

# **Fisk-Vanderbilt Master's to PhD Bridge Program: A Guide to Building Bridges**

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(NSF HRD 1826755)

**Please cite as**

**Stroud, D., Tanenbaum, C., Roby, R., Campbell, E. P. C., Holley-Bockelmann, K., & Burger, A.  
(2022). Fisk-Vanderbilt Master's-to-PhD Bridge Program: A guide to building bridges Fisk-  
Vanderbilt LSAMP Regional Center of Excellence**

## Introduction

This Guidebook is a product of the Fisk-Vanderbilt LSAMP Regional Center of Excellence (FVCoE) in Broadening Participation (NSF HRD 1826755). The goal of this work was to build on the original Fisk-Vanderbilt Master's-to-PhD Bridge Program (FVBP) toolkit, providing an overview of the FVBP, greater context for the use of the tools, and analysis of supporting research-based literature. It is structured around a set of 5 logic models, one intended to give a snapshot of the program as a whole and 4 outlining its main components: Recruitment and Admission, Faculty Collaboration, Mentoring, and Promotion. We hope this guide is useful to practitioners looking to adopt or adapt our practices; please see our website ([fisk-vanderbilt-bridge.org](http://fisk-vanderbilt-bridge.org)) for more information.

## Fisk-Vanderbilt Master's-to-PhD Bridge Program Mission Statement

To identify promising, talented scholars who bring a passion for science and who possess the potential to succeed in a science or engineering career; to prepare these individuals for a successful transition to the PhD in science or engineering through caring one-on-one guidance, multiple tiers of mentorship, a challenging scholarly and research-driven environment that fosters personal and professional growth, and a warm, nurturing social network with other students and faculty; to become the nation's top producer of underrepresented minorities earning the PhD in science and engineering; and to advance entire fields of science and engineering toward full inclusion and diversity.

## FVBP History and Outcomes

Since its creation in 2004, The Fisk-Vanderbilt Master's-to-PhD Bridge Program has become a national model for identifying and fostering underrepresented minority talent at the PhD level in Materials Science, Physics, Astronomy, Chemistry, Biology, and Biomedical Science (Stassun et al., 2010, 2011; Rudolf et al., 2019). As of August 2022, 172 students have enrolled in the FVBP, 137 Master's degrees have been awarded, 120 students have bridged to PhD programs, and 52 students have earned the PhD, 41 of those from Vanderbilt. Today, 24 students are in a Vanderbilt PhD program, while 20 are in a Fisk Master's program. 52% of the students are African-American, 21% Hispanic, 7% other minorities, including Native Hawaiian and Pacific Islander, and 17% white or other non-minority. 58% identify as female. Moreover, our students represent many marginalized and underserved populations, such as first-generation, low-income, physical and learning disabilities, and sexual and gender minorities.

The success of our practices is born out in our programmatic outcomes. The past few years have seen important gains in the awarding of STEM Bachelor's and Master's degrees, however there is still a significant gap in STEM PhDs and the professoriate (NSF, 2019). Underrepresented minorities (URMs) are over 30% of our national demographic but receive less than 8% of the STEM PhDs (Slovacek et al., 2021). Within that landscape, the FVBP makes a significant impact. In astronomy, for example, given the incredibly low number of URM in physics and astronomy, **FVBP makes the largest contribution of any single US program**. Data from the American Physical Society indicates that only 4 out of 126 Astronomy PhDs and only 20 of over a 1000 Physics PhDs awarded between 2013 and 2017 went to African-Americans (APS, 2019). Over half of those 24 students came through the FVBP. We have an extraordinary completion rate compared to US

programs: the national 10-year completion rate for URMs to a STEM PhD is 44%, with the highest attrition rate (47%) in physical and mathematical sciences. We have now graduated 50 PhDs with a 10-year completion rate of 88%. FVBP students earn national fellowships and awards approaching twice the rate of their traditional PhD track counterparts, publish at the same rate, and keep apace with their traditional PhD-track counterparts in graduate coursework. Alumni are primarily employed in academia, industry and national labs. It is clear our students are making a vital contribution to the STEM workforce.

