. This latter survey will help gauge the success in smoothing the STEM transfer process once students arrive at the four year institution, and point out weaknesses that require improvement.

*3) Improve student learning (and therefore student success) in pivotal math and science introductory discipline courses by instituting supplemental instruction (SI) programs.*

We implemented SI programs adopted after the University of Missouri-Kansas City model at CSUF and SAC. Mt. SAC had already implemented SI using this model prior to the grant and uses TEST:UP funds to expand SI workshops. Results to date indicate consistent grade point average improvements and passing rate improvements in key gateway STEM courses. At CSUF, a goal was to improve SI strategies and to expand conversations with community college partners to develop a regional SI network. In spring 2009 10 SI workshop sections were offered including an introductory level biology lab course, pre-Calculus, Calculus I, and Calculus II. In fall 2009, SI workshop sections rose to 17 with additional courses added including Organic Chemistry I, and College Algebra. In spring 2010, SI workshops increased to 20 sections and included Organic Chemistry II, and Physical Chemistry II. In fall 2010, SI workshops increased to 35 with additional courses now including Cellular Basis of Life, and three gateway computer science courses in ECS: Introduction to Programming; Programming Concepts; and Data Structure Concepts. In spring 2011, CSUF is fielding 39 SI sections, all entirely funded by this grant with re-purposed funds. Through the end of the fall 2010 semester, approximately 2,657 students have been involved in 3 or more sessions of the SI workshops at CSUF, including 97 in chemistry, 811 in biology, 1,555 in mathematics and 117 in computer science. These SI workshops have been very successful. In introductory gateway biology courses the average improvement in GPA (students attending SI sessions regularly versus those who did not participate in SI) is 0.72 going from 2.25 to 2.97. In mathematics, the improvement in GPA is 0.50 going from 1.90 to 2.40, and the passing rate for SI participants was 82% versus 69% for non-participants.

More data are needed to statistically define the impact of SI in improving student GPAs in chemistry and computer science. As we continue to collect more data with the SI experience at both CSUF and our community college partners, we expect to define statistical confidence in results and to use these data to publish and share with the higher education community. Further, we hope to demonstrate that the use of SI in STEM courses improves graduation rates and retention in STEM majors so that we can economically justify the institutionalization of these activities. Each of the SI sessions is led by a student who has strong content and communication skills. The SI leaders in all of the disciplines also attend a day-long training session led by professors from the disciplines, most of whom have attended the U.

Missouri Kansas City SI training program. In biology and chemistry, students in targeted SI courses have the option to attend SI sessions that are offered twice each week. In mathematics, students sign up for the SI as a separate 1 unit course and are required to attend. In computer science 147 students had the opportunity to join the workshop after the semester had already begun and 117 participated. In all the disciplines, SI leaders attend the professor's lecture each day to ensure that their SI sessions are current, and to act as a role model for students in the course. SI leaders then meet with students at least 3 hours per week to creatively work on problems based on that week's lessons, using tools like the 'Jeopardy' game to engage students. Each SI leader receives ~ \$1,500 per semester as compensation for their time. At SAC, SI groups were created in spring 2009 supporting 2 sections of an introductory microbiology course. In fall 2009, SI was expanded to 4 biology sections; in spring, 2010 SI was expanded to 8 biology sections, and in fall 2010, SI was offered in 8 biology and 2 mathematics sections. Due to SAC's rapid immersion in the TEST:UP program, additional re-purposed funds were provided to support SI activities. Dr. Kathy Takahashi of SAC has oriented her peer tutors at the CSUF training sessions and is assessing their effectiveness. Results to date indicate improved retention in classes and higher grades. In fall 2009 2010 average retention rates with SI increased from 71% to 92% in biology courses and from 80% to 96% in math courses. Grades (%) improved from 69% to 83% in biology courses and from 78% to 91% in math courses. Data for fall 2010 are under analysis. Mt. SAC continues to offer SI in courses established prior to TEST:UP and Eva Figueroa is the SI coordinator on campus. Mt. SAC is expanding its SI programs using TEST:UP resources starting in fall 2010, with 265 students participating in the following courses: 50 in PHYS 2AG (general physics I), 25 in PHYS 2BG (general physics II), 75 in BIO 2 (plant and animal biology), 55 in CHEM 40 (introductory chemistry), 30 in CHEM 80 (organic chemistry), and 30 in MATH 160 (pre-calculus). Mt. SAC experience in the past two years also indicate similar and consistent improvements in passing rates and GPA with students attending at least 6 SI sessions in math and science.

