Specific Aims for the *Bridges to Biomedicine* Program

Texas State University–San Marcos (TxState) will partner with two of the Alamo Colleges; San Antonio Community College (SAC) and Northwest Vista Community College (NVC), to establish a *Bridges to Biomedicine* program focused on both strengthening student transfer relationships and increasing success of URM transfer students in biomedicine upon arrival at the baccalaureate institution. Development of the activities that comprise the *Bridges to Biomedicine* program all stem from discussions between TxState, SAC and NVC faculty to identify and address the most important obstacles to upper-division transfer and degree completion by URM students showing an early commitment to a career in biomedicine. These obstacles include: (a) misguided transfer advising at the community colleges that leads to incomplete foundational course sequences in math, chemistry and biology and requires extra semesters; (b) inadequate academic preparation for math and science courses, leading to poor performance and a lower science self-efficacy; (c) financial challenges that require students to work jobs while in school and distract from their academic focus; (d) failure of students to appreciate the activities, benefits, and relevance of a biomedical research career; and (e) student families do not understand the commitment or post graduate time required to prepare for biomedical careers, and so do not value or support students' continuing biomedical education.

The partnering institutions have crafted a plan to address each of these impediments by carefully designing institutional reform and student development activities at SAC and NVC, directly targeting *Bridges to Biomedicine* participants and indirectly impacting all biomedical students enrolled. We expect these activities to result in several specific improvements in BS success rates for biomedical students beginning their studies at the community colleges. Accordingly, Specific Aims for the *Bridges to Biomedicine* program are as follows:

Specific Aim 1: ***WE WILL IMPROVE THE RATES OF TRANSFER FROM SAC AND NVC TO BIOMEDICAL BACCALAUREATE PROGRAMS, AND WE WILL DECREASE THE AVERAGE TIME TO BS DEGREE COMPLETION.***

Rationale: Existing course recommendations mean biomedical transfer students have typically not completed the prerequisite early course sequences in chemistry, math, and biology by time of transfer. Students then transfer off-track, which delays BS degree completion and reduces persistence in biomedical programs. The aim will be accomplished through several activities focused on improving the curricular recommendations and degree plan advising in order to ensure community college biomedical students remain on-track and are prepared for a smooth transition into biomedical BS programs, increasing the likelihood of transfer, upper-level persistence, and degree completion.

Specific Aim 2: ***BRIDGES STUDENTS WILL SHOW MEASURABLE IMPROVEMENT IN ACTUAL AND SELF-PERCEIVED ACADEMIC PREPARATION FOR MATH AND SCIENCE COURSEWORK.***

Rationale: Students in south Texas increasingly enter college underprepared for college-level content mastery For example, in 2010, 89% of the entering freshmen at SAC and NVC required at least one "developmental" math, reading, or writing course (5). Even students testing college-ready often have a steep learning curve for study skills that impedes content mastery and hurts academic performance. We will use several approaches to help Bridges students learn how to learn effectively and efficiently thereby improving classroom performance. Improved math and science performance has been shown to increase persistence, increasing the likelihood for a smooth transfer to a biomedical baccalaureate program and completion of a biomedical BS degree. Simultaneously, we will deliver activities that increase the self-confidence of the Bridges students regarding their own capabilities in math and science (their "science self-efficacy"). Self-efficacy is often found to predict academic performance and career-related outcomes (6); thus, improving science self-efficacy is expected to increase performance and persistence in biomedical research curricular paths.

Specific Aim 3: ***WE WILL IMPROVE STUDENT AND FAMILY UNDERSTANDING OF BIOMEDICAL SCIENCE AND HOW IT AFFECTS THEIR LIVES. WE WILL EDUCATE STUDENTS AND FAMILIES OF PATHWAYS TO, AND BENEFITS OF, GOING INTO A CAREER IN BIOMEDICAL RESEARCH.***

Rationale: The general public, and particularly the first-generation students in our target population, have little understanding of what biomedical research is and how it is relevant to their lives (7). URM students in particular desire careers through which they can "make a difference;" yet many promising students fail to persist on a biomedical path since they do not see the value to society of a biomedical career (8, 9). To address this obstacle, we will: (a) add minority health disparities content to a core general education course; (b) offer co-curricular seminars featuring biomedical approaches to minority health disparities; and, (c) provide dinner social events featuring *promotores* to help us connect with the students *AND* their families and promote an appreciation for the value of biomedical careers and relevance of biomedical research to their communities. This is expected to improve persistence and increase transfer and biomedical BS degree completion.

RESEARCH EDUCATION PROGRAM PLAN

A) Introduction

The Partnering Institutions

Texas State University (TxState) is a large Hispanic-Serving Institution (*HSI*) located in San Macros, TX and serving the south-central Texas region. The location of TxState and its reputation as a student-centered university have resulted in a very rapidly growing and increasingly diverse student body. Fall 2012 enrollment at TxState was 34,113 students with 35% of the student identifying as an underrepresented minority (URM; 1). Over the past decade, TxState has experienced a 45% increase in overall enrollment; however, it is noteworthy that minority student representation within this growing student body increased at about 4x this rate, and the number of URM students at TxState more than doubled over the same timeframe. Of the 35% URM students at TxState, most are Hispanic (26% overall; 1).

The *Bridges to Biomedicine* (*B2BP*) program is a partnership between TxState and two colleges in the Alamo Community College District (ACCD) located in San Antonio, TX, about 50 miles from TxState*.* ACCD is comprised of five community colleges having an overall enrollment of 57,286 students with 63% identified as URM (2). ACCD serves San Antonio and 28 counties in the south Texas region. Transfer students from ACCD colleges to TxState are comprised of about 50% URM students and currently represent about 1/3 of all URM transfer students that enter TxState baccalaureate programs (1).

For the Bridges to Biomedicine program, TxState will partner with the two largest colleges in ACCD; San Antonio College (SAC) and Northwest Vista College (NVC), with student populations of 25,567 and 25,567, respectively (2). Both of these colleges report 55% overall URM enrollment and are also designated as *HSI*s. Together, SAC and NVC represent nearly 60% of all students in the ACCD that have declared a major in a biomedical science discipline. In addition, 65% of all ACCD biomedical students that eventually transfer to a BS/BA institution come from either SAC or NVC (3). SAC and NVC maintain the highest biomedical student transfer rates to baccalaureate programs of the five ACCD colleges – 22% and 31%, respectively, with biomedical URM transfer rates of 18% and 29%, respectively (Table 1). TxState will partner with faculty from SAC and NVC to implement the various institutional and student development activities proposed.

These brief institutional introductions have highlighted the high potential gained by a partnership of these three *HSI* Institutions. TxState, SAC, and NVC have individual and shared commitments to minority student success, reflected in their institutional missions and current strategic plans. This commitment, along with vibrant, diverse, and growing student communities and the relatively close physical proximity, provides a natural platform for implementation of student development activities and mentored research experiences. SAC and NVC already have excellent target populations for increasing URM enrollment in the various biomedical majors offered at TxState. Moreover, the high URM enrollment numbers in biomedical programs at SAC and NVC (58% at both SAC and NVC; Table 1) suggest that activities designed to increase institutional transfer rates for these students would likely impact large numbers of URM biomedical majors.

Bridges to Biomedicine Program Overview and Expectations

Faculty at all three partnering *HSI* institutions (TxState, SAC, and NVC) have shared interests in strengthening transfer relationships and increasing the success of URM transfer students in biomedicine. To address these shared interests, we met to discuss and assess the most likely impediments to URM transfer and completion of biomedical degree plans. The results of these meetings were identification of 5 obstacles to URM students entering and succeeding in upper-level biomedical programs (Table 2). All 5 of the obstacles identified can be addressed by cooperation between the faculty and administrators at the partnering institutions or by implementation of activities specifically designed to address them. Three fundamental objectives can address these obstacles: (1) improve student advising and recommended curricula at the community colleges; (2) improve student preparation and science self-efficacy to promote success in core math, chemistry, and biology coursework; and (3) educate students and their families about the relevance of biomedical research, the path to biomedical training, and the value of careers in biomedicine. These fundamental objectives that address the 5 student obstacles are reflected in our three *Specific Aims*. We have defined several measurable outcomes for each specific aim that allow short- and long-term evaluation during *Bridges to Biomedicine* program operation to ensure we remain on target to accomplish the *Specific Aim*. The *Specific Aims* will be addressed through implementation of 6 *Activities* designed to overcome the originally identified obstacles (see Table 3 and Section E, below).

The 6 *Activities* within the *Bridges to Biomedicine Program* (*B2BP*) are collectively designed to connect with URM students early in their academic career and help them prepare for efficient transfer to an upper division university and complete a baccalaureate degree in the biomedical sciences.

Table 2: Five obstacles to URM student persistence in community college, transfer to a baccalaureate program, and completion of a biomedical degree:

(1) Science students intending to transfer to upper-division schools to complete their BS degree receive poor advising at the community college, leading the student to enter the baccalaureate program off-track and out-of-sequence.

(2) Students enter college inadequately prepared to succeed academically in the early math, biology, and chemistry course sequences.

(3) Students must be employed to attend school and the type of work they find often distracts from, rather than augments, their academic pursuits.

(4) Students are unfamiliar with what researchers do, what biomedicine is, and what types of careers in biomedicine are available to them.

(5) The students' families do not understand or appreciate the value of biomedical research or envision careers in biomedicine.

***Bridges to Biomedicine* Program Measurable Outcomes:**

Our planned program activities will provide institutional interventions at SAC and NVC that are expected to target individual Bridges program participants, but also improve transfer pathways for all their biomedical science majors. Ultimately, we expect our program to result in:

A) *Improved curricular recommendations and advising at SAC and NVC that will systematically affect all community college biomedical students, and especially Bridges students, so they stay <u>on-track for efficient transfer into a biomedical BS</u> program.* The activities related to this goal are will address *Specific aim 1* and are expected to **improve transfer rates among biomedical majors by at least 5% from each of the two partner colleges**.

The current rate of transfer for all biomedical students at SAC is 22%, and for NVC, it is 31%, producing a total of ≈550 biomedical transfer students annually (Table 1). URM students (predominantly Hispanic) comprise about half of the biomedical baccalaureate transfer student pool for each college. If we meet our goal of a producing a 5% increase at each college, then each year **at least 28 more biomedical transfer students will pursue a BS/BA degree, and half of these would be URM**. Applying the TxState degree completion rate for ACCD students that transfer to TxState (Table 1) results in an estimate of **6 additional URM and 10 non-URM biomedical baccalaureate degree holders annually**.

(B) *<u>Increased completion rates</u> of biomedical BS degrees among URM transfer students, and especially the Bridges students. A B2BP outcome of Specific Aim 1 is to **decrease the average time to baccalaureate completion for biomedical transfer students** coming from the partnering colleges.*

A recent draft report from the Texas Higher Education Coordinating Board (THECB) highlights the difference in time-to-completion for transfer students compared to native freshmen at state universities (4). Although TxState has a smaller gap than the state average, transfer students still take an additional 1.5 yrs to graduate (6.83 yrs) compared to native freshmen (5.37 yrs). At The University of Texas at San Antonio (UTSA), another common transfer destination for SAC and NVC students, the difference is nearly 2 years (5.84 yrs vs. 7.67 yrs)(4). Both of these averages for transfer students are troubling considering the reduced length of time students may draw on Pell grant funding (starting in 2012, this is reduced to 6 years). The Pell grant mechanism targets very low-income students and is often the critical difference for minority students being able to afford college. The 6-year Pell grant limit indicates the average SAC or NVC student transferring to TxState or UTSA would exhaust Pell eligibility before s/he completes their biomedical degree. For many Pell grant recipients, loss of Pell funds will translate to failure to complete a degree. This underscores the importance of staying "on-track" and our planned effort to reduce the time-to-completion.

Current course recommendations for biomedical students at community colleges take transfer students off-track for completing a BS degree in 4 years (Table 4), since they are designed to lead students to finish an AS degree (that community colleges see as their primary mission). This front-loads the general education requirements into the first 2 years, while they are distributed over 4 years in a biomedical BS program. The increased general education requirements at community colleges do not leave enough room for all the required foundational science and math courses. When these students transfer, they are off-track (i.e., without the required prerequisites) and out-of sequence (i.e., when they do complete the foundational

courses, they often must wait an additional semester for the upper-division course to be offered). When students enter the upper-division programs out-of-sequence or off-track, they usually will require at least one additional year, and perhaps more, to get back on-track and in-sequence (Table 4). Our planned interventions will serve to implement course schedules that prepare ACCD students to transfer on-track and in sequence, and, in so doing, decrease time to completion of the BS degree.

(C) *Increased URM transfer rates, both generally for all biomedical students from community college, and particularly for the Bridges students, into biomedical baccalaureate programs.* **The *B2BP* will achieve a 80% transfer rate for Bridges students that persist in the program in good standing for at least one full year.** Also, for Bridges students that transfer into upper-division BS/BA programs, we expect to achieve at least a 70% rate of degree completion or students "on-track" to graduate within 4 years of transfer (see B, above)

The current degree completion rates for minority STEM students transferring from ACCD Colleges to TxState are 43% completion within 4½ years of transfer (i.e., the 6-yr graduation rate for transfer students; Table 1). In the first five years of the *B2BP*, three cohorts of *B2BP* program students are expected to have had the opportunity to transfer. We expect **80%** (**24 of the 30) of these students will have transferred into an upper division BS/BA programs** over the first 5 years of the program. Of these 24 students, at least **18 will be expected to have graduated or be on-track to graduate** within 4 years of transfer.

(D) *Increased URM student interest in biomedical science and research career pathways.* We will work to implement student development activities to address *Specific Aim 2* that produce **increased performance and higher GPAs in math and science courses for *B2BP* students** who have been in the program for at least one year, relative to non-Bridges student cohorts.

Improved math and science performance has been shown to contribute to increased persistence in science curricular paths and thus improves the likelihood for a smooth transition to a baccalaureate program and completion of the BS degree. This increased persistence may result from a variety of factors impacted by improved academic performance, including: (a) improved science self-efficacy; (b) increased likelihood of being "on-track" in the degree plan; and (c) an increased likelihood of qualifying for grants, scholarships, and loans that help fund education. Increased persistence from improved science performance is particularly likely to impact our student population, which increasingly enters the community college underprepared for the rigors of college level work (e.g., in 2010, 89% of the entering freshmen at SAC and NVC required one or more developmental courses; 5). Although none of the *B2BP* students will need to take further developmental education (see *Selection* section), current statistics indicate an overall lower level of content mastery that presents a risk to academic progress, transfer from the community college, and ultimate degree completion. Boosting math and science performance will help to negate this risk and increase persistence.

In addition, within one full year of tenure in the *B2BP* **we expect science self-efficacy to significantly increase for Bridges students** (*Specific Aim 2*). How students perceive their own performance in math and science –their "science self-efficacy" – strongly influences their likelihood to persist in biomedical programs. Self-efficacy is often found to predict academic performance and career-related outcomes (reviewed in 6), and improving it is expected to increase student persistence in biomedical research educational pathways.

(E) We will institute several mechanisms that are expected to increase Bridges student interest in, and preparation for, post-graduate studies in biomedical research.

The general public, and particularly the students in our target population of south Texas, have little understanding of what biomedical research is and how it is relevant to their lives (7). Several studies have reported that URM students, in particular, desire to enter careers through which they can "make a difference". Many biomedical students fail persist in a science curriculum because they do not see social value in this career path (8,9). To address this obstacle, we will insert minority health disparities emphasis into a core sociology course at the partnering community colleges and offer co-curricular seminars featuring biomedical approaches to minority health. This is aimed at providing useful context to help students appreciate the relevance of biomedical research to their families and communities. Thus, **we expect students participating in the health disparities course and seminar series to show an increased interest in pursuing or continuing studies towards a career in biomedical research**.