Our model has gained considerable national attention (Rudolph et al, 2019; Gamez et al, 2021). Indeed, we provided the base for the American Physical Society Minority Bridge Program (Hodapp and Woodle, 2017; Sapnur, 2021) which has now expanded to include the American Chemical Society and the American Geological Society (Poffenberger, 2018; Posselt, 2020) in the Inclusive Graduate Education Network (IGEN). While we see progress in higher education practices, there is more work to be done. **Fundamentally, the greatest barrier to increasing diversity, equity, and inclusion in STEM are the discriminatory policies that exclude those from marginalized communities** (Ivory, 2018; Dancy et al. 2020; McGee, 2021). Systemic racism and discrimination are largely ignored as a component of admissions and retention (McGee, 2020), particularly by scientists who believe in their own objectivity or cling to a fixed mindset (Harding, 2020). “Expanding the pipeline” does not keep it from being “leaky” as a lack of inclusion, insufficient mentoring, daily microaggressions, chilly or even hostile climates, stereotype threat and imposter syndrome leads to students leaving the academic environment (Lykkegaard and Ulriksen, 2019; Hinton et al., 2020; Wu and Uttal, 2020;). As a result of these challenges, programs such as the FVBP, where concerted efforts have built a community of scholars from marginalized and underserved groups with formalized mentoring, development and financial support, have significantly greater retention and completion. However, many of the primary components of the model can be applied anywhere to the benefit of all students.

**Theory of Action:** In collaboration with Center for Institutional and Social Change at Columbia University and funded by NSF I-cubed and pilot AGEP grants, we have developed a working theory of action with which to understand the Bridge program’s core precepts (Stassun et al. 2010, 2011). The key elements of the theory of action are:

1. Identifying students with “unrealized potential:” Selecting promising students on the basis of the usual metrics alone will not broaden the pool. Assessing promise for success then requires alternative measures, involving in situ observation of academic capability, probes of personal traits such as performance character (e.g. Colvin, 2008) and direct observation of research skill.
2. Facilitating transitions across critical educational junctures through mentor/mentee relationships and faculty-to-faculty handoffs: In our experience, the most successful handoffs of students occur between mentors engaged in collaborative research, which must be actively developed and choreographed (Jalali et al., 2021).
3. Monitoring student performance: Reactive interventions that respond only when student performance drops below some absolute threshold or even when performance is just trending

downward may not be agile enough to prevent attrition. Progress must be carefully monitored through layered mentoring networks to notice subtle “inflection points” that signal it is time to check in with the student (Raman et al., 2016; Cobb et al., 2018; Sarabipour et al., 2022).

4. Tapping into and connecting students with the broader scientific community: For the ultimate professional development and scientific identity of students, they must become engaged with the broader communities of their discipline(s) (Casad et al., 2017; Franciolla et al., 2020). Such networking and visibility require mentoring and orchestration among multiple mentors, ideally connected through collaborative research (Hinton et al., 2020; Sarabipour et al., 2022).

# Fisk-Vanderbilt Bridge Program Overall Logic Model

Mission: The mission of the Fisk-Vanderbilt Master's to PhD Bridge Program is to increase the number underrepresented minorities in STEM Rationale: Underrepresented students more frequently use the Master's degree as a stepping-stone to the PhD

## Increasing the number of underrepresented groups in STEM

National Need for Expanded STEM Workforce

Systemic Discrimination Leads to Inequalities in STEM Access and Inclusion

Need to Reach Out to the Larger STEM Talent Pool

Overreliance on Standardized Test Scores Limits Participation in STEM

## Key Activities

Identify Talent through Holistic Admission Processes

Build Faculty Relationships between Institutions and Students

Improve Retention through Mentoring

Promote Students through Professional Development and Networking

## Outputs "Goal State"

Identify Students with Potential Overlooked by Traditional Metrics

Develop Joint Research or Funding and Connect Students with Faculty

Provide Support from a Network of Mentors with Focus on Student Goals

Provide Professional Skills, Academic Culture Information and Individualized Opportunities