**Supplemental Instruction Impact 2009-2010 (with SI vs no SI)**

provided as intermediate indicators

<b>CSUF (Cumulative impact)</b>	<b>with SI vs no SI</b>
Math	
Passing rate	82% vs 69%
GPA	2.40 vs 1.90
Biology	
Passing Rate	Not analyzed
GPA	2.97 vs 2.25
<b>SAC (avg f09/sp10)</b>	
Biology	
Grade %	83% vs 69%
Retention %	92% vs 71%
Math	
Grade%	91% vs 78%
Retention %	96% vs 80%
<b>Mt. SAC</b>	
Math	
Passing Rate	86% vs 79%
GPA	2.58 vs 2.41
Sciences	
Passing rate	88% vs 79%
GPA	2.66 vs 2.40



While recruiting SI leaders takes some directed effort, our experience is that there are a number of undergraduate students who are excited about this opportunity. An exit survey was given to the SI leaders at the end of the semester in year 2. The purpose of this survey was to give SI leaders the opportunity to anonymously express their experience in the program as well as to share their observations and recommendations for future SI. The survey asked SI leaders, based on a 5-point Likert scale, to give their level of agreement or disagreement with fifteen different statements pertaining to SI. The survey centered on five important ideas or constructs:

- a. Level of preparedness of students in the course
- b. Level of effectiveness of SI on increasing student achievement
- c. Level of satisfaction with the experience of being an SI leader
- d. Impact on academic self-perception for SI leaders
- e. Impact on career self-perception for SI leaders

Each construct was explored with at least two questions using opposite scales so as to minimize answering bias. Of the 26 SI leaders, including 22 at CSUF and 4 at SAC, 20 (77 %) submitted completed surveys. Results showed that SI leaders felt that the experience was positive to very positive for them both academically and professionally. Eighteen of the twenty students indicated that the SI gave them 'valuable classroom teaching experience,' while 17 of the SI leaders indicated that the experience has made them become more interested in either 'considering teaching as a career' or 'going to graduate school.' There was some disagreement on level of satisfaction with the pay (\$ 1,500 per semester, or about \$10 per hr), with mean score of 4 but a standard deviation of 1.08. SI leaders generally agreed that students in the SI lacked basic skills for success in the course. Indeed, SI leaders regularly 'built in' practice for these skills on their bi-weekly worksheets to help SI students strengthen these skills in the context of problems in their mathematics, biology, or chemistry course.

Overall, the exit survey showed evidence that the experience was valued by the SI leaders and helped give them the opportunity to view themselves as future professionals that they might otherwise not have had as undergraduates. Based on the initial results of impact of both SI participants and SI leaders, we envision three articles targeting audiences in education, mathematics education, and science education. Upon collection of the 2010-2011 data we expect to have enough data to initiate these articles. We also are looking into a Southern California Conference on SI to collect and compare results from 20 to 30 institutions of higher education in this region, as suggested by our External Advisory Board.