We also recognize that minority and first-generation students in the south Texas region mostly come from large, extended families that are very influential in the students' educational decisions and support the students' education in many ways (9). Indeed, an NIH assessment of the Bridges program found that Bridges students are more likely to depend on their families for educational financial support (7). Because biomedical

research is not widely understood among the overall public (only about 23% of the populace in the region are college educated; 10) and many minority or first-generation student families have no context to understand post-graduate education, they fail to see a benefit in continuing biomedical education beyond a professional certification or AS degree. Many families exert pressure on students to complete their AS degrees and enter the workforce, and this pressure reduces minority persistence in continued biomedical education. We will address this by organizing family events that are focused on improving understanding of the value of a biomedical career and continuing biomedical education, by the whole family. We intend to use these dinner and social events to inform and clarify the educational path from community college, to BS level work, and to post-graduate training in biomedical research. **Helping families understand the challenges and value of continuing biomedical education is expected to significantly impact persistence of first generation students in biomedical education, even beyond the baccalaureate***.*

B) INSTITUTIONAL ENVIRONMENT AND COMMITMENT

The South-Central Texas Region and Participating Institutions

TxState is located in San Marcos, TX between the technology rich capital city of Austin, Texas (≈30 miles north) and the large urban expanse of San Antonio (≈40 miles to the south). The Austin–San Antonio corridor region of Texas is currently experiencing one of the highest residential growth rates in the nation (11)

SAC and NVC are located in San Antonio and are about 20 miles apart. SAC is located in the center of the city and thus draws from a very urban and less financially-affluent populace then does NVC. NVC is located at the western edge of the San Antonio metropolitan area and serves a mixed populace ranging from suburban developments to west Texas farm and ranch families living in the southwest hill country.

San Antonio is the largest city in south Texas and the 7th-largest city in the nation, with a majority-minority population of 1,327,407 (63% Hispanic, 7% African American, 27% non-Hispanic white; 12). About 23% of the San Antonio population is college educated (10). The 28-county south Texas region surrounding San Antonio has a URM population of over ≈2.9 million. Hispanics constitute greater than 90% of the URM population in this region, with African-Americans comprising 5%. Hispanic representation in the South Texas region is twice the Texas state average, and Hispanics in Texas overall are represented at 5x the national average.

The Partnering Institutions

Texas State University at San Marcos (TxState)

TxState is a predominately undergraduate institution and the 6th largest public university in Texas, serving as the flagship for the 8 universities within the Texas State University System. TxState was originally established as a teacher's college over 104 years ago (Southwest Texas State Teacher's College) and evolved into a university with increased enrollment in early 1970's (Southwest Texas State University). In 2002, the ever-increasing student enrollment topped 25,000 and led to another name change to better reflect its rising status as a major regional university (Texas State University-San Marcos). Current projections from the THECB indicate TxState enrollment will continue to increase to 37,000 by 2015, and is expected to be over 41,500 by year 2020. As one of Texas's major comprehensive institutions of higher learning, overall student enrollment at TxState in 2012 (fall semester) was 34,113, with 28,995 (85%) being undergraduate students and 5,118 (15%) pursuing advanced degrees.

TxState has recently been designated as a Hispanic Serving Institution (*HSI*), with a student body that is 26% Hispanic (35% URM)[1]. The *Hispanic Outlook in Higher Education* consistently ranks TxState as one of the top institutions nationally for granting bachelor's and master's degrees to Hispanics (14th and 30th, respectively, in 2011). TxState has worked hard to improve minority second-year retention and graduation rates, with the impressive result of nearly equal retention for minority and non-minority students alike (Hispanic: 78%, African American: 83%, White: 79%; 1). Graduation rates are likewise trending positive (Hispanic: 52%, African American: 49%, White: 57%; 1). In accordance with its core principles, TxState remains committed to continuing efforts to increase student retention and success.

TxState was recently designated as an "emerging research" institution. Total research expenditures in 2010 were $30,560,431 with $7,994,795 from federal sources – and represent a 3-fold overall increase from 2002. This increase is largely due to the recruitment of research-oriented faculty into the College of Science and Engineering, including the departments of Chemistry & Biochemistry and Biology.

Although TxState is primarily an undergraduate university, it offers nine very specialized Ph.D. degree programs, none of which are related to the biomedical or behavioral sciences. Thus, TxState remains eligible for NIH programs reserved for undergraduate institutions, such as the NIH Academic Research Enhancement Awards (R15). The College of Science and Engineering has 185 faculty with undergraduate and graduate

students pursuing studies in 6 academic departments (Chemistry & Biochemistry, Biology, Computer Science, Mathematics, Physics, and Engineering Technology), plus the Ingram School of Engineering.

Programs in the Biomedical Sciences at TxState

TxState offers a number of thriving biomedical BS programs, including very popular programs leading to ACS-certified BS degrees in biochemistry and in chemistry. The Biology Department offers a BS program in general biology, with an additional special-emphasis degree in microbiology. Students interested in pre-health professions may major in any of the above degrees plans, but are advised through by "pre-health" faculty advisors. Recently, many pre-professional students have opted for a BS in biochemistry. This is a relatively new program at TxState (5 years old), but has become quite popular since it is ACS-certified and almost all students in the program perform at least one year of hands-on research in the laboratory of a faculty mentor.

The biomedical BS programs in both the Chemistry & Biochemistry and Biology are rigorous and generally require (1) a year of inorganic chemistry, (2) a year of organic chemistry, (3) a year of physics, and (4) math through Calculus I (although the chemistry programs require math through Calculus II). There are other courses that are needed in most majors, and all but Chemistry requires a year of general biology and a semester each of microbiology and genetics, plus upper-level biology or biochemistry electives.

Biomedical faculty provide significant opportunities for undergraduate research regardless of the student's major. These programs all provide strong preparation for post-graduate study in biomedicine, demonstrated by the many examples of successful admission and completion of TxState graduates to post-graduate programs in biomedical science.

The Alamo Community Colleges District (ACCD)

The 5 sister colleges that make up the Alamo Community Colleges District (ACCD) are all located in San Antonio, about 1 hour south of TxState. ACCD is considered a very large community college district, with an estimated enrollment in 2011 of 57,286 students (63% minority; 2). All 5 sister colleges are designated *HSI*s and 39% of the students enrolled in 2010 received Pell grants (2).

Biomedical AS degree programs offered at ACCD include Biology, Chemistry, Chemical Research, Pre-Medicine, Pre-Dentistry, Pre-Pharmacy, Pre-Veterinary Medicine, and Pre-Optometry. Articulation agreements exist for all biomedical majors between TxState and ACCD, although they are currently out-of-date. All colleges in ACCD have aligned their degree program requirements (i.e., the requirements for an AS in Biology are the same at all 5 colleges), although not all colleges offer the same collection of programs. Table 4 presents a comparison of the math and science requirements for the first two years of biomedical BS programs at TxState (these are representative of most of the local biomedical programs) and biomedical AS programs offered at ACCD colleges. It is clear that the AS degree requirements do not include as many science and math hours in the first two years, leading these students to be off-track in one or more of math, chemistry, and biology course sequences when they transfer to a BS program.

The two largest colleges in the ACCD are San Antonio College (SAC) and Northwest Vista College (NVC). Both SAC and NVC have been active and highly successful at securing external grant funding focused on improving transfer pathways and increasing recruitment, retention, and graduation of STEM students, including biomedical majors. This is reflected in NVC's is current management of $1,210,187 in active state, federal, and foundation grants. The biomedically-relevant programs and key resources at SAC and NVC are summarized in Table 5.

San Antonio College (SAC) Founded in 1925, SAC is the largest single-campus community college in the state. It offers the following biomedical AS degrees: Biology, Pre-Dentistry, Pre-Medicine, Pre-Pharmacy, and Pre-Veterinary Medicine. SAC had a 2011 enrollment of 25,567, with 60% overall minority enrollment and Hispanic enrollment 53% (2). In Fall 2010, the enrollment in biomedical majors was 1,219, with 58% minority (primarily Hispanic; Table 1). The overall transfer rate to BS/BA programs for this cohort was 31% (Table 1), and 50% of this biomedical transfer pool was URM. However, the URM transfer rate was 8% lower than the non-minority (18% vs. 26%; 3).

Northwest Vista College (NVC) NVC is a much younger campus than SAC, with a campus grand opening in 1999. It offers the following biomedical AS degrees: Biology, Pre-Medicine, and Pre-Veterinary Medicine. NVC had a 2011 enrollment of 16,067, with 60% overall URM enrollment and Hispanic enrollment 55% (2). In Fall 2010, the enrollment in biomedical majors was 1,219, with 58% URM (primarily Hispanic; Table 1). The overall transfer rate to BS/BA programs for this cohort was 31% (Table 1), and 53% of this biomedical transfer pool was minority. However, the minority transfer rate was 5% lower than the non-minority (29% vs. 34%; 3).

B2BP **Directly Responds to the Core Mission of all Partnering Institutions**

An integral part of the TxState 5-year Strategic Planning includes the development of a distinct *Diversity Strategic Plan* that serves **"*as a bold blueprint to increase URM representation*"**. *An overarching goal of the TxState Diversity Plan is to increase the number of faculty/staff/students from all underrepresented groups in order to promote an inclusive community reflecting the rich diversity of the state.* As stated by TxState President, Dr. Denise Trauth, at a recent announcement for an NSF "Partnerships for Research and Education in Materials (PREM)" award to Chemistry & Biochemistry faculty; ***"It is our sincere intent to increase the number of under-represented groups in science, technology, engineering and mathematics fields.*** *Receiving this grant is a significant event that will help us achieve that goal and augment the growing research reputation of Texas State".*

The *B2BP* also overlaps perfectly with the mission of the Alamo Colleges, "Empowering our diverse communities for success." The Goals for Alamo Colleges include an "outreach focus on **underrepresented populations**," "provid[ing] students with degree planning and academic advising," and "engag[ing] in improvement and alignment of institutional systems and practices to improve student success." Indeed, the *B2BP* is a clear, long step towards the goal to "**collaborate with area universities to provide transfer programs that align with baccalaureate degrees.**" NVC additionally has Strategic Objectives, which include a directive to "**improve support programs and processes for underrepresented populations that lead to degree completion and/or transfer**."

Rationale for Partnership Between TxState, SAC and NVC

In this *B2BP* proposal, TxState is the lead applicant (baccalaureate) institution with SAC and NVC serving as the partnering (AS degree) institutions. All three institutions are designated Hispanic-Serving institution (*HSI*). The close work between enthusiastic faculty at these campuses to come together and develop this proposal, even when it will be cause for considerable realignment in student advising and course recommendations at their home campus, bodes well for success in this program. This is reflected in the letters of support by the respective institutional representatives.

A Texas state-wide higher education program called Closing the Gaps was launched in 2000 (13), and included as program goals decreasing the gaps in minority participation and degree attainment and increasing the recruitment, retention, and graduation of STEM majors in Texas public colleges and universities by 2015. As public institutions in Texas, TxState, SAC, and NVC all have related institutional goals emerging from participation in this program. Therefore, when TxState approached SAC and NVC to investigate the pre-transfer coursework for biomedical majors, all involved were eager to seize this opportunity to develop and implement a program that addresses their institutional strategic aims and works toward statewide higher education goals.

Vision and Anticipated Value of the Bridges to Biomedicine Program

At SAC, almost 40% of incoming freshmen state they intend to transfer to 4-year program and pursue a BS degree. However, the majority of these students do not transfer, and their talents and cultural perspectives are lost from the biomedical research arena. It is known that URM students exhibit a particularly low rate of persistence in biomedical education, and this is reflected in our data by lower rates of URM transfer relative to biomedical students overall (Table 1). The NIH and other agencies have already raised alarm regarding the disparity in racial and ethnic representation between the national population and the population of doctorates in biomedical careers, as risks omitting or under-valuing minority perspectives to health research and presents cultural barriers to health care for vulnerable populations, leading to adverse health outcomes. Echoing a similar anxiety from a different perspective, the THECB has established a statewide program to increase minority participation and persistence in higher education and increase the recruitment, retention, and graduation of biomedical and STEM majors.

To address these concerns, TxState, SAC, and NVC will partner to implement a program that will increase URM persistence in biomedical training both at the community-college level and through transfer into a baccalaureate program.

Identification of obstacles to URM student persistence in biomedical programs

TxState, SAC, and NVC faculty examined possible explanations for the lack of URM student success in biomedical training programs. The results of these sessions are identification of the following most important obstacles to student retention in biomedical programs:

1. **Poor transfer advising:** At the community college level, there is clearly confusion about the most appropriate science and math coursework for biomedical students intending transfer to a four-year biomedical program, and poor advising resulting from recommendations to direct students to AS degree

plans that do not prepare them for on-track transfer into nearly any local biomedical BS program (Table 4). Failure to have taken the appropriate coursework before transferring inevitably leads to two or more semesters spent catching up in math, chemistry, and/or biology prerequisites and getting on-sequence to take their upper-level coursework. These catch-up semesters are expensive, adding an extra year or more in time and tuition costs to matriculation in a program, and decreasing the students' self-perception that they are prepared to study science ("science self-efficacy"). Each of these increases the risk of failure for the student to complete a BS degree in a biomedical preparatory program.

2. **Inadequate academic preparation and worse performance:** Students beginning study at community college often have not mastered necessary study skills and have gaps in lower-level science knowledge and comprehension, decreasing their preparation to succeed in introductory math and science courses. An incomplete understanding of the study skills (note-taking, reading, review), and/or weak critical thinking and scientific thinking skills that are necessary for mastery of content in the science and math curriculum leads to poor performance in foundational science and math courses, endangering the student's financial aid and academic standing. Such students then must either re-take the course(s), getting off-sequence and costing time and money, or they may progress in the sequence but with lower content mastery. Both of these keep the student perpetually behind and lower the student's sense of science self-efficacy, decreasing their interest in persisting in biomedicine. Even if they choose to persist, they are less competitive for transfer admission to baccalaureate and post-graduate programs.
3. **Financial challenges:** URM students are particularly likely to need to work a job to help afford their education. These students typically fail to find employment that will augment and enhance their studies and/or allow them to gain experience to envision a biomedical career. In the absence of such types of jobs, the workplace distracts them from their academic endeavors, rather than reinforcing them, leading to lower academic performance and decreasing persistence.
4. **Students are unfamiliar with what researchers do and what biomedicine is.** The students have a poor understanding of what the biomedical sciences are, what research is, what researchers do, and they also have a poor grasp of the relevance of biomedical research. Failure to clearly see the value of a biomedical career reduces persistence. Several studies have reported that URM students, in particular, look to enter careers through which they can "make a difference" (8, 9); many biomedical students fail to persist because they do not see social value in the biomedical career path. If students are not aware of even the basic intentions of a career, they will not choose it as a target. This lack of awareness of biomedical research careers is particularly true of students who are first-generation college students, which is the case for many minority students in the south Texas region.
5. **Students' families do not appreciate the value of biomedical research or envision careers in biomedicine.** Minority students often depend on their families for a variety of forms of support, so that families are substantial contributors to educational decisions. The family support groups for URM students often have a nebulous understanding (if any) of what biomedical researchers is, and, like much of the public, may not appreciate the relevance of biomedical research for their own lives. When family members do not appreciate the value of a biomedical career nor the relevance of biomedical research to their lives, they often pressure the student to finish and get into the workforce, pushing students away from transfer plans and the long educational pathway to a biomedical career.