## Outcomes

Students Complete the PhD and/or Master's Degree and Transition to the STEM Workforce

## Chapter 1. Fisk- Vanderbilt Master's to PhD Bridge Program Overview

Founded in 1866, Fisk is the oldest university in Nashville and the first HBCU to both gain full accreditation by the Southern Association of Colleges and Schools and to establish a chapter of Phi Beta Kappa (Cohen, 2001). Approximately 98% of the student body represents underrepresented minorities, and nearly 90% of the student body is African American. Fisk offers STEM Master's degrees in Biology, Chemistry, Clinical Psychology, Physics, Social Justice and Data Science. The program is centered in the School of Natural Sciences, Mathematics, and Business in the Department of Life and Physical Sciences.

Vanderbilt is a research-intensive Primarily White Institution (PWI) with an associated School of Medicine and Engineering, representing approximately 25 STEM PhD granting programs. It is one of the top 20 schools in the nation for science and engineering grant funding (Barnett et al, 2017). The FVBP is an independent graduate program within the College of Arts and Sciences and is physically housed within the Physics and Astronomy Department at Vanderbilt.

Fisk University and Vanderbilt University are 3.4 miles apart from one another near downtown Nashville, Tennessee. Their close geographical proximity fosters faculty collaborations, joint service on student MS and PhD committees, as well as attendance by Fisk trainees and faculty at the myriad of seminars, scientific program retreats, and workshops hosted by Vanderbilt. Both institutions provide office space for the students as well as for the administrative team.

**1.1 Program Basics:** The design of the FVBP is based on the finding that underrepresented students are more likely to use the Master's degree as a stepping stone to the PhD (Lange, 2006). Thus, the program begins with a Master's at Fisk. Students come from all over the country and from a range of institutions. The program provides financial support for all tuition and fees as well as a stipend. During the Master's phase, typically 2 years, the students take courses both at Fisk and Vanderbilt and are engaged in research. To remain in the FVBP, students must maintain a 3.0 GPA, complete at least one Vanderbilt course with a B or above, and demonstrate adequate progress in research. If the student wishes to continue to a PhD program, we help with the application process and advise students to apply to several places that meet their career goals. They aren't required to apply to or attend Vanderbilt, nor are they guaranteed to get in. The aim is to help the students meet their individual goals through flexible coursework, research experience and mentoring. While the objective is to help students transition to the PhD, we consider it a success if the students finish the Master's degree or move on to STEM work. The student is the center, not the number of PhDs produced.

There is an intentionality to our mentoring practices and community building activities to try to keep students engaged long-term with particular emphasis on points of transition. The Master's phase is the most intensive time of mentoring as the students are experiencing two transitions back-to-back: the first being making the transition to graduate school and the second to the PhD. After students move to the PhD, regardless of the institution they attend, we continue to provide

mentoring. We seek to engage students at PhD transitions: candidacy exams, writing the PhD dissertation and seeking post-PhD employment. Additionally, we remain available to all alumni for whatever help we can provide as they move through their STEM careers.

Undergirding the Fisk-Vanderbilt relationship is our Cross-Registration Agreement. Any student at Fisk can register for a class at Vanderbilt and any student at Vanderbilt can take courses at Fisk with no monetary exchange. That is, Fisk students pay the Fisk tuition rate to Fisk for classes taken at Vanderbilt and vice versa. Those Vanderbilt courses can then be transferred and applied as credit for the Vanderbilt PhD. Furthermore, core physics courses taken at Fisk count for PhD credit at Vanderbilt. In this way, students can complete a considerable amount of their PhD coursework during their Master's phase if they continue to Vanderbilt. This agreement allows us flexibility in defining an individual student's curricular path.