The principal challenge at CSUF has been securing stable institutional funding for the SI peer facilitators and faculty involved in offering the SI courses. Program funding has been obtained on a semester by semester basis, largely through external and internal grant support. This was not envisioned as a challenge at CSUF at the time our proposal was submitted so funds were requested for faculty to organize and administratively develop and support the program and create faculty involvement and buy-in. However, the reduction in state funding to CSUF has compromised our ability to operate this program with the needed predictability. However, enrollment in the program is expanding and the campus culture is changing as students are telling one another about the benefits of the SI workshops and successful results (improvements in GPA and pass rates) are being achieved. Within CSUF, SI was expanded to ECS in 2010 and is planned to expand to the College of Business and Economics to overcome mathematics-

based bottleneck courses like accounting and statistics. The community college partners recognize the value of SI which is already institutionalized at Mt. SAC. SAC is very enthusiastic about SI and is hoping to make it required in the key math and science courses, as they have some flexibility in hours per course without changing the units. Requirement will allow us to rule out the self-selection variable.

With the economic problems in California, the sustainability of the successful programs of TEST:UP, such as SI, will need to be defined in monetary terms. Quite simply, improved graduation rates will save money at the CSU State level and the CSU system has an initiative to increase graduation rates. The programs we are evaluating in TEST:UP are expected to point the way towards higher graduation rates among our STEM transfer students. TEST:UP programs are consistent with and are informing CSU system wide and CSUF campus efforts to increase the graduation rates of all CSU students. So, we are optimistic that funding stability will be obtained in particular since CSUF is focusing efforts on moving students more rapidly to graduation and that our SI program is targeting courses that historically have had high repeat rates that slow progress towards graduation. The Colleges of NSM has now funded the cost of mandatory face-to-face transfer student advisement to increase graduation rates.

*4) Develop a teaching intern/mentoring program to improve the pedagogical and mentoring skills of CSUF graduate students interested in seeking two-year college teaching careers.*

CSUF has a significant number of graduate students who seek to obtain a teaching position at a two-year college. These students are trained at CSUF through formal coursework, mentored on best practices for engaging students and implementing active learning strategies, and have teaching experience as assistants in labs and discussion sections. We proposed to establish a teaching internship program at our community college partner institutions to provide CSUF graduate and M.S. students with an attractive transition toward a professional career. In addition, our plan was to further connect STEM students at the two-year institutions with CSUF through these teaching interns.

To implement this strategy, CSUF teaching interns were to be placed in positions at the two-year colleges where they were to function as adjunct or part-time faculty instructors. Each teaching intern was to be hired using two-year college (not NSF) funds and assigned a community college faculty mentor. In addition to their teaching commitment, each intern was to receive a stipend from NSF TEST:UP funds to carry out advisement and mentoring duties at the two-year college site. This program was first planned to be implemented in fall 2009. However, with the budget crisis in California, we were concerned that implementation of this program would come at the expense of displacing existing, long-standing part-time instructors. Therefore, start of this program was delayed until fall 2010 with a single section of mathematics at SAC. A second planned mathematics section taught by a CSUF graduate student was aborted due to family illness. We had no biology graduate students available from CSUF in fall 2010 as they were all engaged in CSUF lab teaching activities. Two CSUF mathematics graduate students are teaching at SAC and one CSUF biochemistry graduate students is teaching at Mt. SAC in spring 2011.

## Training and Development

TEST:UP is engaging faculty from CSUF, SAC and Mt. SAC in new and more focused efforts to attract and retain more STEM students . TEST:UP is providing the impetus for the three campuses to work together to institute or increase the number of SI sections and other programs to improve student learning and performance in key gateway math and science courses.

TEST:UP participating faculty at CSUF and SAC and the CSUF Coordinators for STEM Transfer Student Services attended workshops held at the University of Missouri-Kansas City to learn about the UMKC SI model. Instructional strategies are being modified and new approaches being taken on the CSUF and SAC campuses. Participating TEST:UP faculty are learning about effective strategies to increase student learning and performance in entry level math and science courses, and are sharing this knowledge with one another. Conversations between some CSUF, Mt. SAC, and SAC faculty have developed as part of this collaborative SI effort.