We have developed discrete activities to address each of obstacles listed above. The activities we have developed incorporate all of the proven programmatic interventions recommended in *Expanding Underrepresented Minority Participation* (14) and elsewhere (15). The activities to be employed and the *Specific Aims* that each activity will address are shown in Table 3 and detailed in section E2 *Developmental Activities* (below). ***B2BP*** **student development programs: Collaboration and Complementation**

Table 3. *B2BP* activities directly address the 5 obstacles to URM persistence through 6 Activities that will accomplish the goals delineated for each of the 3 *Specific aims*. For each planned *B2BP* activity, the expected impact on the respective *Specific Aim* is estimated as **XXX** – strong impact ; **X** – lesser or indirect impact

Obstacles →	*Poor advising leads to off-track transfer and delayed graduation.*	*Inadequate preparation for science success*	*Financial challenges*	*Lack of student understand-ding of biomedical research*	*Lack of family support for continuing education*
Specific Aims →	**Specific Aim 1:** Improve transfer advising	**Specific Aim 2:** Improve preparation to succeed in science		**Specific Aim 3:** Increase student and family understanding of and interest in biomedical careers	
Activity 1: Address transfer difficulties institutionally	**XXX**				
Activity 2: Directly facilitate transfer for Bridges students	**XXX**			**X**	
Activity 3: Engage Bridges students in biomedical research and increase scientific preparation	**X**	**XXX**	**XXX**	**XXX**	**X**
Activity 4: Increase student preparation for academic success	**X**	**XXX**	**X**		
Activity 5: Increase student interest in biomedicine by showing its relevance through minority health disparities content	**X**			**XXX**	**X**
Activity 6: Increase family support for continuing biomedical studies through family education events				**X**	**XXX**

***B2BP* student development programs: Collaboration and Complementation**

The *B2BP* will join a network of academic and student development programs that both complement and collaborate to improve the academic preparation and student performance (Table 5).

Student Resources at SAC:

At SAC, the MESA (Mathematics, Engineering, and Science Achievement) program provides academic support in math and science for all students, in the form of tutoring, group study and meeting space, physical and electronic resources for math and science content, and workshops to support academic development. Bridges students will benefit from these resources, and we anticipate coordinating with the SAC MESA program director, Ms. Analisa Garza, to offer study skills workshops and other academic development activities targeted for students in academic tracks leading to biomedicine. The MESA program was established through funds from a MSEIP program called *ACCESO*, which also provides professional development to STEM faculty to implement pedagogical best-practices. This overlaps our intent to support science faculty interested in revising their courses, we expect to coordinate with *ACCESO* to ensure that resources are used most efficiently.

SAC is home to the BioSpot, which offers access to lab resources (microscopes and slides, preserved specimens, and plastic models) to improve lab performance and biology study resources (textbooks, videos,

and computer programs) to improve biology content mastery. The SAC Biology Department manages "Biology University", which provides online access to a variety of electronic forms of biology content for student support in biology. We expect to work with both BioSpot and Biology University to promote use of these resources, especially among the Bridges students.

In addition to these academic support and research training programs, SAC also provides a variety of non-academic support services, including: Counseling and Advising Services; disABILITY services; an Empowerment Center; Services for Women and Non-Traditional Students (SWANS); and a childcare center that accepts subsidies. *B2BP* will invite Counseling and Advising Services to participate in the program-facilitated discussion to improve advising of biomedical transfer students.

Student Resources at NVC:

NVC offers academic support, study access to lab models, and STEM student advocacy through the Math and Science Advocacy Center (MSAC). We anticipate working closely with MSAC to encourage student utilization of their resources by Bridges students. NVC has been awarded funds for a Title V HSI program called *Project INNOVISTA*, targeting Hispanic and low-income students at entry to college to provide increased academic support, efficient progression through developmental education, establishment of learning communities, and improving academic advising. We will work with this program in the area of advising; thus, we will be sure to include *INNOVISTA* program personnel in our discussions on transfer advising. NVC offers its STEM students two scholarship programs: an S-STEM program called Math-Intensive Majors Scholarship (MIMS) project and a state-funded program called T-STEM Challenge Scholarship program. It is our plan to coordinate with MIMS to ensure that our participants do not violate regulations regarding participation in more than one federal program, and we will coordinate with T-STEM to investigate whether students can participate in both programs. NVC is also partner in a PREM program that focuses research on nanomedical applications. This program will likely be drawing participants from the physics majors, and so we are will not share an applicant pool. However, since this program also employs undergraduate research early in college for minority STEM students, we expect to exchange ideas that work to improve undergraduate research in this population. Finally, NVC is a partner with SAC in the proposed *Project CIMA* program, described above.

Beyond these, NVC provides support through counseling and mentoring services such as: the CaTS Center for career and transfer advising; Wildcat Mentors; Disability Support Services; a Degree Plan Advising Center; and, a wellness center. The B2B program will invite the CaTS center and the Degree Plan advising center to participate in the program-facilitated discussion to improve advising of biomedical transfer students.

Student Resources at TxState:

Through the Dept of Chemistry and Biochemistry, TxState offers an NSF summer REU program called CheMIE (REU on Molecular Innovation and Entrepreneurship). Although this REU has more of a chemistry-focus than biomedical one, the timeframe and the goals coincides with the *B2BP* goals in regard to undergraduate research experiences. The populations of student researchers will be quite similar in levels of academic preparation and personal background. Also, about 1/3 of the research to be performed through this program is biochemistry. The Bridges students will be housed in dorms alongside the REU participants, and at least some will share labs for the summer. Additionally, Bridges students will join them in the evenings for community-building social activities and research skills development workshops.

At TxState, there are a number of advising resources available to support the transfer students, including the College of Science and Engineering (CoSE) Undergraduate Advising Center, a dedicated science faculty advisor for chemistry and biochemistry, a collection of pre-professional advisors, and science faculty ready to advise as needed. Although students must already be TxState students to use student-fee-supported advising services such as CoSE, the faculty advisors are able and willing to meet with pre-transfer students to help them be best prepared for a seamless transfer. We plan to utilize these faculty advisors before transfer to help the Bridges students both plan for efficient, on-track transfer and to make personal connections to Texas State, providing an additional familiar face once they transfer.

For Bridges students who transfer to Texas State, there are a number of academic and student development resources. There is a scholarship (at least $1000) that is specifically earmarked for a transfer student, in addition to a variety of other competitive scholarships. Since they will no longer be receiving funding from the Bridges program, they will be eligible to be a scholar with financial and academic support through the H-LSAMP program. Given their research experience and background, the transfer Bridges students should be competitive for selection as NSF-funded H-LSAMP scholars, and we will strongly encourage them to apply.

All URM students are eligible to participate in peer tutoring and other services offered through the LSAMP-staffed Collaborative Learning Center. Separate from the H-LSAMP program, Texas State offers Student Support Services (a TRiO program) for students who are low-income, first-generation, or with a disability. Many of the Bridges students would qualify for assistance under one or more of those criteria, providing them with extensive academic support; we will encourage former Bridges students to apply for these services, as well. Students who do not qualify for support through Student Support Services will still be eligible for academic support through the Student Learning Assistance Center (SLAC).

We hope to have inspired a deep interest in doing research in the Bridges alumni. At TxState, there are several programmatic avenues for former Bridges students to continue to participate in paid undergraduate science research on-campus, including a newly-launched SURF program and mentored research through H-LSAMP (for H-LSAMP scholars only). These are in addition to simply asking individual faculty members about possibly working in their labs outside of a specific program. We expect to encourage former Bridges students to take advantage of these opportunities, and make introductions and connections as necessary to facilitate further undergraduate research.

There are likely to be two programs to facilitate post-graduate biomedical studies for interested minority students. Concomitant with our Bridges to Biomedicine proposal submission, TxState is a partner with the University of Texas health Science Center at San Antonio (UTHSCSA) in submitting a proposal for a *South Texas Bridges to the Doctorate* (STBD) program to NIGMS for funding consideration. If this doctoral Bridges program is supported, minority students (including former Bridges to Biomedicine students) may apply for funding to cover tuition and expenses for a Master's degree in Biochemistry at TxState, with strong preparation for admission to the biomedical doctoral program at UTHSCSA. **Particularly promising undergraduate minority students can apply for early admission to the doctoral Bridges program, where they would begin their Master's studies in the senior year of the baccalaureate program.** In this case, their tuition for senior year of the BS would be covered and they would earn the MS in the following year. We expect to advertise this program through our biomedical career family event, and otherwise ensure that Bridges students are aware of this opportunity, should it be funded.

Institutional Commitments

The senior leadership at each of the three partner institutions (TxState, SAC, and NVC) is thoroughly committed to the broader principles of diversity and to the education, training, and success of minority students. This is explicitly stated in the institutional strategic objectives of each institution and by each of the key institutional leader in their attached letters of support.

To underscore institutional commitments to the goals of the program, TxState, SAC, and NVC will each provide financial and/or in-kind support through the mechanisms detailed below. These commitments are echoed in the relevant letters of support from TxState (Provost), SAC (President), and NVC (President).

TxState Commitments

*Total estimated value **$268,094 over 5 years (average $53,619 annually)***

- TxState will provide room and board for all Bridges students for undergraduate summer research experiences at TxState. Housing for the Bridges students is provided through in-kind support; it is valued at **$157,500 over the 5 years** of the program, or an average of $31,500 per year.
- In addition TxState will provide meal plans for the summer research students estimated to cost **$40,500 in total**, or an average of $8,100 per year.
- TxState will purchase multi-passes for the TxState Tram for each Bridges student to permit the students to travel to events on-campus and to facilitate TxState faculty advising for anticipated transfer students. This commitment is estimated to cost **$4,950 over 5 years**, or an average of $990 annually.
- TxState will provide 1 month summer salary plus benefits as an in-kind match to Bridges to Biomedicine PI Dr. Walter (on 9 month academic year contract) to permit time for program administration and supervision of program activities. This commitment is valued at **$96,344 over the 5 years** of the program, or on average, $19,269 annually.
- TxState will provide resources to support the bi-annual family events through in-kind support. We estimate that this support is valued at **$9000 over 5 years**, or an average of $1,800 annually.
- In year 1 of the program, TxState will commit to facilitating inter-institutional discussions to improve the recommended schedules for lower-level coursework at SAC and NVC for anticipated biomedical transfer students. TxState faculty advisors will be invited to participate in these transfer advising workshops, and TxState will contribute in-kind support refreshments at these workshops.

- TxState invites the Bridges students to participate in research skill development workshops already offered annually to participants of the CheMIE REU.
- TxState commits to host the website for the Bridges to Biomedicine program.
- TxState commits to allow faculty advisors to contribute advising time to the Bridges students annually so that they clearly understand what coursework to complete before transfer, and what coursework to expect upon transfer.

SAC Commitments

- SAC is committed to improve STEM advising services and increase faculty advising. Improving transfer pathways will be a priority in the years to come.
- SAC commits to offering regular advising workshops for STEM faculty, and invites TxState to participate as trainers to impress upon faculty the importance of course sequencing.
- SAC commits to improved communication of transfer information, particularly for biomedical majors, through the activities described in the proposal.
- SAC commits to continue support for the STEM centers (MESA and BioSpot) and STEM student clubs (Society for the Advancement of Chicanos and Native Americans in Science – SACNAS – and the Biology Club).
- SAC commits to continuing to support Ms. Analisa Garza, director of the MESA center, through MSEIPO grant funds, including supporting her development and delivery of workshops for Bridges students.
- SAC commits to encouraging science faculty to take advantage of financial support to implement pedagogical change in the classroom.
- SAC supports the proposed incorporation of minority health and health disparities content into a core sociology course, and commits to presenting any necessary proposals for revised or new curricula to the THECB.
- SAC invites all Bridges students to present their research results at their annual undergraduate research symposium.
- SAC commits to improving data collection on educational outcomes of biomedical majors, and will support Bridges' evaluation efforts.

NVC Commitments

- NVC will provide the necessary facilities and additional resources to adequately support the Bridges activities specified in the proposal.
- NVC commits support from non-academic areas (Recruitment, Admissions, Financial Aid, Math and Science Advocacy Centers – MSAC, and the Advising and Career Services areas) through coordinating existing services at NVC.
- NVC science faculty are eager to take advantage of the resources provided to revise course pedagogies, and NVC applauds these intentions. Faculty are also ready to provide targeted faculty advising and encourage student access and use of supportive services.
- NVC commits to continue improvements of advising services and faculty advising, and improve communication of pre-transfer information
- NVC commits to participating in partnership efforts to establish more appropriate course sequencing/schedules for biomedical students intending to transfer
- NVC commits to continue to support development of the MSAC and ensure its availability for Bridges students
- Support the sociology faculty as they incorporate the minority health and health disparities content into existing courses
- Improve data collection on the educational performance and outcomes of biomedical majors, and assist with evaluation efforts by sharing data as requested.

TxState has been described as "a leader among Texas public universities in all aspects of transfer success" (4). Bridges students that transfers to TxState can expect access to the following types of support to increase their ability to persist and succeed:

Financial Support: TxState provides transfer scholarships to eligible, competitive transfer applicants, and offers a number of other competitive scholarships to a broader University population. Moreover, Bridges students are likely to be qualified and competitive for admission into the H-LSAMP Scholars program, which provides annual stipend support in addition to placing students in paid undergraduate research positions. Besides grant support, TxState offers work/study employment, continuing undergraduate research opportunities, and assistance with loan applications and documentation.

Academic Support: TxState will provide academic support to transferring Bridges students through: student-centered faculty; Student Support Services (for qualified students); the Student Learning Achievement Center (SLAC); the Writing Center; the H-LSAMP-staffed Collaborative Learning Center; H-LSAMP Scholars program (for competitive students); and the College of Science and Engineering Advising Center.

Emotional and Cultural support: Peer Mentors (provided by the Bridges program); Multicultural Student Affairs office (and student support and activity groups associated with MSA); the Counseling Center; P.A.W.S. (Positive Action With Students) Alert system; and, continued contact with the TxState program coordinator, Dr. Volk de García.

C) PRINCIPAL INVESTIGATOR

Ronald B. Walter, PhD will be the PI of the *B2B*P:. As a Professor of Biochemistry and University Endowed Research Chair at TxState for more than a decade, Dr. Walter has been a University leader in obtaining grant funding from NIH to support his group's research on molecular carcinogenesis using aquatic models (*Xiphophorus*, medaka, and others). He has maintained continuous federal funding (average >$1M per year) since his arrival at TxState in 1990 and provided a strong push to establish the University's status as emerging research institution, even as it remains a primarily-undergraduate institution. Dr. Walter has been PI or Co-PI for over 30 research and/or program grant awards from various federal agencies, including the NIH (P01, P40, RO1, R24, and R21 awards). For nearly 20 years, Dr. Walter has been the Director of the *Xiphophorus* Genetic Stock Center and the affiliated Molecular Biosciences Research Group, through which he has mentored dozens of undergraduate and Master's students, post-doctoral associates, and junior faculty and produced more than 110 publications. His current group includes 2 undergraduates, 3 Master's students, 6 post-docs, plus a handful of technicians. Recent studies have focused on the molecular determinants of carcinogenesis using *Xiphophorus* interspecies hybrids melanoma models, biomarker discovery using the medaka fish model, and bioinformatic (i.e., genomic and transcriptomic analyses) exploration of the molecular genetics underlying complex traits. Dr. Walter was Co-PI on a doctoral Bridges grant between UTHSCSA and TxState (then Southwest Texas State) that was active until 2005. Dr. Walter's extensive history of both strong biomedical research and undergraduate mentoring, as well as his strong performance in managing NIH and other federal grants, provide firm evidence that he will be a skilled administrator and supervisor of the proposed B2B program.