The Fisk Master's students are also given VUNetIDs which allow them to access digital library resources and software. They also have a physical Vanderbilt ID that provides building access and free public transportation. This is particularly helpful for students that are taking the bus route between the campuses. For students that do have cars, they are able to purchase affordable "Friends of Vanderbilt" parking permits. The students are also invited to attend any Vanderbilt events that are open to graduate students.

**1.2 Funding Sources:** There are multiple mechanisms of funding for the program. Funding for the students in the Master's phase is through grants from the NSF, NIH, Department of Education and individual research grants to our Fisk and Vanderbilt faculty. The College of Arts and Science at Vanderbilt also provides funding for 10 graduate student lines, stipends and tuition included. These are primarily used to fund students in their first year of the PhD. However, it has the flexibility to be applied at later stages when funding gaps may arise as students are approaching PhD degree completion. For many years, the program was run by the Co-directors with the input from the Bridge Steering Committee and two part time effort program coordinators. All faculty involvement was unpaid and voluntary. However, with the growth of the program and to ensure its long-term administrative sustainability, an Executive Director was hired and is supported 80% by the College of Arts and Science at Vanderbilt. The College also provides an operating budget of approximately \$80,000. This covers things such as GRE fees for students applying to the PhD, social and professional development activity costs, speaker fees, and conference travel for students and administrators. Currently, in addition to the Executive Director, we have an Assistant Director at Vanderbilt and a part-time Program Coordinator at Fisk, both paid from grants or individual start-up funds.

**1.3 Organization and Management:** We strive for continuous improvement; therefore, we take opportunities to measure and reflect on outcomes, gather feedback and make adjustments to practices or activities. Because the program is centered on the students, we are particularly interested and reactive to their needs. In general, any substantive changes are done in collaboration with the Bridge Program Steering Committee.

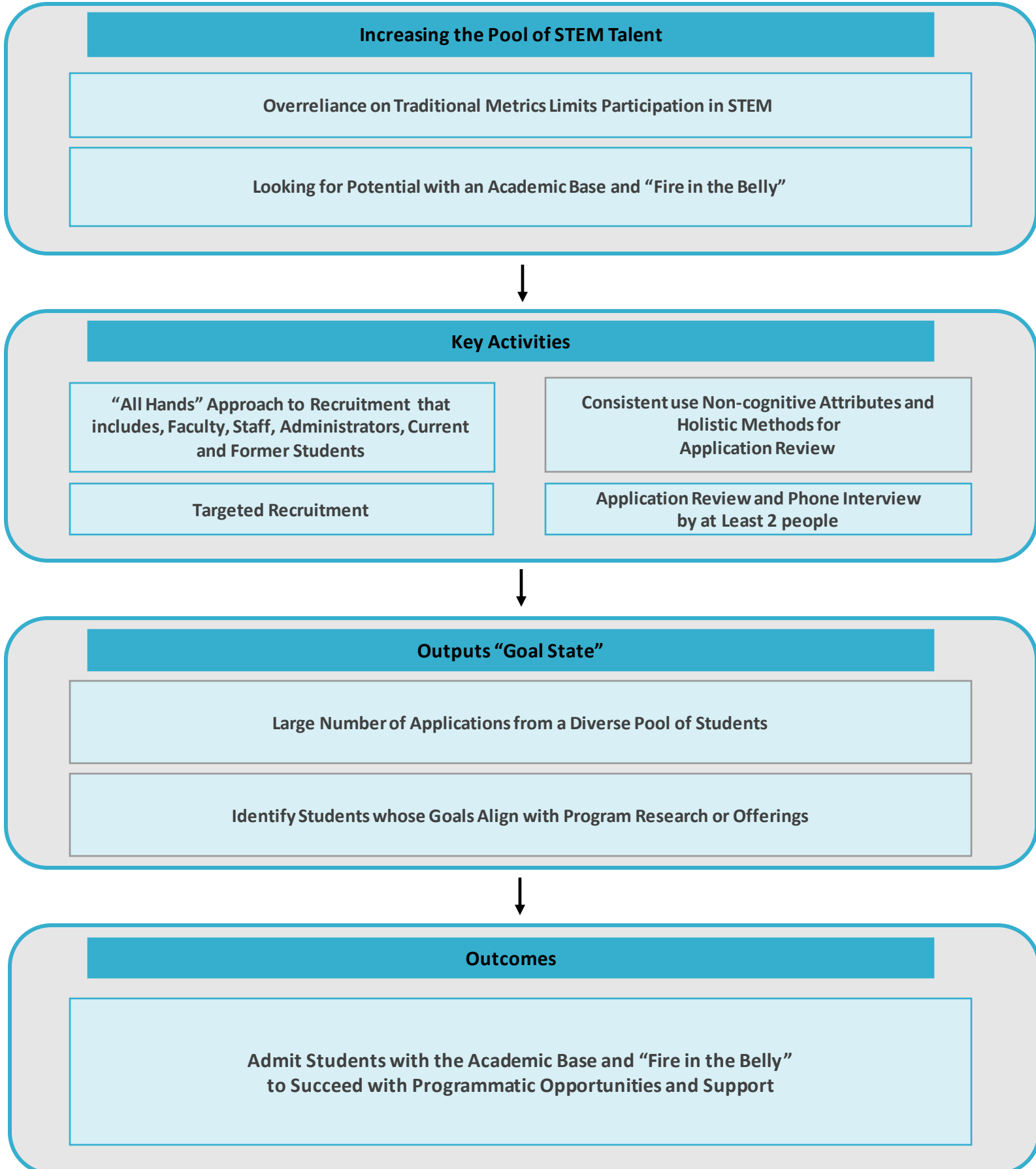
The Steering Committee is made up of Fisk and Vanderbilt faculty and staff and at least two student representatives. Ideally, these would be one each from the Master's and PhD programs. Terms for the faculty and staff committee members are for 2-3 years with the chance to renew. Students serve for one year only and care is taken not to burden them with programmatic responsibilities. The group meets monthly and handles things such as developing tools for providing student feedback, identifying funding opportunities, as well as assisting with recruiting and admissions.