CSUF PIs Mark Filowitz, Rochelle Woods, Marty Bonsangue (Math), and CSUF faculty members Sean Walker (Biology), Nicole Engelke and Todd Cadwalladerosker (Math), and others, are actively involved in College of NSM retention efforts and regularly attend meetings related to TEST:UP goals. The full-time CSUF Coordinator of STEM Transfer Student Services and the two half-time STEM advisers are honing skills in advising and counseling and learning about STEM careers. The Coordinator also is strengthening and applying her skills in student services to form student communities and to make students aware of the coursework and achievement needed for transferring to four-year institutions in STEM fields. Ricardo Lopez, our STEM Student Success Coordinator hired from re-purposed funds, is also similarly strengthening and applying his skills.

The CSUF Coordinator of STEM Transfer Student Services has attended SI Supervisor Training, at Kansas City, Kansas, the NSF-STEP Two Year/Four Year Partnership Workshop, at Belknap, Oregon, the National Institute for the Study of Transfer Students conference in Addison, Texas, and the NSF STEP Project Directors Meeting in Arlington, Virginia. She attends the NSF STEP Grantees Meeting in Washington, DC.

The number of CSUF undergraduate and graduate student SI leaders is growing and these students are being educated in methods of engaging students and stimulating them to advance their learning by working cooperatively to solve problems. Several of these students have gained interest in teaching and are now considering teaching careers in math and science, an unplanned outcome of our STEP project. New CSUF undergraduate peer mentors have joined our project and these students are learning the importance of learning communities and are being educated in how to engage students, organize activities, and develop functioning learning groups.

Similarly faculty and students working in the SI program at SAC are developing skills in improving instruction and education in STEM courses. At SAC, an additional advantage of TEST:UP is that NSF funds have provided opportunity and the resources for faculty to meet and make contact with STEM faculty from other colleges and universities. Dr. Cher Carrera (Department Chair, Mathematics) has attended the NSF STEP Two-Year/Four Year Partnership Workshop at Belknap, Oregon. This workshop

laid the foundation for her further involvement in this program. In spring 2010, Cher Carrera and Carol Comeau (Dean of Science, Math and Health Sciences) attended the NSF STEP Program Directors meeting in Arlington, Virginia, and in 2011 the NSF STEP Grantees meeting in Washington, D.C. From Mt. SAC, Larry Redinger, Dean of Natural Sciences and Math, and Iraj Nejad, professor of chemistry, attended the NSF STEP Grantees meeting in Washington, D.C. in 2011. Eva Figueroa, SI Coordinator at Mt. SAC, and Kathy Takahashi, biology professor at SAC, attended the January, 2011 SI workshop at California State University, Fullerton (CSUF) with SI student leaders.

## Outreach Activities

We have made other community colleges aware of TEST:UP and its programs and goals. Our original vision was to use TEST:UP as a vehicle to form closer bonds between CSUF and neighboring community colleges in order to facilitate the transfer of STEM students. To date, TEST:UP has served as the foundation for expanding CSUF STEM relationships with two other community colleges: Citrus College and Cypress College. We completed subcontracts with Citrus for increasing STEM advisement and with Citrus and Cypress for providing summer research experiences on the CSUF campus for two-year STEM students. Our agreement with Citrus College enabled us to hire a second full-time Coordinator for STEM Transfer Student Services who developed similar STEM advisement programs at Citrus College. Citrus College reported a 7-fold increase in STEM majors in the contract period. This same person, Ricardo Lopez, was hired for the TEST:UP program with re-purposed funds, upon conclusion of the Citrus program. At CSUF, we continue to expand outreach activities to increase awareness of the value of a STEM education and career opportunities in STEM fields, particularly with underrepresented populations.

At SAC a total of 26 outreach and social events were sponsored since grant inception, including visits to CSUF and NASA laboratories, STEM Week activities, research weekends, conferences (such as SACNAS) and workshops on STEM opportunities and application processes to enroll in four-year universities. At Mt. SAC only 5 outreach and social events were sponsored by the grant since inception, as the program got off to a slow start on that campus in the first two years. We are seeing accelerated activities at Mt. SAC going forward as they inaugurated a new natural history and exploration center in a prime campus location in spring 2011, and Professor Iraj Nejad is now actively participating in the grant with Dean Larry Redinger.