Dr. Walter will serve as the principal investigator for the *B2BP* and work closely with Dr. Volk de García, who will serve as the Lead Program Coordinator. Dr. Walter will monitor implementation of program activities and serve as the liaison representing the program as needed for TxState administrative units or offices. Dr. Walter will also serve on the participant selection committee and as an undergraduate research mentor within his research program. He also expects to serve as co-PI of the anticipated doctoral Bridges sister program (STBD Program) submitted in partnership with UTHSCSA. Dr. Walter will be able to facilitate connecting student activities and mentorships between the B2B baccalaureate program and the STBD doctoral program, synergistically increasing the probability that Bridges students will continue to post-graduate study in biomedicine.

D) PROGRAM FACULTY

Sara Volk de García, PhD will serve as the Lead *B2B* Program coordinator. Dr. Volk de García is a program faculty member in the Molecular Biosciences Research Group in the Department of Chemistry and Biochemistry at TxState. Dr. Volk de García completed her PhD in Biochemistry and Molecular Biology at Johns Hopkins University in 2006, where she studied the role of ubiquitin in DNA damage tolerance. She followed this with postdoctoral research studying arbovirus phylogenetics at the University of Texas Medical Branch in Galveston, TX. In keeping with a strong interest in teaching underserved populations, Dr. Volk de García moved to Our Lady of the Lake University (OLLU) in San Antonio, TX, a non-selective HSI in the 11th-poorest neighborhood in the US. As Assistant Professor of Biology, she taught biology, mentored many undergraduates in research, and advised students, earning warm praise for her efforts. Through her work over three years at OLLU, Dr. Volk de Garcia saw first-hand the particular struggles of minority students, particularly transfer students, working to complete biomedical degrees. She moved to her current position to work more effectively to alleviate these struggles.

In her capacity as Lead B2B Program Coordinator, Dr. Volk de García will either supervise or directly execute development and implementation of all program activities as presented in the proposal. She will consult with Dr. Walter to coordinate recruiting and program activities with partnering program coordinators, program consultants, research mentors, and student participants. She will also serve to connect to the

existing network of student support and development programs, at both TxState and at SAC and NVC. Dr. Volk de García will monitor students' progress once they have left the program, and will keep in contact with Bridges alumni. She will also provide administrative support for the program by interacting with the evaluators and Dr. Walter. Dr. Volk de García has experience intensively working with minority biomedical undergraduate populations through teaching and undergraduate research, and this is supported by a strong biomedical research background. Dr. Volk de García is clearly well-equipped with the skills and experience required to execute the duties of Lead B2B Program Coordinator.

Partner B2B Program Coordinators at SAC and NVC

We have identified outstanding faculty representatives for the *B2BP* at both SAC and NVC. These faculty representatives will serve as partner Bridges Program Coordinators and will assume similar duties at each campus. The partner B2B Program Coordinator will be the on-campus contact person for all Bridges activities, frequently interacting with Bridges students. The duties each will perform at their respective campuses include: serving on the Bridges student selection committee; carefully monitoring student academic performance, and intervening when necessary; participating in Bridges student development activities; serving as academic advisors and mentors; and, working with the Dr. Volk de García to ensure all program activities run smoothly. SAC and NVC Bridges Program Coordinators will additionally facilitate discussions on their campuses to work toward improving recommended course schedules for students anticipating transfer into biomedical BS programs, and will serve to promote the Bridges program and its activities among the science faculty at their campuses.

Prakash Nair, PhD will serve as the NVC B2B Program Coordinator. Dr. Prakash has 11 years' experience advising and teaching chemistry to minority community college students, currently serving as Assistant Professor of Chemistry and Academic Chair of the Department of Natural and Physical Sciences. A foundational understanding of chemistry is critical for student success in biomedical education and research, and so Dr. Nair's work relates directly to the mission of the NIH. Prior to teaching, Dr. Prakash spent 10+ years doing biomedical research (see attached biosketch), producing numerous peer-reviewed publications (including 3 first-author papers in the past 6 years). With the support of experienced grant management staff at NVC, Dr. Nair will also manage the subcontract budget. Dr. Nair is well-prepared with the knowledge, skills, and experience necessary for an excellent NVC B2B Program Coordinator.

Krishnan Madappat, PhD will serve as the SAC B2B Program Coordinator. Dr. Madappat is a Professor of Chemistry in the Department of Chemistry at SAC. He has taught at the community college level for 26 years, and has been recognized for the quality of his chemistry teaching with several awards. Like Dr. Nair, Dr. Madappat's work teaching chemistry to biomedical students relates directly to the NIH mission. In addition to many years of teaching, he has also had nearly a decade of research experience. Dr. Madappat capably served as the SAC program coordinator for a Bridges to the Baccalaureate program in 2000 *(PI: Dana García)*. Dr. Madappat clearly has the knowledge, skills, and experience to proficiently serve as the SAC B2B Program Coordinator.

Undergraduate Research Mentors: We have selected 20 faculty actively doing biomedical research in the departments of Biology, Chemistry and Biochemistry, and Nutrition at TxState to be summer research mentors for Bridges students. We have also selected 11 faculty from the Genetics department at TBRI to serve as research mentors during the school year. Table 6 lists some of these mentors and provides information about their research areas and funding. Per the guidelines, this is only a representative sample of 10 of the research mentors (of 20 total at TxState and 11 total at TBRI); however, all of the mentors are performing research relevant to the mission of the NIH, and all have peer-reviewed research publications.

E) THE BRIDGES TO BIOMEDICINE PROGRAM

E-1) Program Participants and Recruiting

To recruit students into the Bridges to Biomedicine program, Dr. Volk de García will visit introductory biology and chemistry major courses very early in the fall semester, briefly describing the program and distributing application material (Dr. Madappat and Dr. Nair will assist with this as far as possible). However, as described elsewhere,[7] this strategy may miss a number of quality applicants (e.g., late to class that day, not enrolled in the targeted courses). To supplement the classroom visits, we will also recruit in the following ways: (1) Provide program information to faculty and transfer advisors in early August, when they are meeting with the majority of their advisees and can directly, personally recommend the program to appropriate candidates; (2) Record a brief recruiting video, post it online at the Bridges website, and share it with instructors of likely biomed-majors (chemistry, math, biology), as well as with freshmen orientation instructors so they may share it with their students (link on course webpage) and also post it on various relevant SAC and NVC webpages; (3) Initiate relevant connections through social media (Facebook, GoogleGroups, etc.)

and share program information through these connections; and (4) send an email blast about the program to registered freshman biomed majors.

We will be actively recruiting and accepting applications from mid-Aug through late Sept; we will encourage electronic submission of applications, but Dr. Nair and Dr. Madappat will also accept paper applications. By mid-October, 10 students will have been identified by the selection committee (Drs. Volk de García, Madappat, Nair, and Walter) to begin program activities. Bridges student selection will be based on a number of different factors that reflect program guidelines and the program goals. To this end, we have developed a weighting system (described below). Several characteristics are required for all accepted Bridges students, including: enrolled as a full-time student in a biomedical major at SAC or NVC (if not currently registered as a biomed major, students must attach a copy of the completed major declaration sheet with Bridges application); be a member of underrepresented minority group, AND a US citizen or non-citizen national or permanent resident; they must be ready for college-level math and English (this is a requirement to ensure the student can be promptly advised for on-track progression, as it is a prerequisite for enrollment in science courses); be able to dedicate significant time to the activities of the program; and, they must either have internet access at home or be willing to travel to campus as needed to complete Bridges activities (home internet access is not assumed for these students). Students who do not meet these criteria cannot be considered for the program. However, they can apply again once they do meet the criteria (e.g., have completed developmental education).

We anticipate our recruiting efforts will yield many more than 10 applicants meeting the minimum criteria above. To select Bridges students from among this pool, we will use an initial weighting system, followed in some cases by a personal interview. The GPA used for reference is college GPA; students who are new freshmen must have high-school GPAs above 2.9, and the high-school GPA receives no weight).The characteristics given most weight (+2) are: interest in graduate school; college GPA 3.5+; entered school with 10+ hours of college-level credit from high school; and, has passed an introduction to biology or chemistry majors course, or college algebra or pre-calculus. The reason these factors have been given higher weight is that we view our program as both a stronger push to transfer and complete a BS degree for students who may not have managed without our intervention and a mechanism to ensure students who are already on an early path to post-graduate study are nurtured and kept on-track, looking toward the overarching goal of the NIH Bridges program. We do not expect many students with these criteria. If we find that our selection pool is strongly top-loaded with these students, we will modify the weights (e.g., so that students cannot receive more than 2 of the highest weights), to ensure our Bridges program is not only serving students who would be successful in any case.

We also have characteristics weighted less (+1), or even negatively weighted (-1 or -2). The Bridges program is designed to best help students who are early in their degree program, so that we have the highest likelihood of getting them on-track and in-sequence. Therefore, students who are NOT in their first two semesters of loan/grant eligibility (first 3 semesters if the student needed developmental courses) will be penalized with -2. Note that some of these students may still be desirable based on other characteristics. And, a sophomore who is on-track will have already completed a math or science course, and thus have the penalty negated. Students who are in their first 2 semesters will gain +1, as will students who have GPAs 3.0-3.49, those who plan to transfer to a BS program, and those with 6-9 college-level credits from high school. Students with lower college GPAs (2.5-2.8) will be slightly penalized (-1).

To provide us with flexibility, students will also be asked to compose a short essay about why they want to join the program. We can award up to +2 for reasonable references to wanting to do research, interest in post-graduate study, quality writing, or other desired qualities. Additionally, for students tied for acceptance or otherwise on the brink, we may choose to meet with them personally to better assess whether the *B2BP* will serve them well. We will make some effort to balance the number of NVC and SAC students, but it will not be foremost in selection criteria. Depending on how the applicant pool develops over the years of the program, and the performance of Bridges students, we may modify these weights to best recruit students that most serve the program goals.

E-2) Developmental Activities through Bridges to Biomedicine

To address the identified needs of URM biomedical students at the Alamo Colleges *(*See *Vision*, in Section B), we propose six activities that directly address each of the obstacles to student transfer from community college and persistence in upper-division biomedical programs. These activities collectively accomplish the *Specific Aims* and *are expected to meet our stated goals (*See *Overview and Expectations* in Section A). Table 3 in the *Vision* section concisely shows which obstacles and Specific Aims are targeted by each activity.

Below, we provide a detailed explanation of how each activity: (1) will serve to increase student competitiveness for transfer and completion of a biomedical baccalaureate degree; and (2) addresses the specific needs of URM biomedical students at SAC and NVC.

Specific Aim 1: ***WE WILL IMPROVE THE RATES OF TRANSFER FROM SAC AND NVC TO BIOMEDICAL BACCALAUREATE PROGRAMS, AND WE WILL DECREASE THE AVERAGE TIME TO BS DEGREE COMPLETION.***

Activity 1: Address curricula recommendations and transfer difficulties institutionally

Associate's degree completion rates are used to evaluate community colleges success in Texas, which directly impacts college funding levels. Thus, there is incentive for community colleges to direct students into AS degree plans. However, one of the primary obstacles to efficient transfer from ACCD is that NONE of the biomedical AS degree plans will prepare a student for on-track transfer into any biomedical baccalaureate program (Table 4).

Therefore, Activity 1 works at the institutional level to develop improved course schedule recommendations for biomedical majors expecting to transfer. This problem is the result of too few math and science courses taken at the community-college level. Whether majoring in biology, chemistry, or biochemistry, a rising junior at TxState or other local universities will have completed a full two years of chemistry (through Organic Chemistry II), and will have completed math through at least Calculus I (Table 4). Biochemists and biologists additionally will have completed at least a full year of biology. At ACCD, none of the most widely-accessible degree plans has students complete all of these foundational math and science course sequences. Therefore, even though the transfer students are technically juniors (by total credit hours), their progress in their major is equivalent to a freshman or sophomore, leading to extra time necessary for baccalaureate degree completion and replete with extra costs. Increasing either the cost or the time necessary to finish reduces the likelihood that students will complete their degrees as a result of a variety of factors (including the new 6-year time limit on Pell grant funding).

To resolve this problem, we will use our partnership to facilitate cross-institutional discussions aimed at increasing appreciation of the importance of sequencing in science curricula, and improving the general understanding and communication of what courses students should have completed to be prepared for efficient transfer. These transfer discussions will occur in the first year of the program, facilitated by participation of Dr. Volk de García, Dr. Madappat (SAC) and Dr. Nair (NVC), and transfer advisors and science faculty advisors from all three institutions. We expect these discussions to result in improved course recommendations by the end of the first year for students intending to transfer so that they're on-track for efficient transfer into any biomedical baccalaureate program, whether at TxState or another university. We predict that increasing the students' preparation for on-track transfer will both increase the transfer rate and reduce the time-to-degree completion for those who transfer into biomedical baccalaureate programs (supporting **Specific Aim 1**).

To help generally improve communication of the coursework necessary for efficient transfer into a biomedical program, Dr. Volk de García will ensure chemistry and biology articulation agreements for TxState are up-to-date and clear. Additionally, all program coordinators will encourage freshmen orientation instructors at SAC and NVC to communicate awareness of the importance of being on-track as early as possible. We will also encourage these instructors to advertise the availability of existing institutional pre-transfer resources, including pre-transfer advising at their transfer institution (e.g., TxState) to help students begin planning their path as early as possible. We expect that increased early awareness of transfer resources and increased early consideration of a path to transfer will increase the likelihood that biomedical students who enter with the intention to transfer will actually transfer, and will transfer on-track, supporting **Specific Aim 1**.

The only resource necessary to execute this strategy is participation by institutional personnel. TxState, SAC, and NVC have all already agreed to support participation in these discussions, as described in the letters of support. Indeed, support for these activities is particularly strong at SAC, as they are directly in line with existing transfer improvement efforts through the Foundations of Excellence® Transfer Focus self-study currently ongoing there. Given the widespread support for this activity and the variety of possible approaches to improve recommended course schedules, we see few impediments to implementation.

Activity 2: Directly advise and facilitate transfer for Bridges students

The institutional changes of Activity 1 are expected to increase transfer for all biomedical students at the ACCD, but institutional changes occur at glacial speed. However, we will directly and intensively advise Bridges participants in their course scheduling to ensure efficient on-track progression through math, chemistry, and biology course sequences, thus immediately facilitating transfer readiness for our Bridges

student participants. Within the first month of admission to the program, students will meet individually with either the SAC or NVC Bridges Program Coordinator (Dr. Madappat or Dr. Nair) and Dr. Volk de Garcia to form an individual degree plan that will get the student on-track in math and science and will diagram coursework through the anticipated transfer. At this initial meeting, we will also provide students with a timeline showing when they should expect to do activities necessary for transfer (e.g., apply to the BS program, register, etc.). The students will also be advised about the damage done to the plan if they do not pass a course in the math and science sequences, emphasizing the importance of staying in-sequence by addressing any problems in their coursework early. These degree plans will be revisited each semester, and revised as necessary to ensure students remain on-track and clearly understand the necessary sequences. Additional transfer support will be provided by faculty advisors at TxState, with whom Bridges students will meet at least once per year. The TxState faculty advisors will extend the individual degree plans to reflect anticipated upper-level coursework taken after transferring, and will supplement the transfer timeline as needed. These efforts will help the Bridges students better envision the logical order of their activities (coursework and otherwise) necessary to transfer and complete their baccalaureate degrees. We expect that, as a result of this increased understanding, Bridges students will be more likely to transfer and complete their degrees efficiently, supporting achievement of **Specific Aim 1**.