# Fisk-Vanderbilt Basic Logic Model – Recruitment and Admissions

Goal: To Identify students with clear potential and desire for the PhD that can be well-served by the program.

Rationale: By using non-traditional metrics and looking for potential, we can reach a larger pool of students and increase STEM diversity.



## **Chapter 2- Recruitment and Admissions**

There are many factors that influence and differentially affect student pathways to the STEM doctorate, some of which are particularly unique and challenging to students from underrepresented backgrounds. These factors can include parental education, sources of financial support, education-related debt, and time-to-degree (NSF, 2018). But, racial and ethnic stereotypes that assume students of underrepresented backgrounds lack innate STEM talent, do not have the qualifications to excel at the highest levels in STEM, and/or are not interested in pursuing a PhD is one of the most adverse barriers to broadening participation in STEM PhD programs (Rudolph et al., 2019; Aspray & Bernat, 2000).

STEM graduate departments and admissions committees at research universities, despite voiced commitments to holistic approaches, continue to implement recruitment and admissions policies and practices that take a fixed mindset approach, in which intelligence is understood as an inherent capacity or ability, to identifying talent (Posselt, 2016; Scherr, 2017). Research shows that PhD programs in STEM typically advantage applicants who have earned their undergraduate degrees from elite universities, despite data showing that minority-serving institutions, including Historically Black Colleges and Universities (HBCUs), Hispanic Serving Institutions (HSIs), and Tribal Colleges are the major producers of STEM baccalaureate degrees among students from underrepresented backgrounds (AAS, 2018). Stronger connections and more meaningful relationships between faculty at doctorate-granting PWIs and faculty at MSIs is critical for more expansive and targeted recruitment (Posselt, 2018; Stassun et al., 2011). Cross-institution faculty relationships can serve as a significant lynchpin in the identification and successful recruitment of high-potential, talented undergraduate students as faculty who know and trust each other exchange information and recommendations for who may be a good fit for certain programs. Without a professional network of colleagues at MSIs or deep familiarity with MSI STEM programs, research university faculty are frequently unaware of the learning and skills students at these types of institutions are developing and the experiences and perspectives they could bring to their labs. They are more inclined to recruit students from colleges and universities with which they are familiar and have strong professional networks to whom they can turn for recommendations (Posselt, 2018; Aspray & Bernat, 2000). Recruitment efforts can also be boosted by faculty at PWIs proactively attending venues that bring together students and scientists of color to develop and strengthen faculty and student connections to identify and encourage talent in the field that may otherwise be overlooked (AAS, 2018).