The STEM advisers have developed educational and curricular roadmaps for STEM transfers. A STEM recruitment DVD was completed at SAC and informative STEM web sites at the three campuses are all now active and up to date. Good progress was made to more fully integrate STEM advisers with regular academic services on all three campuses, and to more actively involve STEM faculty in TEST:UP. Classroom visits in STEM subjects are increasing on both community college campuses with the permission of the Deans, department chairs and instructors, who generously allow class time to promote STEM awareness, career opportunities, surveys, and events. STEM weeks on the community college campuses and invited speakers from four-year institutions both provide forums to educate students on STEM career opportunities. One critical component of this has been to teach students how to

apply to the CSU as a transfer student. We are leveraging our NSF STEP grant with other external funding by involving a number of SAC and Mt. SAC STEM majors in weekend and summer research experiences at CSUF supported by programs like the Howard Hughes Medical Institute (HHMI) biomedical research program, thus integrating the impact of the research experiences with the goals of TEST:UP. In 2011 we also initiated a research immersion during the regular semester for 5 new STEM transfers.

At SAC, the TEST:UP counselor is working with SAC Early Decision students to provide STEM advisement. These are high school students from local feeder high schools in the Santa Ana Unified School District that were placed into their first college course in fall 2010. Preliminary math placement tests indicate that over 1,000 students went through this process. Handouts were developed for these students identifying STEM counseling contacts and student contact information collected so that counseling staff can follow-up when they arrive on campus.

In fall 2010 at SAC (# students): a CSU application workshop (38); a workshop on undergraduate research opportunities (9); STEM week featured a video showing of “State of the Planet’s Wildlife” (118), a STEM resume workshop (38) and a STEM faculty/student mixer (38); 4 attended a conference etiquette workshop; 200 new SAC students saw STEM classroom presentations on TEST:UP; 4 attended the SACNAS national conference in Anaheim; and 4 more participated in HHMI weekend research experiences at CSUF. Recruitment materials advertised the TEST:UP program, and a book voucher system has been put into place for use in conjunction with the mentor program. Mentor and mentee information packets were also produced and a DVD was made to recruit students into the STEM majors. SAC purchased computers and software, funded by the TEST:UP grant, to improve supplemental instruction provided in the center and provide a unique space for biology students, the Biology Study Center. Instructional assistants and tutors for STEM students are hired each semester and both the Supplemental Instruction (SI) Program and the Tutoring Program are being held in this facility. A Science Club was founded in fall 2008 and is quite active. One of the goals of this club is to inform STEM students of resources that are available to them through the TEST:UP program and the Biology Study Center at SAC. For a number of reasons, Mt. SAC started off much more slowly than SAC in implementing the tools to achieve the program’s mission. In year 3, we have welcomed the participation of Prof. Iraj Nejad in the TEST:UP program at Mt. SAC and activity is picking up nicely so there will be lots more to report from Mt. SAC in the future. In fall 2010, 13 students participated in a CSUF/Cal Tech visit to discuss STEM transfer and career opportunities, 14 participated in a UCLA visit, and 30 high school students participated in early registration STEM counseling.

The CSUF Coordinator for STEM Transfer Student Services met with science and mathematics department chairs and faculty and gained access to introduce TEST:UP in classroom visits and to administer the pre-transfer surveys described earlier. The sciences at Mt. SAC recently relocated into a new building containing a study center that houses tutoring services and supplemental instruction activities. As noted earlier, a study campaign similar to the 25-35 empowerment campaign at CSUF (encourage students to study 25-35 hours per week outside of class time) has been implemented at SAC with the goal of increasing student study time in STEM courses. Also as noted earlier, students and their families often do not recognize that compared to high school, much more time is needed outside of the classroom to succeed in college. This is particularly true for first generation college students. The College

of NSM has also implemented and funds an NSM Day that takes place before the start of the first semester at CSUF for both transfer students and first time freshmen and their families.