In addition to the formal advising presented above, we propose informal "peer" advising through conversations with upperclassmen and graduate students in biomedical programs at TxState. Bridges students may be somewhat skeptical of claims made by faculty, but they are more likely to trust information coming from advanced students who have already traveled the path they intend to use. A recent white paper about retention of Hispanics in STEM indicates that these types of interactions with more-advanced peer students have been consistently shown to positively impact Hispanic persistence (16). Based on the literature and our own observations, we feel that these conversations with students who have committed to biomedical education and research will provide relevant information about the rigor and value of the baccalaureate programs, lending impetus to continue and contributing towards accomplishing **Specific Aim 1**. Particularly since TxState has significant minority representation among the biomedical upperclassmen and graduate students, the literature indicates that these interactions are also likely to improve the Bridges students' sense of science identity since they will see students like them doing research and succeeding in science, contributing towards **Specific Aim 2**.

B2BP Students transferring to TxState:

Most of the activities of the Bridges to Biomedicine program target pre-transfer student participants. However, internal studies have shown that, after transferring off-track, the second most significant obstacle for minority transfer student success in biomedicine at TxState is a failure to join academic social support networks (17). Without connection to a community, the students miss out on the collaborative learning that is increasingly important in advanced classes, and they feel overlooked and forgotten amid such a large student body. These all negatively impact academic success and decrease the likelihood of degree completion. For students transferring but not to TxState, Dr. Volk de García will make every effort to connect the student with transfer support at the new institution. To address this obstacle for TxState transfer students, we will provide peer mentoring activities to support retention of the Bridges alumni post-transfer, promoting integration into academic support networks and acclimation to the new campus and program. Upon transfer to TxState, newly-transferred Bridges students will be paired with minority biomedical upperclassmen, the peer mentors for their first year post-transfer. We expect Bridges alumni that are matriculating upperclassmen at TxState to be peer mentors in later years of the program; however, an impediment we expect to face is that we will have no such alumni available in the early program years. Until Bridges alumni are available, we will select minority biomedical upperclassmen with undergraduate research experience. Whether Bridges alumni or not, the peer mentors will be selected for their ability to relate to the transfer students' background, understand their fears, and help them navigate obstacles to success. The peer mentors will initially provide a personalized campus and degree program orientation for their mentored transfer students early in the year and, in conjunction with Dr. Volk de García, will help them identify and take advantage of the myriad student support resources provided by TxState (e.g., Student Learning Assistance Center, Student Support Services, the Collaborative Learning Center). Throughout the first year after transfer, the peer mentors will have frequent "check-in" face-to-face meetings (at least 1 hr/wk) with the transfer students, in addition to near-daily contact through social media (e.g., Facebook, texting). These mentoring relationships will be closely monitored by Dr. Volk de García to ensure the mentorship is working to help Bridges students to adjust to the different college environment and the rigorous upper-level courses and academic program. Peer mentors will meet regularly with Dr. Volk de García to discuss concerns and accomplishments of the mentored transfer students. We

expect peer mentors will increase retention of the Bridges students in the biomedical pipeline by helping the transfer students acclimate to the new campus and department, and integrate into academic social support networks that are critical for persistence in biomedical studies; all of these support achievement of **Specific Aim 1**.

Specific Aim 2: ***BRIDGES STUDENTS WILL SHOW MEASURABLE IMPROVEMENT IN ACTUAL AND SELF-PERCEIVED ACADEMIC PREPARATION FOR MATH AND SCIENCE COURSEWORK.***

Activity 3: Engage Bridges students in biomedical research and increase scientific preparation

The data in the literature is clear: Undergraduate research experiences significantly improve persistence in STEM, particularly for minority students (16). As an example of the level of impact such undergraduate research can provide, one recent analysis found that minority undergraduate researchers were 17% more likely to persist in STEM than otherwise-comparable minority students who had not participated in research[9]. In keeping with all existing recommendations for increasing minority representation in biomedicine, we propose to provide extended research experiences for each Bridges student.

Since the Bridges students are doing research so early in their careers and have not had extensive science coursework, we expect them to find the research experiences challenging. Challenging the students will help them to apply developing critical thinking skills to acquire the information to understand their experiments and their projects, and will strongly support increased science self-efficacy and science identity (**Specific Aim 2**). However, "challenging" could easily become "overwhelming," leaving the student with *lower* self-efficacy. To prevent these early-career students from becoming overwhelmed, we will place them in pairs for their research experiences, in which they work together on a project. Several faculty involved in the *B2BP* have observed this innovative team project approach for early undergraduate research improves several outcomes when compared to individual projects, including increased pace of research (important for a 10-week experience), reduced "learning curve" for lab techniques, improved understanding of the experimental rationale, and strongly-improved sense of science self-efficacy. This intimate collaboration will also help the Bridges students form academic support networks that will likely extend far beyond the research experience, acting as valuable aids to science learning (**Specific Aim 2**).

How the student perceives his/her experience during the research period is critical for this activity to positively impact his/her interest in continuing towards a career in science. To quickly identify students who are having difficulties in their research experience, we will require students to maintain an online journal that is accessible only to the student and Dr. Volk de García. The students will be aware of the purpose of the journal, and will be required to make brief entries nightly about their experiences. Dr. Volk de García can quickly review these and speedily intervene to assist the student overcome a rough spot or, if needed, alter mentorships that are not functioning well.

Undergraduate research is effective at increasing persistence because it serves to improve both psychological factors and academic preparation. Psychologically, doing undergraduate research increases engagement and interest in science (**Specific Aim 3**) and sense of science self-efficacy and science identity (**Specific Aim 2**). Academically, research helps to increase preparation for science courses (**Specific Aim 2**) by: building scientific and critical thinking skills; increasing understanding of the process of science; helping to connect abstract concepts to course lessons, making concepts easier to understand and retain; and, by increasing engagement and interest to improve academic performance. It also solidifies their understanding of what biomedical researchers do, helping to shape student career goals and academic trajectories and increasing interest in continuing education towards a biomedical career (**Specific Aim 1**). Moreover, since our student researchers are paid well, it provides employment that augments their academic endeavors instead of distracting from them, indirectly improving academic performance (**Specific Aim 2**). Because it is so effective at building young scientists, the Bridges to Biomedicine program will provide opportunity for research both over the summer and throughout the school year, where it will act in conjunction with students' courses to synergistically increase learning (**Specific Aim 2**). All Bridges research mentors have active biomedical research programs and peer-reviewed publications and usually with undergraduate co-authors.

During the academic year, the students will be working for ~10 hours per week under the supervision of scientists at the Texas Biomedical Research Institute (TBRI) in San Antonio. TBRI is one of the largest independent biomedical research institutions in the US, specializing in genetics, virology, and immunology. It is home to the Southwest National Primate Research Center, and boasts the only privately-owned BSL-4 lab in the US and one of the world's largest computing cluster dedicated to human genetic analysis. Here, the Bridges students will perform undergraduate research supervised by world-class biomedical researchers. Table 6 lists examples of 4 of the TBRI research mentors the Bridges students may benefit from. As directed

in the guidelines, these are merely representative of the scientists that we have selected as potential mentors – we have already had 11 TBRI researchers from the Genetics department accept our invitation to become *B2BP* mentors, enough to provide mentors for all of our Bridges students (because the students will work in pairs). Although the TBRI is a pure research institution, its scientists host numerous high school and undergraduate researchers over the summer, so these researchers are familiar with the mentoring needs of fledgling Bridges students scientists.

During the summer, the Bridges students will be doing undergraduate research under the supervision of TxState biomedical research mentors (examples listed in Table 6). More than 20 TxState faculty from the biology, microbiology, biochemistry, and nutrition programs have been carefully selected as potential Bridges mentors on the basis of the quality and biomedical relevance of their research and their experience mentoring undergraduates. This provides the *B2BP* twice as many mentors as necessary for students working in pairs. With these mentors, students will receive an immersive biomedical research experience, working full-time for 10 weeks over the summer. Moreover, the Bridges students will be part of an undergraduate research community on campus that also includes students participating in and NSF supported *Chemistry Molecular Innovation and Entrepreneurship* (CheMIE) REU program *(Dr. Linette Watkins, PI)*. Alongside the 12 REU students, the Bridges students will participate in weekly research skills and career development workshops (including such topics as: keeping a lab research notebook; attending a professional meeting; writing to share research results; preparing for oral and poster presentations; applying for graduate school; biomedical career paths; and, multiple workshops on research ethics– see RCR section, below) and will participate in community-building social activities in the San Marcos area (e.g., science movie nights in the dorms, tubing in the nearby Guadalupe River). Since being an integral part of this science community is expected to strongly support an increased sense of science identity and lead to improved science self-efficacy (**Specific Aim 2**), we will additionally foster community development among these undergraduate researchers through housing together on-campus.

Separate from the science, the personal connection to the mentoring scientist is additionally valuable as a resource for career or academic advice. In the case of a minority mentor, students can see that there are scientists that look like them, possibly improving the students' sense of science self-efficacy and science identity (**Specific Aim 2**). A number of Bridges mentors at both TxState and TBRI are minorities that will be valuable role models for the Bridges students.

In addition to informal presentations during the research experience, students will have the opportunity to present their research results at undergraduate research symposiums held at least annually at SAC. Moreover, since we expect our students to be invited to present at regional professional meetings, we have budgeted to provide travel funds for each student to travel annually to regional professional meetings. These opportunities to present the science they performed and to be treated as scientists are expected to significantly increase their sense of science self-efficacy (**Specific Aim 2**). We expect the research experiences will increase student understanding of what biomedical scientists do and the relevance of such research (**Specific Aim 3**), increasing their likelihood of continuing biomedical education (**Specific Aim 1**) and entering a biomedical research career.

This activity requires substantial human resources, in the form of research mentors; we have identified more than enough research mentors, and they have lab space and active biomedical research projects. The undergraduate researchers will be paid for their work, and mentors should be reimbursed for the cost of the research materials used; funds for both are provided for in the budget. The Bridges students require summer room and board, which will be covered as a match from TxState. The annual research symposium will be hosted by SAC.

Although we feel we have carefully designed the activity to minimize problems, we anticipate that, with 10 pairs of Bridges student researchers, we may encounter occasional difficulties finding TxState summer mentors with space. Even though we have recruited and selected more than twice the number of necessary mentors, TxState science faculty have increasingly full labs, and their summer salaries and activities can be unpredictable, so we may find that we are short on summer mentors at TxState for some summer. In the unexpected event that we ever do not have enough TxState mentors for all of our Bridges research teams, we have the option to use academic-year research mentors at TBRI for the summer, as well. We would ensure that such students would continue to participate in the weekly evening workshops and activities on-campus, and otherwise interact with the TxState undergraduate research community regularly. Additionally, the Bridges students are likely welcome at a number of research labs at UTHSCSA, with whom TxState is partnered for an anticipated doctoral bridges grant. We are absolutely certain that we can provide extensive undergraduate research experience for all of Bridges students, even if we encounter minor difficulties.

Activity 4: Increase student preparation for academic success

Our self-assessment identified that biomedical students were often inadequately-prepared for success in math and science courses, which has an obvious negative impact on persistence in biomedicine. To support study skills development and increase science/math content mastery, we propose the multi-faceted approach outlined below:

(A) We will foster academic skills development though workshops and providing online resources. Both SAC and NVC have recently increased institutional support to enhance mastery of science study skills and knowledge (Table 5). We will encourage awareness and use of these valuable resources for Bridges students. In particular, MESA (Mathematics, Engineering, and Science Achievement) is a national program dedicated to preparing disadvantaged student populations for studying STEM. Analisa Garza, the director of the MESA site at SAC, has broad training and experience providing academic support and development workshops targeting minority and first-generation community college students in STEM. Ms. Garza will develop and offer academic support workshops (e.g., effectively studying science, quality note-taking in science classes, time management to balance research and studying, searching for and reading scientific literature) specifically for Bridges to Biomedicine students. The other institutional support centers provide access to online resources for both study skills and science and math content, which we will advertise and encourage use of for Bridges students. Developing students' study skills and providing supplemental resources will improve their abilities to master science and math content.

(B) We will facilitate collaborative learning by providing space for study groups, and explicitly encouraging it. A recent analysis indicated that students who studied with other students had higher rates of persistence (up to 27% increase in frequent group-studiers compared to never group-studiers)(9). We will strongly encourage the use of study groups among the Bridges students, making study spaces available through science study centers (described above) to support such collaborative learning. Besides increasing persistence, the peer academic support developed through study groups has been shown to provide a wide variety of valuable benefits that also increase content mastery in STEM and biomedicine, particularly for community-college students (18).

(C) We will provide face-to-face and online tutoring, and will closely monitor academic performance of Bridges students, requiring tutoring as needed. Face-to-face tutoring services are offered through the academic support resources, and we will ensure the Bridges students are familiar with their service schedule. To supplement tutoring offered institutionally, we will also purchase access for virtual, individual tutoring through the online service SmartThinking. SmartThinking provides quality tutoring in a variety of critical disciplines (math, biology, chemistry, English, et al.) through trained advanced-degree holders. Anecdotal evidence from discussion with students who have used such services indicates that the quality of such academic support is fairly high. The benefit of this supplemental tutoring is that it increases the students' access to support, providing service wherever the student is studying (provided there is internet access) and substantially extending the hours students can get help relative to face-to-face tutoring (e.g., math tutoring is available 24 hours a day, and biology tutoring is often available until 2 am). Besides optional tutoring, the SAC and NVC program coordinators (Dr. Madappat and Dr. Nair) will increase persistence by closely monitoring academic progress and performance of Bridges students in science and math courses, and requiring tutoring when necessary. The monitoring will be performed through a combination of weekly emails with individual Bridges students and requiring Bridges students to promptly report all grades and scores on an electronic spreadsheet shared between the program coordinator and the individual student. Close monitoring of academic progress will permit us to intervene early for struggling Bridges students, providing the best chance for keeping students on-track.

(D) We will improve student learning in science institutionally by providing support for science faculty to adopt pedagogical best-practices through travel support for meetings that focus on teaching/learning in the sciences, and through summer release time to permit course renovation. It is widely recognized that pedagogical strategies can have a substantial impact on the engagement of biomedical students with course content and on content retention (19, 20). Examples of pedagogical strategies shown to improve minority student mastery of science and math content include problem-based learning, POGIL, the 5E model, and other active-learning strategies. Despite the evidence supporting its utility, understanding how to revise the teaching strategies for a course is often bewildering for faculty, interfering with course renovation. To assist science faculty interested in improving their teaching effectiveness, we will offer travel support to SAC and NVC science faculty for attendance at meetings focused on implementing accepted pedagogical best-practices in their science classes. These faculty will

then be prepared to renovate their science courses to improve teaching effectiveness and student engagement, with considerable impacts in student science learning institutionally.

However, even with a clear plan, pedagogical revision of a course is a time-intensive activity. Multiple published guidelines for encouraging implementation of pedagogical best-practices recommend supporting faculty by providing time to invest in course revision[21]. To encourage incorporation of pedagogical best-practices in undergraduate science courses, we will provide summer stipends to support SAC and NVC full-time science faculty prepared to revise their teaching strategies accordingly. Individual faculty willing to extensively revise the pedagogy of their course may be awarded a stipend based on the merits of a short proposal submitted to Dr. Volk de García. This proposal should briefly describe the planned pedagogical revision, including: a rationale for the course revision (e.g., "increase student engagement with the content"); an overview of pedagogy/ies planned for implementation; resources to facilitate successful incorporation of pedagogy into class (e.g., a colleague who has revised her own course, membership in a support network, information from a conference previously attended); an estimate of the timeline for the revision activities; and, information about how the revision might impact the department (e.g., the revision of General Chemistry taught by Faculty X could facilitate a future revision of General Chemistry taught by Faculty Y). Up to one summer stipend per year will be awarded for meritorious proposals. Faculty may apply jointly for half of a stipend each, but they must explain how they intend to collaborate. Faculty that previously participated in conferences related to their intended curricular change will have preference in a competitive selection. We expect that the stipend will allow interested science faculty time away from summer teaching to put towards effort-intensive pedagogical renovation of their courses, facilitating improved student learning for all students in their courses.