In admissions, GRE scores continue to carry heavy weight in graduate admissions processes (Posselt, 2016), despite concerns about the test's ability to serve as an accurate reflection of women's and racial and ethnic minority students' cognitive abilities (Clayton, 2016). Well-documented research shows that the test is a weak predictor of graduate school progress, performance, and successful degree completion (Miller and Stassun, 2014; Moneta-Koehler et al., 2017; Miller et al., 2019; Clayton, 2016). For example, a study examining the predictive validity of GRE scores on graduate student success in a biomedical program demonstrated the test's failure to accurately predict a student's likelihood to complete the doctoral degree, pass the qualifying exam, complete their degree in a shorter timeframe, obtain individual grants or fellowships, and publish more first-author papers (Moneta-Koehler et al., 2017). These

traditional metrics do not account for the full range of qualities a student brings to their doctoral pursuits, including their socioemotional/non-cognitive competencies (Sedlacek, 1998). They also fail to contextualize a students' academic record such as "how students' characteristics and achievements reflect not only their potential, but also the opportunities they have had, their developmental trajectories, and known sources of error in standard metrics" (AAS, 2018, p. 12).

### **2.1 Collective and Targeted Recruitment**

For recruiting, we take the approach that everyone engaged in the program, the faculty, administration, and students, contributes. Be it sharing about the program when giving an academic talk at another institution, seeking out students at talks or poster sessions, or sharing out on social media. We also engage with program directors (MARC, McNair) who have access to a larger number of students across the country.

For the past several years we have been collecting data regarding how students hear about our program. We do this by adding a link in our form letter of interest, which can be found in the Toolkit (TK 1), that asks three questions. How did you hear about the Bridge Program? What conferences did you attend this year? Did you talk to anyone from the Bridge Program at a conference? Reviewing six years and over 300 responses, we find that students most frequently hear about the program from online searches (25%, N=79), faculty (23%, N=72) or through their school (17%, N=54). The primary conferences attended were SACNAS and ABRCMS, but many students (44%, N=137) had not even attended a conference. Moreover, only 17 percent (N=52) of those that attended conference or event report speaking to someone from the Bridge program at a conference or event. While, this information only provides a limited picture of how students learn about the FVBP, it highlights the need to go beyond conferences and recruiters to identify potential applicants.

Our Graduate School Dean of Diversity is an important part of our recruiting efforts in general. He has spent considerable time traveling to minority serving institutions not just to meet students and tell them about Vanderbilt and the FVBP but to build relationships with the program managers or faculty. Faculty are more likely to recommend students go to institutions where they know someone or know there is a supportive community (Tuitt, 2012; Lucas, 2018; Murray Johnson, 2019).

Our recruitment materials (TK2) prominently feature our students because they are the foundation of the program. For some, it may be one of the first times they see so many faces that reflect their own identity. Others recognize those who have been influential in their own development, students that have now gone on to be faculty or that have devoted time to mentoring. Indeed, the students themselves are excellent ambassadors for the program.