## Publications

### Abstract of Poster Presentation:

Hoese, W.J. & S.E. Walker. Getting the horse to drink: The effect of supplemental instruction on student performance in introductory biology at a large, urban, commuter university. Encouraging and Enabling Student Active Learning. (Examples include Case Studies, POGIL, Clickers, Problem Based Learning), American Association for the Advancement of Science: Transforming Undergraduate Education in Biology: Mobilizing the Community for Change. July 15-17, 2009, Washington, D.C. **Goals & Intended Outcome:** Our primary objective is to improve student performance in the introductory majors biology course (Evolution and Biodiversity) that serves 400 students annually. Secondly, because CSUF is primarily a commuter campus, we seek to provide an opportunity for students to build peer- networks and gain a sense of community. **Methods & Strategies:** We implemented a modified model of supplemental instruction where advanced undergraduates lead voluntary discussion sections for students in Evolution and Biodiversity. **Evaluation Methods & Results:** We monitored attendance at sessions and student performance in the course. Over five semesters approximately thirty percent of students took advantage of these sessions. The students who attended these sessions had higher exam scores and were more likely to pass than students who did not. **Dissemination Activities & Plans to Disseminate:** We plan to disseminate via conferences and are writing a manuscript of our experiences. **Impacts of Project or Anticipated Impact:** We experienced a positive impact on student performance with a manageable amount of faculty time investment. Our supplemental instruction leaders found that they enjoy teaching and learn more of the material as a result of their experiences. **Challenges:** It has been difficult to offer supplemental instruction sessions during times that match well with student schedules. Faculty need to promote supplemental instruction sessions to the students, but once students begin attending sessions and they experience the benefits of supplemental instruction, they tend to continue attending throughout the semester. It has been challenging to identify supplemental instruction leaders.

Bonsangue, M., Carrera, C, and Renne, C. *Supplemental Instruction Workshops in Gateway STEM Courses at Cal State Fullerton and Santa Ana College*. Creating Pathways for STEM Transfer Student Success, Asheville, NC, Sept 20, 2010. As part of the NSF Project TEST-UP, the Colleges of Natural Science and Mathematics at California State University, Fullerton and Santa Ana College proposed to improve student success and encourage greater numbers of students to persist as STEM majors by concentrating on key entry level mathematics courses. Results showed that (1) students participating in SI had a passing rate of approximately 84 % v. 64 % for the non-SI group; (2) students participating in SI outscored non-SI group by more than half a grade point (2.59 v. 1.97); and (3) students participating in SI had a F/WU failure rate less than half that of non-SI group. While students self-selected into the SI, there was evidence of value-added from SI participation. First, there were no

significant differences between SI and non-SI groups in SAT-M, SAT-V, or HSGPA, so that SI participants did not seem to have a pre-college academic advantage. Second, there were no significant differences between SI and non-SI groups in college GPA and course-repeating patterns, so that SI participants did not seem to have an in-college academic advantage. And third, in multiple-section courses such as Math 150A and Math 150B, the non-SI group achieved at or above the level of all other non-SI sections, suggesting that the achievement of SI students did not do come at the expense of the achievement of non-SI students. Exit survey data indicated that more students would have participated in SI had they known about the SI program when setting up their schedule, especially in calculus. This review found that there was both quantitative and qualitative evidence to support the expansion of the SI program at both CSUF and SAC. In addition, there was evidence that the experience was valued by the SI leaders and helped give them the opportunity to view themselves as future professionals that they might otherwise not have had as undergraduate students.

URL <http://nsm.fullerton.edu/testup/> This is a dedicated website for CSUF's TEST:UP program. The website contains links to websites for SAC and Mt. SAC, Internal and External advisory committees for participating institutions, strategies and programs, reports and presentations. The website also provides contact information and will distribute publications and other program products.