Collectively, these academic support strategies will improve student academic performance (**Specific Aim 2**), keep students on-track (**Specific Aims 1**), and improve their competitiveness for transfer admission and scholarships. These, combined with an improved sense of science self-efficacy (**Specific Aim 2**), will increase the likelihood that students will transfer to biomedical BS programs with competitive levels of science mastery (**Specific Aim 1**), graduate on time (**Specific Aim 1**), and consider post-graduate study in biomedicine.

The resources necessary for this activity include: institutional academic support centers and their personnel, purchase of access to SmartThinking for student tutoring, and funds for faculty travel and summer stipend/course release to support pedagogical change. The activities described here would be more easily implemented with easy access to a laptop and portable projector, allowing us flexibility in offering academic support workshops. We do not expect implementation of any of these activities to be problematic.

Specific Aim 3: ***WE WILL IMPROVE STUDENT AND FAMILY UNDERSTANDING OF BIOMEDICAL SCIENCE AND HOW IT AFFECTS THEIR LIVES, AND EDUCATE ABOUT THE PATHWAYS TO AND BENEFITS OF GOING INTO A CAREER IN BIOMEDICAL RESEARCH.***

Activity 5: Increase interest in biomedicine by showing its relevance

Our self-assessment identified that students lack appreciation of the value of continuing biomedical education, as well as of the relevance of biomedical research. This is an obstacle to persistence, because students want to work towards a career path through which they can "make a difference"(8). If they cannot clearly see the likely positive impact of their career path on their communities or society, they often change academic trajectories (9), failing to persist in biomedicine; this is particularly true for URM students.

To address this obstacle and improve student understanding of the relevance of biomedical research institutionally, we propose renovating an existing sociology general education core curriculum course, "Social Problems," so that it includes an emphasis on health disparities. Concurrent with the course, the Bridges program will offer a public seminar series featuring presentations by local and regional minority health/health disparities researchers who use biomedical approaches. The seminar series will be promoted in the sociology course, and the Bridges students will be required to both enroll in the renovated course and attend each seminar. We expect this innovative course and seminar series will increase both student awareness of health disparities and student interest in studying minority health/health disparities. Moreover, by using health disparities as an example of a societal problem that can be studied through biomedical research, we expect that students will better understanding that biomedical research has concrete relevance to their communities, and will have heightened interest in entering or persisting in biomedicine (**Specific Aim 3**), leading to improved institutional persistence to complete a BS degree and perhaps recruiting new biomedical majors.

We expect this course renovation to occur in Summer/Fall 2013, and will be first offered to Bridges and other NVC and SAC students in Spring 2014. This renovation will initially impact only sections taught by full-

time NVC and SAC faculty, but we anticipate that eventually all sections of the course will reflect this emphasis. We have consulted with the sociology faculty at both colleges, and they are enthusiastic about our proposed revision, but worry they don't clearly understand the relationship between biomedicine and health disparities research. To ensure they are provided enough time to prepare for this course revision, sociology faculty will be provided with 2 stipends to cover a summer course release (1 each for NVC and SAC). Additionally, the Bridges program will provide funds to cover other small expenses to facilitate this cross-institutional course renovation (e.g., reference texts, purchase access to electronic resources). We expect that the faculty will be able to use their release time to take advantage of resources for online courses such as that offered by the Health Disparities Education, Awareness, Research & Training Consortium (HDEART), and to consult with health disparities researchers and educators from such local groups as Institute for Health Disparities Research at UTSA and the Institute for Health Promotion Research at UTHSCSA.

For the affiliated seminar series, we plan to offer 3-5 seminars over the course of the semester. We will identify and invite local and regional minority health/health disparities researchers who use biomedical approaches to present about their research. Examples of such speakers include: Dr. John Blangero from TBRI, who is working to understand the genetic components of heart disease in Mexican-Americans, for whom this is a leading cause of death; Dr. Rector Arya from UTHSCSA, who is looking for molecular precursors for Type-II diabetes and Metabolic Syndrome, which is an epidemic among Mexican-American children in San Antonio; and, Dr. David Lopez at the UT-School of Public Health, who studies pathways that contribute to cancer-related racial/ethnic and health disparities. The speakers will be advised to make their presentations appropriate for freshmen biomedical majors and relevant to minority health and/or health disparities. We will also ask them to spend 5-10 min talking about why and how they entered biomedical research. Presenters from graduate schools will be encouraged to bring recruiting materials. The seminars will be recorded and converted for access and viewing online through Biology University, a website maintained by SAC to provide access to online biology resources.

In San Antonio, the disparity in health outcomes among different populations is stark, and we expect that this approach will be highly effective to increase the perceived relevance of biomedical research to the lives of the students in the course (**Specific Aim 3**), inspiring them to consider biomedicine as a way to "make a difference" for their communities. With an increased appreciation of the value of biomedical research for society, we expect that students will be more inclined to persist in biomedicine or switch to biomedical majors.

To implement this activity, we will need to provide resources to permit the sociology faculty at SAC and NVC renovate their course. For the seminar series, we will need to recruit seminar speakers. Additionally, we will need a seminar room at SAC or NVC (with a portable projector and laptop, it need not be technology-enabled), and a camera to capture the seminar. We anticipate that the initial implementation of the revised course sections may be slow – perhaps even only one revised section in the first semester – but this should not impact our ability to achieve our specific aims.

Activity 6: Increase family support for continuing biomedical studies

Research has shown that familial support is an important determinant for minority persistence in STEM fields, including biomedicine (16), and that lack of family support is associated with lower persistence. Anecdotal evidence from discussions with our students helped us to confirm that this finding is a relevant obstacle to persistence for our student population; the NIH also reported that Bridges students nationally are more likely to rely on family for financial support[7].

To increase family understanding of and support for careers in biomedicine, we will invite families of Bridges students to attend bi-annual events featuring presentations by biomedical researchers in minority health. These presentations will target a lay audience with the intent to improve understanding of how biomedical research impacts their lives and communities and to explain the educational path of a community college student interested in becoming a biomedical researcher, and they would be recorded for online access. They will feature accessible information about the relevance of biomedical research to their communities and families, and additionally will present information about the advantages of continuing beyond an Associate's in biomedicine, including salary comparisons for careers associated with an AS degree to careers with more advanced degrees, and financial aspects of continuing biomedical studies. Particularly the latter provides the opening to explicitly state that students do not accrue further loans when enrolled in a typical biomedical PhD program; their tuition is paid, and students are paid a stipend for their PhD research activities. This is not widely known, and can easily make the difference between students choosing medical/health professional school or graduate school. Moreover, TxState is partnering with UTHSCSA to apply for doctoral Bridges sister program. If funded, the STBD program will provide opportunities for a fully-funded Master's degree from Texas State and a direct line to entry to a doctoral

program at the UTHSCSA. Furthermore, *B2BP* alumni are likely to be competitive applicants for early admission to the doctoral Bridges program, which would also pay for the final year of their baccalaureate.

In addition to the biomedical scientists, we will have presentations by *promotores* – peers of our students' parents who can address the parents' questions and concerns from a shared perspective. These *promotores* would be either minorities who recently entered biomedical research themselves through a similar pathway as the Bridges students, or parents of such advanced biomedical research students. The *promotores* would be able to address parental concerns about educational cost, length of time for educational pathway, financial aid, and value to the community.

To identify the *promotores*, Dr. Walter and Dr. Volk de García will take advantage of our network of connections to biomedical graduate programs at UTHSCSA, where we will find minority graduate and/or faculty researchers that can either be *promotores* themselves or can connect us with their parents, who may more readily understand the concerns of our Bridges parents. Also, Dr. Volk de García knows several minority students with backgrounds very similar to the Bridges students who have gone on to graduate school in biomedical programs through her teaching experience at Our Lady of the Lake University. In addition, we may look through reports to identify minority students from Alamo Colleges who went on to a doctoral program. Since the density of minority scientists is much higher than average in San Antonio, we don't anticipate that it will be a problem to recruit at least one *promotor* in the early years. As the Bridges alumni continue their schooling, we expect that some will get their PhD; these students will be very strong *promotores* for our program, once available.

We anticipate that these innovative family events featuring biomedical research presentations and the *promotores* will help Bridges student families understand the value of continuing biomedical education beyond the Associate's level, increasing family encouragement to pursue more advanced studies in biomedicine (**Specific Aim 3**) and leading to increased retention of the Bridges students in the biomedical education pipeline.

To offer this activity, we require space from SAC or NVC in which to hold the event biannually. We will also need to recruit *promotores* and a biomedical health disparities researcher (preferably bilingual in Spanish and English), and to provide technology for a presentation and recording. We will need food and refreshments for the events (covered by TxState, as described in the letter of support). Additionally, we would want to consider having bilingual materials (invitations, programs, etc) for the event. We anticipate no difficulties with implementing this activity.

Research Development workshop topics include: Interpreting figures and creating figures from scientific data; what to expect in the research experience; lab math; Keeping Records: Maintaining a research notebook; Keeping Records: Using Mendeley and Zotero to manage references from literature and the internet; effective literature searching; reading primary literature (multiple); research ethics (multiple); Telling a story in science: Communicating your science in presentation, poster, and paper forms (multiple)

E-3) Proposed schedule for Bridges to Biomedicine program

A brief summary of the proposed schedule for the *B2BP* activities in Year 1 is as follows:

Summer 2013	• Begin discussion about revising pre-transfer scheduled coursework and recommendations; • begin to plan academic development workshops; • begin renovation of sociology course to incorporate health disparities content; • encourage science faculty to consider using support for pedagogy changes; • begin to gather baseline data for evaluation
Aug to Sept	• strong push for recruiting; • gather Bridges student applications
Sept to Oct	• review and loosely score applications, and interview students as necessary; • select Year 1 Bridges student cohort
Oct to winter break	• begin academic development workshops, and encourage use of academic support resources (as described in text) • Get baseline student data for evaluation • introduce students to possible spring research mentors, and begin basic research development workshops (see topic list below); students know their research teammate and mentor by break • closely monitor students' academic progress, and intervene if necessary

	• students meet with program coordinators to map out personalized transfer plan, and prepare for spring registration • Review final grades, and create provisional Bridges contract with specific goals and activities to return student to eligibility • Sociology course is renovated and ready to launch
Jan –May	• Students begin research 10 hrs per week in TBRI labs; Dr. Volk de García monitors their experience to ensure successful placement • Students take renovated Sociology course and attend Biomed Health Disparities seminars • For any students planning a fall transfer, facilitate transfer process to ensure fall registration. Connect these students with transfer advisors at transfer school. • Visit TxState; students meet with TxState upperclassmen and grad students • Students learn about TxState labs and mentors for summer research • First family event • Review final grades, and create provisional Bridges contract with specific goals and activities to return student to eligibility
Jun 1 -Aug	• Students do full-time summer research, with weekly research development workshops • Conclude discussion about revising pre-transfer scheduled coursework and recommendations; move to implement revised recommendations for Fall • Undergraduate Research Symposium • Second Family Event

E4) Monitoring Progress and Retention of Bridges Students During and After Participation

We will be able to easily monitor Bridges student progress for active participants, since we have built it into our program activities (NVC and SAC program coordinators will monitor academic performance). A student who is struggling, especially in math and science courses, will be required to attend tutoring. We will also meet with the student to attempt to clearly identify the problem to facilitate resolution. We may also reduce the student's research hours (in consultation with the research mentor) to ensure the student has enough time to focus on academic success.

To manage academic performance problems that are not resolved over the semester, we will use a provisional retention contract. Students will be required to maintain a GPA above 2.5 to stay in the program. If a student fails to meet this criterion, the student may continue to participate, but must help develop and sign a provisional retention contract with specific goals and activities to return the student to eligibility by the end of the following semester. If a student does not return to eligibility, he may not remain in the program except under extraordinary circumstances (e.g., a major personal distraction interfered with fulfilling the requirements of the provisional contract). Because personal catastrophes are sadly common in our target student population, students may step out of participating in the program for up to a year, then return to continue with another cohort. We wish to encourage this as an appropriate way to protect academic performance and progress while the student manages the crisis.

The Department of Chemistry and Biochemistry has needed to track widespread participants in undergraduate research programs before the Bridges program (e.g., for the CheMIE REU and the PREM program); we have developed a framework to manage this. To track Bridges alumni after participation, we will create a Bridges program registry with redundant contact methods, including at least 1 non-school email and phone number. Through Facebook, students will also be asked to subscribe to the TxState Undergraduate Research page. We will then connect with the students at least annually, requesting any updates in: contact information; enrollment or employment; major/degree completed or in progress; or, intended career path. In addition to student updates and communication, we will annually request information about each student from the National Student Clearinghouse to ascertain educational progress. Furthermore, we expect that social connections that develop over the two years of participation will lead to extending networks from which we can obtain updated information. Since we expect to be in contact at least once per semester after the students transfer, we should be able to keep track of any changes in contact info or progress.

F) Plan for Responsible Conduct of Research

Our proposed plan for teaching responsible conduct of research (RCR) builds upon professional development workshops that are already developed for and offered to the CheMIE REU undergraduate researchers annually. These RCR workshops have been developed and are presented by Dr. Gloria Thomas, Assistant Professor of Chemistry at Xavier University of Louisiana.

Dr. Thomas studies bioanalytical applications of electrophoresis and microdevice technology, but, as a minority scientist, Dr. Thomas also has a deep interest in broadening participation of minorities in science. She sits on the Minority Affairs committee of the American Society for Biochemistry and Molecular Biology, and has been active in the National Organization for the Professional Advancement of Black Chemists and Chemical Engineers (NOBCChE) as a member of the Executive Board (2005–2009). Dr. Thomas has received several recognitions for her energetic contributions to improve minority success in science.

As a PI for an REU of her own, Dr. Thomas developed an RCR workshop series rooted in guidance from "Guidelines for the Teaching of Professional Ethics"[22] and enhanced through training through the University of Pittsburgh's Survival Skills and Ethics train-the-trainers program. Her workshops present both a broad overview of research and professional ethics as relates to science research as well as a more-in-depth evaluation of selected case-studies that students discuss with each other and with their mentors. Dr. Thomas has facilitated RCR training for HHMI and La-STEM summer programs at Louisiana State University, the Summer Research Academy of the Xavier/Tulane University Center for Bioenvironmental Research, and several REU programs. A link to a presentation describing her approach to teaching RCR to undergraduates is provided in (23).

Content in Dr. Thomas' RCR workshops covers the majority of topics specified in NIH NOT-OD-10-019; the remaining topics will be covered through informal training and topic-specific training sessions during the academic year. Lab safety is covered as a priority in the first week of research by mentoring faculty. The summer RCR workshops typically last 4-5 hours total. In accordance with NIH NOT-OD-10-019, R25 programs may justifiably use fewer hours of RCR training, reflecting the relatively short-term nature of such training programs. The proposed training is an appropriate duration for the length of research experience offered (equivalent to ~17.5 40-hour research weeks per year). In addition to these formal RCR workshops, all research mentors will help students understand RCR as it applies to their specific projects through informal interactions over the course of their research experiences, and Dr. Volk de García will use case-studies and other RCR teaching materials from the National Ethics Center to further explore RCR topics in workshops over the academic year.