## Contributions Within Discipline

Our project is currently just completing its third year and we are working to transform our findings into professional products, including peer-reviewed publications, for distribution to others.

Increasing the numbers of STEM transfers to four-year institutions and the number of STEM baccalaureate degrees is of national significance and stand as the principal goals of this project. Various strategies for achieving these objectives are being used in two- and four-year colleges throughout the country. In TEST:UP, we are focusing on the developing approaches that prove most successful with the students that populate our three campuses. These populations are characterized by high numbers of: 1) traditionally under-represented students in STEM fields, 2) students with little or no parental college experience, and 3) students that come from low-income families. Moreover, our institutions are commuter campuses where students move back and forth between home, work, and school. It has historically been difficult to produce large numbers of STEM students from a student population dominated by these characteristics. Yet, increasingly in southern California and various parts of the country, campuses like our own are becoming more highly populated by students with these characteristics. Through TEST:UP, we hope to improve our understanding of the effectiveness of approaches to recruit, retain, and successfully transfer or graduate these students in a timely way.

Members of our TEST:UP team have been active in attending STEP PI meetings held by NSF as well as other meetings focusing on STEM transfer students and on student learning. We are working on more complete and robust analysis of TEST:UP program elements with our external evaluator with emphasis on STEM advisement at the two-year colleges and Supplemental Instruction outcomes for enrolled students as well as the impact of participation on the peer facilitators. One of our goals is to work with individualized data to eventually predict the characteristics of entering freshmen and transfer

STEM students who will most benefit from programs that facilitate their transition to CSUF. The idea is to target these students and to institutionalize those best practices of our program that enable the retention and persistence of these students.

### Contributions to Other Disciplines

We are increasing knowledge among traditional STEM faculty of the importance of taking a more holistic approach in assisting STEM students- an approach that strongly involves student affairs. In addition, we are working with some success to increase dialogue within and between faculty in the various STEM disciplines focusing on the identification of best practices for achieving elevated student performance in STEM subjects. In addition, we have expanded discussion of Supplemental Instruction among non STEM disciplines (such as our Mihaylo College of Business and Economics) at CSUF and also transferring lessons learned from our new student orientations, study campaigns, and other activities designed to facilitate the transition of new students to the campus.

### Contributions to Human Resource Development

We are developing students and staff with increased skills and knowledge to work in the fields of STEM teaching and STEM recruitment/retention. In the second year of the grant, Gina Garcia, one of our original project staff, entered a Ph.D. program at UCLA to pursue dissertation work in these areas. We know that other TEST:UP participants are advancing their careers with knowledge and experience obtained from our program. The current coordinator for STEM Transfer Student Services was accepted into a Master's program in counseling at California State University Long Beach and will begin course work in May 2011. This work was inspired by her work with the two partner community college counselors.

An unplanned outcome of the SI program is the increased interest in teaching careers from undergraduate peer facilitators. We are working to quantify this and to explore relationships between SI facilitator experiences and increases in the number of students seeking to become math and science teachers.

### Contributions to Resources for Research and Education

We have developed improved advisement materials and roadmaps to guide STEM students in developing realistic plans to transfer from Mt. SAC and SAC to CSUF. We continue to develop SI materials to be shared among our participating campuses. In addition, we have established web based informational resources that will make STEM students more aware of careers, internships, and research opportunities. We now have active websites for TEST:UP at all three institutions. We also have stimulated faculty and staff dialogue on means to improve the transition of entering STEM students on the CSUF campus.



## Contributions Beyond Science and Engineering

We continue to develop improved understanding of STEM programs and the needs of STEM students for counselors, advisers, and others on our campuses. In addition, we are working to increase the dialogue between STEM and non-STEM faculty about STEM students and opportunities, as well as with other persons who may work with or advise STEM students at our institutions. Our College of Business and Economics is planning to adopt SI as a tool to improve success in accounting and finance courses.

### Special Reporting Requirements Information Specifically Required

We will provide data to demonstrate the need for and impact of improved advisement practices and procedures for STEM students, particularly on the two-year campuses.

The budget crisis in California forced 10% fewer enrollments in 2009-2010 and a large reduction in STEM class offerings; decreases in upper division transfer student admissions to CSUF occurred in fall 2009 followed by a sharp reduction in spring 2010 admissions (33 spring 2010 transfer admissions vs. 2,681 in spring 2009) due to the budget-driven need to control enrollment; reductions planned for 2010-2011 were temporarily alleviated by California's FY 2011 budget. For 2012 it is almost certain that severe budget driven reductions in upper division transfer student admissions will take place. These factors resulted in the number of STEM transfers from all community colleges to the Colleges of NSM and ECS decreasing since 2006-07, the year before we received STEP funding (e.g., 368 per academic year in 2006-2007; 324 in 2007-2008; 307 in 2008-2009; and 236 in 2009-2010). In 2010-2011 STEM total transfer enrollment in the two CSUF STEM colleges rebounded strongly with 447. For SAC and Mt. SAC, the same trend was apparent with 68 STEM transfers to CSUF per academic year in 2006-2007 (36 Mt. SAC, 32 SAC); 48 in 2007-2008 (23 Mt. SAC and 25 SAC); 38 in 2008-2009 (13 Mt. SAC and 25 SAC); 35 in 2009-2010 (13 Mt. SAC and 22 SAC); and rebounding to 58 in 2010-2011 (22 Mt. SAC and 36 SAC). CSUF has implemented impaction plans that raised the admission criteria for transfer students outside Orange County (3.7 GPA in 2010-2011 and 3.3 GPA in 2011-2012), our local admissions area. This contributed to the decline in incoming transfers from Mt. SAC, which is in Los Angeles County outside of our service area, during 2009-2010. However, 2010-2011 was a rebound year as described above and we attribute this in part to re-opening of spring admissions in 2011 and TEST:UP efforts counteracting the impaction barriers. Budget difficulties in California make the numbers of transfers to be admitted to CSUF during 2011-2012 uncertain at this time. The State budget has not yet been finalized and signs are not encouraging. So we might not expect any spring 2012 admits as was done in 2010.

Collective bargaining agreements at the community colleges specify the roles of counselors and faculty members. Faculty members are generally not allowed to be directly involved in the advisement process. This makes it difficult to impress on students the hierarchical nature of STEM curricula, requiring prerequisite courses to progress on to upper division courses at the four-year institutions. With cooperation from the Deans at Mt. SAC and SAC, the influence of our on-site counselors, and weekly visits by our Coordinator for STEM Transfer Student Services, we have succeeded in breaking down some of these traditional barriers, despite considerable resistance at the outset.

We found that transfer students are not very receptive to intrusive interventions, like our early warning system. They believe that they do not need it and/or that they are so used to less help that they do not see the need to change. Community colleges do not always have the data infrastructure to provide a number of information items we need to track students. Some do not have email or other means to communicate with students. Most difficult is determining transfer statistics for students who move on to four-year institutions; indeed information from the community colleges is based on exit interviews, as noted previously. National Student Clearinghouse information was found to be inaccurate. Due to a number of issues, including illness of key personnel, the program got off to a slow start at Mt. SAC. The unspent funds at Mt. SAC from years one and two were re-purposed. Mt.SAC has improved its activity in year three and with addition of Iraj Nejad to the project Mt. SAC will now be moving forward even more rapidly with TEST:UP programs.

We believe that we are achieving success and we can increase or even maintain our rate of success in elevating student performance in our entry level STEM courses as a result of TEST:UP programs despite the cuts in State resources.

### Animals, Human Subjects, Biohazards

No changes to report in procedures for animal care and use, use of human subjects, or biohazards from what has previously been approved.