Our proposed RCR plan is consistent with the recommendations outlined in NIH NOT-OD-10-019 regarding: **format** (face-to-face); **content** (Dr. Thomas covers all of the recommended topics in her RCR workshops); **faculty participation** (faculty mentors will supplement the formal RCR workshops with informal, project-relevant RCR discussions with students); and, **duration** (the summer workshops supplemented with further periodic training are appropriate for the length of our proposed research experience).

G) Evaluation of Bridges to Biomedicine program effectiveness

Rockman et al, a San Francisco-based research and evaluation group, will conduct the external evaluation of the Bridges to Biomedicine project. The lead evaluator, Kristin Bass, has a PhD in Education and Psychology from the University of Michigan and a certificate in experimental design and statistical analysis from the US Department of Education's Institute for Education Sciences. She has considerable experience in evaluation, having been the evaluator on four NIH Science Education Partnership Award (SEPA) projects and dozens of other federally- and privately-funded interventions.

This evaluation is designed to track the accomplishment of the project's specific aims by collecting data based on baseline, short-term and long-term metrics (Table 7). This data will include participant information such as: numbers served and retained throughout the program; demographic characteristics; and educational levels attained. As seen in the table below, evaluators will compare Bridges participants to matched control students for relevant specific aims, thereby documenting the effectiveness of the intervention. The evaluation will also utilize formative data from participants (e.g., surveys, focus groups) to direct program improvements.

Whenever possible, evaluators will use existing institutional data or collect information using published instruments validated for content and populations being studied. Alternatively, evaluators will develop project-specific instruments using a systematic, iterative process of construct identification, question creation, and instrument review or validation (24).

Analysis and reporting.

Evaluators will analyze the data using quantitative and qualitative methods as appropriate. In the early years of the project, evaluators will report descriptive statistics that identify trends in data. By the fourth and fifth year, the project will have amassed a large enough number of participants to justify inferential analyses (e.g., t-tests, analyses of covariance). Qualitative analysis will be performed using the Grounded Theory method, a systematic methodology in the social sciences involving the discovery of theory through the analysis of non-numerical data (25). The Grounded Theory method has become the paradigm of choice for

qualitative research and analysis, in that it provides a set of procedures and a means of generating a theory that is reflective of the data.

Evaluators will prepare annual reports for NIH and project PIs, and will generate periodic top-line reports of key findings to facilitate ongoing program improvement.

Table 7. **Summary of data collection measures to assess *B2BP* implementation and outcomes.**

Project Component	***Measure and Methods***
Quality of Implementation	
Perceptions of program strengths and areas for improvement	Annual or semi-annual program satisfaction surveys; Student and family focus groups in year two.
Achieve Specific Aims	
Specific Aim 1: Improve biomedical transfer rates and biomedical BS degree completion • Transfer rates for biomedical majors will increase by 5% within 4 yrs of implementation • Average time to biomedical BS completion will decrease within 5 years • Bridges students will have an 80% transfer rate. 70% of Bridges transfer students will complete their degree within 4 yrs of transfer..	Short-term tracking of institutional data to measure transfer rates and the number of students on-track to complete biomedical BS in five years. The latter outcome is defined by completion of key program requirements (e.g., courses that are prerequisites to the major). Analyses will track Bridges students, while also looking at trends in the student population at large. Specifically, evaluators will compare demographically matched pairs of Bridges/ non-Bridges participants.
Specific Aim 2: Improve academic performance and science self-efficacy • Math and Science GPAs will increase for Bridges students • Science self-efficacy for Bridges students will increase within 1 yr of participation	Collection of institutional GPA data if possible (e.g., data gathered through the registrar's office); if this is not possible, evaluators will use self-reported GPAs. Identification of non-Bridges controls using institutional data. Students will be matched on demographics such as age, race/ethnicity and baseline math/science GPA.
	Pre- and post-program self-efficacy surveys. Evaluators will consult Bandura's guide to constructing self-efficacy scales (26) to generate program-specific items.
Specific Aim 3: Improve student and family understanding of biomedical research and its relevance • Students in the health disparities course will show an increased interest in biomedical careers • Families of Bridges students will increase their support for continuing studies towards a biomedical career	Pre- and post-course surveys, containing items about course satisfaction and career aspirations.
	Retrospective, end-of-event surveys (27) assessing the perceived impact of the activity on family members' understanding of (a) the value and relevance of biomedical research to their lives; (b) the pathways to biomedical careers; and (c) their desire to have their family members pursue such careers.

Table 1. Minority enrollment, transfer, and baccalaureate completion at each of the *Bridges to Biomedicine* partnering institutions.

	Annual enrollment in biomedical majors				Biomedical transfer to baccalaureate programs				Biomedical baccalaureate degree completion			
SAC	**all SAC biomed students (A)**	**1127**	**Minority fraction (B)**	**58%**	**Annual biomed transfer to BS/BA programs**	**Est. Minority biomed transfers (C)**	**105**	**18% of minority biomed students transfer into BS/BA programs (C)**	**Annual biomed BS/BA degrees complete in 6 yrs for SAC transfer students**	**Est. Minority Degrees (E)**	**45**	**43% of minority STEM transfers to TxState complete in 6 yrs**
			Hispanic	*50%*		*Hispanic*		**13% of Hispanic** STEM students transfer (C)		Est. Non-Minority Degrees (E)	75	71% of non-minority STEM transfers complete
			African-American	*6%*		*African-American*		**19% of African-Am** STEM students transfer (C)				
			Native American & Alaskan Native	*>1%*		*Native American & Alaskan Native*		**19% of Native Am/Alaskan** STEM students (C)				
						Overall biomed transfers (D)	210	22% of all biomed SAC students transfer (C)		Est. Overall (E)	120	57% of all STEM transfers complete
NVC	**all NVC biomed students (A)**	**1219**	**Minority fraction (B)**	**58%**	**Annual biomed transfer to BS/BA programs**	**Est. Minority biomed transfers (C)**	**179**	**29% of minority biomed students transfer into BS/BA programs (C)**	**Annual biomed BS/BA degrees complete in 6 yrs for NVC transfer students (E)**	**Est. Minority Degrees (E)**	**77**	**43% of minority STEM transfers to TxState complete in 6 yrs**
			Hispanic	*50%*		*Hispanic*		**23% of Hispanic** STEM students transfer (C)		Est. Non-Minority Degrees (E)	112	71% of non-minority STEM transfers complete
			African-American	*6%*		*African-American*		**24% of African-Am** STEM students transfer (C)				
			Native American & Alaskan Native	*>1%*		*Native American & Alaskan Native*		**43% of Native Am/Alaskan** STEM students (C)				
						Overall biomed transfers (D)	337	31% of all biomed NVC students transfer (C)		Est. Overall (E)	189	57% of all STEM transfers complete
Tx State	**all TxState biomed students (F)**	**1837**	**Minority fraction**	**39%**	**Annual biomed transfer to BS/BA programs**	**Not applicable**			**Annual biomed BS/BA degrees complete in 6 yrs for Tx State students (F)**	**Minority Degrees**	**41**	**40%**
			Hispanic	*26%*						Non-Minority Degrees	105	44%
			African-American	*7%*								
			Native American	*>1%*						Overall	146	43%

Abbreviations: "SAC" - San Antonio College; "NVC" - Northwest Vista College; "TxState" - Texas State University-San Marcos; "IR" - Institutional Research department; "THECB" - Texas Higher Education Coordinating Board; "NSC" - National Student Clearinghouse

(A)	*Biomedical enrollment is based on data pulled from a detailed analysis of the **Fall 2010 and Spring 2011 STEM cohorts, provided by IR for Alamo College and based on data from the NSC**. Biomedical majors included: 26.00 (Biol. Sci); 40.00 (Phys. Sci.); 51.10 (Clin/Med Lab Res & Allied Hlth); and 51.11 (Hlth/Med Prep prgms).*
(B)	*These proportions describe the ethnic/racial enrollment of the **2010/11 STEM cohort at each institution** (they happen to be the same). The numbers for specifically the biomedical majors were not available, but are not likely to differ significantly from these. The numbers do not add to 100% because international and "unknown" were excluded.*
(C)	*This is the estimated number and rate of minority biomed transfers to baccalaureate programs (assumed to be biomedical) based on the rate of transfer of the specific ethnic/racial subgroups in the **2010/11 STEM cohort, provided by IR from Alamo Colleges and based on data from NSC,** and applied to the total annual biomed transfers (see (D)). We expect the STEM transfer rates of these subgroups to underestimate the biomedical transfer rate, as the overall STEM transfer rate is about 6% lower than the overall biomed transfer rate.The rate of transfer for minority biomed students as a group was determined algebraically using the proportion of minority students in the transfer cohort and its difference from the proportion of minorities in the whole cohort, and the overall rate of transfer for biomed majors.*
(D)	*This is the average of 4 years of biomedical transfer data. Data from 2008/09 to 2010/11 comes from analysis of **reports from exit cohorts in these years obtained from the THECB** website. Data for students transferring in 2011/12 comes from an analysis of the **2010/11 STEM cohort provided by IR for Alamo Colleges**.*
(E)	*In the absence of any science-focused degree completion data for the Alamo Colleges, we used the **degree completion rates for minority and non-minority STEM transfer students to TxState from Alamo Colleges provided by IR at TxState** to approximate the general completion rates for biomedical transfer students. This data is potentially misleading, as it is based on a cohort of only 14 transfer students, half of whom were minority.*
(F)	*All of the TxState enrollment and completion data is provided by **data from IR for TxState**. Enrollment is based on a 3-yr average from Fall 2010-2012. The number of biomedical degrees is based on a 3-yr average of degrees awarded from 2009-2011. Six-yr rate of degree completion is based on a 3-yr average from the Fall 2003-2005 cohorts of first-time, full-time freshmen. Unknown and international were excluded from both minority and non-minority categories, but included in overall. Biomedical majors included Biology, Microbiology, General Physiology, Zoology, Biochemistry, Chemistry, and Pre-Vet.*

Table 4. Comparison of biomedical degree plans at TxState and Alamo Colleges

** these all assume that you enter ready to take College Algebra*

	Texas State BS degree plans (first 2 years)				**Alamo Colleges AS degree plans**							
	Chem-istry	Bio-chem-istry	Micro-biology	Biol-ogy	Chem-istry	Chem Re-search	Pre-Pharm	Bio-tech	Biol-ogy	Pre-Dent	Pre-Med	Pre-Opt
Math												
College Algebra	**X**	**X**	**X**	**X**	**X**	**X**	**X**	(A)	B	B	B	**X**
Pre Calc	**X**	**X**	**X**	**X**	**X**	**X**	**X**	-	-	-	-	**X**
Calc I	**X**	**X**	**X**	**X**	**X**	-	**X**	-	-	-	-	**X**
Calc II	**X**	**X**	**X**	**X**	-	-	-	-	-	-	-	-
Chemistry												
Gen Chem I (majors)	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Gen Chem II	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Ochem I	**X**	**X**	**X**	**X**	**X**	**X**	**X**	-	-	-	-	-
Ochem II	**X**	**X**	**X**	**X**	**X**	-	-	-	-	-	-	-
Biology												
Gen Biol I (for Majors)	*N/A*	**X**	**X**	**X**	*N/A*	*N/A*	-	-	**X**	**X**	**X**	**X**
Gen Biol II	*N/A*	**X**	**X**	**X**	*N/A*	*N/A*	-	-	**X**	**X**	-	**X**
A&P I	*N/A*	*N/A*			*N/A*	*N/A*	-	*N/A*	-	-	**X**	-
A&P II	*N/A*	*N/A*			*N/A*	*N/A*	-	*N/A*	-	-	**X**	-
Physics												
Phys I (no calc)	*N/A*	*N/A*	*(jr yr)*	*(jr yr)*	*N/A*	*N/A*	**X**	-	-	**X**	-	**X**
Phys II (no calc)	*N/A*	*N/A*	*(jr yr)*	*(jr yr)*	*N/A*	*N/A*	-	-	-	-	-	-
Phys I (calc prereq)	**X**	**X**	*N/A*	*N/A*	-	-	-	-	-	-	-	-
Phys II (calc prereq)	**X**	**X**	*N/A*	*N/A*	-	-	-	-	-	-	-	-
Other Sci/Math hours in the first 2 years	-	-	-	-	-	**13** (*C*)	-	**19** (*D*)	**8** (*E*)	**4** (*E*)	**4** (*E*)	-
Gen Ed												
Gen Ed hours (F)	20	10	17	17	29-31	29	29-31	29	29-31	29-31	29-31	29-31
Gen Ed hours in last two years	20-21 (*G*)	19	14	14								

Footnotes:

A	*Does not prepare for progression to pre-calculus*
B	*Algebra is one option among a number of eligible math courses*
C	*None of these courses satisfy direct degree requirements*
D	*4 hours of the 19 are Microbiology, which transfers into degree program*
E	*All additional hours are courses that meet requirements for Biology, Microbiology, and Biochemistry programs*
F	*Excluding Freshman Seminar and Comp I and II courses, which are required of all programs, and excluding Science and Math gen ed.*
G	*These include hours required for minor*

Table 5. Student development and research training programs for biomedical undergraduates, by partner institution.

Texas State University (TxState) – Programs for Biomedical Undergraduates						
Program	**Project Duration (Years): Start and Ending Dates**	**Funding Agency**	**Program Goals**	**Number of Partici-pants**	**Target Audience**	**How does this serve biomedical undergraduates?**
CheMIE: A Chemistry REU on Molecular Innovation and Entrepreneur-ship	2012-2015	NSF	Build a research community at TxState that will provide a supportive research environment for students that would not otherwise be able to actively participate in undergraduate research.	12 per year	Underrepresented minorities ("minorities") and students otherwise unable to participate in undergraduate research who are interested in chemistry, biochemistry, or materials science	Fully 1/3 of the undergraduate research done through this program is biochemical research that directly fosters preparation for and interest in biomedical research careers. Moreover, the establishment of this research community will benefit unaffiliated biomedical undergrad researchers by increasing the academic network and by encouraging the development of resources that benefit all undergraduate biomedical researchers.
Houston-Louis Stokes Alliance for Minority Participation Scholars Program (H-LSAMP)	Started 1999, continuing at least through 2013	NSF	Structured as a community of scholars, H-LSAMP is designed to substantially increase the number of students graduating with baccalaureate degrees in STEM, particularly students from diverse backgrounds.	20 students per year	STEM students with diverse backgrounds	20% of the participants in the program can be biomedical majors. H-LSAMP scholars receive financial support, undergraduate research experience
Collaborative Learning Center			Students from the H-LSAMP Scholars Program offer free walk-in tutoring in the CLC Tutoring Lab covering basic & advanced courses in biochemistry, biology, chemistry, computer science, engineering, math, physics, and technology.	No limit	Any STEM student wanting academic support through collaborative learning.	This is a resource offered through the H-LSAMP program, but open to any interested STEM major (including biomedical majors). Biomed undergrads can benefit from the peer tutoring and other academic support offered through this center.

South Texas Doctoral Bridges (funding pending)	July 2013 through July 2018 (pending)	NIH (pending)	Increase minority student enrollment and academic success in the Biochemistry Master's program at TxState, and increase flow of minority students to biomedical doctoral programs.	1 under-grad	Minority biochemistry/ chemistry/ biology juniors who are very strong academically and have undergraduate research experience	If funded, this program will permit 1 outstanding junior biomedical major accelerated entry into the Biochemistry Master's program at the start of their senior year, paying for student tuition and reducing time to post-graduate degree completion.
Student Undergraduate Research Funding (SURF)	Starting AY 2012-2013	TxState Under-graduate Research Program	This program offers all undergraduate students funding opportunities to enhance their education through faculty-supervised research. This fund will support independent undergraduate research on- and off-campus and require presentation of research results at an undergraduate research conference.	At least 19 per year	Any TxState undergraduate is eligible	Biomedical undergrads can apply for this supplemental funding for either independently-designed research or more traditional research through a biomedical lab program. The participants will also have an opportunity to develop research presentation skills. Additionally, the application is a simplified grant application; learning grant-writing skills will benefit biomedical undergrads.
TRiO/Student Success Services (SSS)	Since sometime in the 1990's	US Dept of Ed.	(1) Increase retention and graduation rates, and (2) foster an institutional climate supportive of success for first-generation college students, low-income students and students with disabilities.	200 per year	Must be first-generation college student OR low-income student OR student with a documented disability	Many biomedical majors will be eligible for support through this program.
Student Learning Assistance Center (SLAC)	n/a	TxState	A multi-faceted academic support program, it provides tutoring services (individual, group, online), supplemental instruction (collaborative group study for specific courses), learning and study skills workshops, and learning specialist consultations.	No limit	All TxState students	Biomedical majors can receive academic support through this center.

Partnership for Research and Education in Materials (PREM)	2012-2017	NSF	The mission is to increase participation by underrepresented groups in materials research. One of the main goals of the TxState PREM Center is to create a "Pipeline to Success in STEM Education," designed to provide opportunities for mentoring and research to students at all levels.	Unspe-cified	especially geared toward the population of underrepresented and underserved students	Biomedical majors may benefit from the general STEM educational outreach activities offered through this program.
San Antonio College (SAC) – Programs for Biomedical Undergraduates						
Program	**Project Duration (Years): Start and Ending Dates**	**Funding Agency**	**Program Goals**	**Number of Partici-pants**	**Target Audience**	**How does this serve biomedical undergraduates?**
Advancing Community College Engineering and Science Opportunities (ACCESO)	Start 10/1/2010, end 9/30/2013 (but renewal pending)	US Dept of Ed., through the Minority Science and Engineer-ing Improve-ment Program (MSEIP)	Increase the number of underrepresented minority students, especially minority women, in Bexar County who complete credits and/or associate degrees toward transfer to 4-year programs in science and engineering and obtain science/engineering bachelor's degrees.	No limit	Underrepresented minority students, especially minority women, in Bexar County	This program serves undergraduates through establishing the MESA program (see below) and providing professional development to SAC faculty in science and engineering to implement 'best practices,' improve curricula, and pilot learning communities/ new delivery methods/new course content, improving biomedical student learning.
Math, Engineering, and Science Achievement (MESA) Community College Diversity in Engineering Centers program	Start 10/1/2010, end 9/30/2013 (but renewal pending)	US Dept of Ed. (establishe d through MSEIP-ACCESO and Title V, maintained through institutional funds)	Support SAC students pursuing degrees in the STEM disciplines, and prepare them to continue their education in baccalaureate and graduate studies by providing helpful resources for academic success and degree-planning, and by providing guidance in seeking scholarships, internships, and transferring to 4-year programs.	200+	Low-income and educationally-disadvantaged STEM students	The MESA Center provides activities to increase persistence for biomedical students, including: learning communities; supplemental instruction; tutoring; mentoring; field trips; connection to internships and/or employment; and, support minority science clubs (e.g., MAES/ SACNAS/ SWE).

Adelante Texas, a Title V Cooperative Project	Started 10/1/2011, ending 10/1/2015	US Dept of Ed. (through Title V)	This is a partnership between SAC and Sul Ross State University (SRSU) to increase enrollment, retention, transfer and graduation in the sciences at both campuses. The grant seeks to increase the number of students declaring STEM majors at SAC and matriculate them through to corresponding graduate programs at SRSU. The project will also work to increase the availability and quality of distance coursework in the sciences so that co-enrolled students can take courses toward their degree at either campus, thereby decreasing time to graduation.	No limit	Hispanic and low-income science students at SAC	Biomedical students will benefit from this program through increased access to upper-level courses through distance education, helping to improve likelihood of transfer, keep students on-track, and increase persistence. Also, there will be a clearer pathway to transfer (to SRSU).
Project CIMA (pending funding)	2013 to 2015 (pending funding)	NSF, through LSAMP B2B program	Improve recruitment and retention of STEM majors, deepen and broaden student engagement and learning in STEM, and facilitate and improve the transfer experience for students transferring to universities.	180	STEM students in SAC and NVC, particularly those with diverse backgrounds	Biomedical majors will benefit from this STEM-targeting program through improved academic performance, improved persistence, and improved transfer experience.
T-STEM Challenge Scholarship Program	Started 6/1/2012, ends 2/28/2014	Texas Higher Education Coordina-ting Board	With NVC, increase the number of graduating students in STEM, provide up to $5000 in scholarships to STEM students, and increase the number of graduates working in STEM fields.	72 at SAC in first year	SAC STEM students	Biomedical majors will benefit from the efforts to improve progress towards graduation in STEM, and will benefit from eligibility for scholarship funds.

Northwest Vista college (NVC) – Programs for Biomedical Undergraduates						
Program	**Project Duration (Years): Start and Ending Dates**	**Funding Agency**	**Program Goals**	**Number of Partici-pants**	**Target Audience**	**How does this serve biomedical undergraduates?**
Project INNOVISTA, a Title V HSI program	Started 10/1/2011, ending 10/1/2015	US Dept of Ed. (through Title V)	This program is designed to overcome the significant obstacles to student access, success and persistence through expanding and improving online learning opportunities, advancing students through developmental education, and creating a quality freshman experience through development of learning communities and improved academic advising.	No limit	Hispanic and low-income students at NVC	Biomedical students will benefit from this program through more efficient progress through developmental education and into degree programs, and improved early advising.
Math-Intensive Majors Scholarship (MIMS) project, an S-STEM program	6/2/2011 to 5/31/2015	NSF (through S-STEM)	Increase the number of underserved and financially disadvantaged student graduates in STEM through scholarship assistance to STEM majors	25 per year	underserved and financially disadvantaged STEM students	Biomedical majors are included among the Math-Intensive Majors for this scholarship, and thus are eligible for support.
T-STEM Challenge Scholarship Program	Started 6/1/2012, ends 2/28/2014	Texas Higher Education Coordina-ting Board	With SAC. increase the number of graduating students in STEM, provide up to $5000 in scholarships to STEM students, and increase the number of graduates working in STEM fields.	79 for NVC in the first year	NVC STEM students	Biomedical majors will benefit from the efforts to improve progress towards graduation in STEM, and will benefit from eligibility for scholarship funds.
Partnership for Research and Education in Materials (PREM)	2009-2013	NSF	In partnership with Univ Texas at San Antonio (UTSA), Univ Texas Health Science Center-San Antonio (UTHSCSA), and Northwestern University, NVC receives opportunities for undergraduate research in nanomedical technologies at UTSA.	variable	All NVC students	Biomedical students will receive opportunities for undergraduate research in nanomedical technologies at UTSA, increasing interest in biomedical careers and improving persistence.

Project CIMA (pending funding)	2013 to 2015 (pending funding)	NSF, through LSAMP B2B program	Improve recruitment and retention of STEM majors, deepen and broaden student engagement and learning in STEM, and facilitate and improve the transfer experience for students transferring to universities.	180	STEM students in SAC and NVC, particularly those with diverse backgrounds	Biomedical majors will benefit from this STEM-targeting program through improved academic performance, improved persistence, and improved transfer experience.
Math and Science Advocacy Center (MSAC)	n/a	NVC	This is a learning environment dedicated to helping math and science students with: content mastery; time management; scheduling problems; drop counseling; and, study access to reference models for science labs.	No limit	Any NVC math or science student	The MSAC provides resources to increase persistence for biomedical students, including: supplemental instruction and tutoring; mentoring; assisting with course scheduling issues; and general study skills support. Biomed undergrads can benefit from the peer tutoring and other academic support offered through this center.

Table 6. Summary of 10 Representative Research Mentors at TxState(*) and TBRI(†)

Faculty Name	Insti-tution	Department	Research Area	Current Research Funding *(Dates, Role, Source, Title)*
Raul A. Bastarrachea, MD	TBRI	Genetics	complex metabolic traits, with a major focus in the areas of cardiovascular disease, obesity, and type 2 diabetes	2008-2013 (Co-investigator) **NIH-NHLBI**, "Genetics of Atherosclerosis in Mexican Americans - Project 3: Identification of Obesity-Related QTLs"; 2008-2013 (Co-investigator) **NIH-NHLBI**, "Diet and Genotype in Diet and Genotype in Primate Atherosclerosis - Project 4: Pleiotropic Effects on Obesity and Lipoproteins"; 2009-2014 (co-investigator) **NIH-OD**, "Southwest National Primate Research Center - Chronic Diseases: Metabolic Profiling in Baboons"; 2010-2013 (Co-investigator) **Baylor Research Institute**, "Reversal of STZ-induced diabetes using ultrasound destruction of microbubbles for the delivery of genes to the baboon pancreas"
Rachell E. Booth, PhD	TxState	Chemistry and Biochemistry	structure-function relationships within the epithelial sodium channel in model yeast	2011-2014 (coPI) **NIH**, "Structure-Function of the Epithelial Sodium Channel (ENaC)"; 2012-2015 (senior personnel) **NSF**, "A Chemistry REU on Molecular Innovation and Entrepreneurship (CheMIE)"
Shelley A. Cole, PhD	TBRI	Genetics	molecular genetic variation and how it affects inter-individual variation in disease risk (particularly heart disease, type 2 diabetes and obesity)	2006-2013 (PI) **NIH-NHLBI,** "Strong Heart Family Study"; 2008-2013 (subcontract PI) **NIH-NHGRI,** "Genetic Epidemiology of Causal Variants Across the Life Course"; 2009-2013 (Co-investigator) **NIH-NIDDK,** "Obesity and Diabetes Familial Risk in Hispanic Children"; 2008-2013 (Co-RI) **NIH-NHLBI,** "Genetics of Atherosclerosis in Mexican Americans - Project 3: Identification of Obesity-Related QTLs"; 2008-2013 (Co-RI) **NIH-NHLBI,** "Diet and Genotype in Primate Atherosclerosis - Project 4: Identifying Genes for Obesity QTLs Related to CVD"; 2012-2016 (Co-investigator) **NIH-NIDDK,** "Comprehensive SNP Discovery in SLC2A9 - A Candidate Gene for Uric Acid Nephropathy"; 2012-2016 (Subcontract PI) **NIH-NIEHS,** "Arsenic Exposure, Genetic Determinants and Diabetes Risk in a Family Study"

Anthony Comuzzie, PhD	TBRI	Genetics	genetics of complex metabolic traits (cardiovascular disease, obesity, and type 2 diabetes)	2008-2013 (project leader) **NIH-NHLBI**, "Diet and Genotype in Primate Atherosclerosis - Project 4: Pleiotropic Effects on Obesity and Lipoproteins"; 2008-2013 (project leader) **NIH-NHLBI**, "Genetics of Atherosclerosis in Mexican Americans - Project 3: Identification of Obesity-Related QTLs"; 2009-2014 (project leader) **NIH-OD**, "Chronic Diseases: Metabolic Profiling in Baboons"; 2009-2013 (subcontract PI) **NIH-NIDDK**, "Obesity and Diabetes Familial Risk in Hispanic Children"; 2012-2017 (co-investigator) **NIH-NHLBI**, "Whole Genome Sequencing to Identify Causal Variants Influencing CVD Risk"; 2012-2016 (Co-investigator) **NIH-NIDDK**, "Comprehensive SNP Discovery in SLC2A9 A Candidate Gene for Uric Acid Nephropathy"; 2006-2012 (Co-investigator) **NIH-NHLBI** "Strong Heart Family Study"
L. Kevin Lewis, PhD	TxState	Chemistry and Biochemistry	double-strand DNA break repair	2012-2015 (PI) **NIH,** "Genome-wide analysis identifies genes required for repair of DNA strand breaks"
Corina Maeder, PhD	TxState	Chemistry and Biochemistry	how nucleic acid-protein interactions regulate assembly of large cellular macromolecular complexes using the spliceosome as a model complex	2012-2014 (PI) **Research Corporation for Science Advancement**, to identify key elements in proteins regulating the splicing helicase Brr2; (PI) **TxState Research Enhancement Award**, to identify residues critical for funciton in an essential splicing helicase
Ronald B. Walter, PhD	TxState	Chemistry and Biochemistry	use of fish model systems to study molecular determinants of carcinogenesis using: melanoma models (*Xiphophorus* interspecies hybrids); transcriptomics and genomics; and, molecular genetics involved in complex traits (various)	2010-2012 (Co-PI) **NSF RAPID**, "Collaborative Research: Genetic Impact of the Deepwater Horizon Oil Release"; 2011-2016 (PI) **NIH-ORIP**, "Enhanced development of the Xiphophorus Model System"; 2011-2015 (Co-PI) **NIH-ORIP**, "Advancing the Scientific Potential of Transcriptomics in Aquatic Models"; 2012-2014 (PI) **NIH-ORIP**, "Supplement to Promote Diversity in Health-Related Research"; 2012-2014 (Co-PI) **Japan Society for the Promotion of Science**, Young Researcher Overseas Program, "Transcriptome Expression Analyses of Sexual Reversal in the Wrasse"

Shannon E. Weigum, PhD	TxState	Biology	microfluidic sensor platforms for disease diagnostics	2012-2014 (Subcontract PI) **NIH/NIAID** "Development of a Paper Microfluidic Platform for Viral Gastroenteritis"; (Project PI) **TxState Faculty Research Enhancement Program**, "2-D and 3-D Paper-based Microfluidic Devices for Detection of Intestinal Pathogens"
Steven T. Whitten, PhD	TxState	Chemistry and Biochemistry	structural thermodynamics of protein macromolecules (focus on allosteric regulation)	2011-2013 (PI) **Research Corporation for Scientific Advancement**, "Role of unfolded protein in functional allostery: multi-domain control of DNA binding in the tumor suppressor protein p53"; 2012-2017 (PI) **NSF** "Preliminary studies to investigate the biological activity of intrinsically disordered protein, using p53 as a model system"; 2012-2017 (co-PI) **NSF**, "Texas State University PREM: Center on Interfaces in Materials. A Partnership with the Research Triangle MRSEC"; 2012-2013 (PI) **TxState**, "Structural characterization of the protein ensemble by equilibrium unfolding methods"
Sarah Williams-Blangero, PhD	TBRI	Genetics	genetic epidemiology of complex diseases	2008-2013 (PI) **NIH-NIA**, "Genetic Determinants of Human Transcriptional Aging"; 2009-2014 (PI) **NIH-NHLBI**, "Genetic Epidemiology of Chagas Disease Progression"; 2009-2014, (Co-investigator) **NIH-NCRR**, "Southwest National Primate Research Center"; 2009-2014 (Co-investigator) **NIH-NIDCR**, "Genetic Architecture of a Human Dentognathic Complex"; 2009-2014 (Co-investigator) **NIH-NIAMS** "Genetics of Bone Structure and Metabolism"; 2011-2016 (Co-investigator) **NIH-NCRR**, "Establishment and Maintenance of a Closed SPRC SPF Colony"

Abbreviations: **TxState** - Texas State University - San Marcos; **TBRI** - Texas Biomedical Research Institute (formerly Southwest Foundation for Biomedical Research)

***** Per directions in the guidelines, these are **only 6 of our 20** total TxState research mentors (3 are minorities)

† These are only **4 of the 11** total TBRI research mentors