### **2.2 Holistic Application Review**

We believe to actually expand the pool of talent, you must look beyond traditional metrics, identify potential and provide the support needed to develop overlooked students into independent scientists (Hossler et al., 2019). Our application consists of one personal statement,

unofficial transcripts, and three letters of recommendation. The applications are specifically due on April 15<sup>th</sup> so we are not competing with PhD programs. We do not begin review in earnest until the deadline and will review applications with only 2 letters. GRE scores are not required. There is no application fee. The applications are reviewed by 3-6 people, representatives from both Fisk and Vanderbilt, and decisions are then made as to who will be interviewed.

For the first review to determine which student will be interviewed, we review the whole application using a scoresheet (TK3). There are three scores for each component of the application on a 1-5 scale with 5 being the best score. These worksheets have been useful in speeding up the time needed to decide on interviews and provide valuable data on the consistency of application review in the committee. Additionally, a key factor is whether we can serve the students with the research and academic paths we can offer. Throughout the application, we look for evidence of approaching challenges with a willingness to seek help and problem-solve, key qualities for research.

In the personal statement, we look for motivation for the PhD, clear communication, particularly regarding research experience and long-term goals. Research indicates students with an intrinsic motivator for the PhD are more likely to persist (Simon et al., 2015; McGee et al. 2016). Because students come from a range of institutions with differing availability of opportunities, this experience may manifest in many forms, such as a senior thesis or independent study. When discussing research, we determine if they are able to identify the rationale and significance for the work and any findings they may have produced. We also look for evidence of what they learned from these experiences beyond technical expertise. Evidence of long-term goals, particularly if they can identify a career path beyond the PhD, is viewed as a positive.

In the transcript, we review for exposure to a breadth of courses and a solid background. For example, have they completed their chemistry series, or do they have math courses past Calculus III? We also look at the trajectory of the grades. If there was a dip, we evaluate if the student recovered and if they addressed this in their personal statement. We look for improvement over time, particularly when a course is repeated. At no point do we use the GPA as means of determining who is invited to interview or who is offered acceptance to the program. Indeed, an analysis of the last three years of GPA data from students that were interviewed (N=46) and those that were not (N=84) demonstrate no statistically significant difference.

Reading through the letters of recommendations requires a particular attention to detail. We look for a significant discussion of work ethic, persistence, research ability and ownership, working style, strengths and weaknesses, and evidence of leadership. We provide a guideline (TK4) for our letter writers in the hope that we will get a more comprehensive view of the applicant beyond standard recommendation. Specific examples of concrete actions on the part of the student to further their education, research or opportunities for growth are most helpful. Letters indicating need for development in particular domains, such as higher math, or scientific writing are valuable, as they allow us to put support structures in place before the student arrives.

The letters can be a source of a number of “red flags” in regard to a student application. For example, there may be discrepancies between what the students states as their objectives (PhD in biomedical science) and what the recommender notes (Pharmacy School), or the personal statement may indicate a research experience, but the letters discuss a workshop instead. These applications are viewed less favorably. We are also wary if a key letter, such as from their primary research advisor, is missing from the application. Occasionally, if such a letter is missing, we will reach out to that advisor for a conversation. We will also contact letter writers if we need clarification. This has been particularly useful in making decisions about student interviews. The entire process of application review takes 2-4 weeks.

### **2.3 Interview Processes**

We typically interview twice as many applicants as we plan to make offers. Given that every year our available positions are determined by our grant funding, this number is variable. Interviews are 30 minutes done by conference call or zoom without a camera. We intentionally do not use cameras to avoid well-documented biases for physical appearance (Shahani et al., 1993; Hosoda et al. 2003). We typically book interview sessions in blocks with 15 minutes between. There will be 2-6 faculty and administrators present, and there are always representatives from Vanderbilt and Fisk. Before the call, an order for who will ask the questions is established. There is a single set of questions for each interview (TK5).

The questions are based on those described in William Sedlacek’s “Beyond the Big Test” (2004) and are intended to assess a specific characteristic associated with success based on his research and our experience with students. These are as follows: short and long-term goal definition, positive self-concept, support person availability, realistic self-appraisal and perseverance. A rubric of these and additional non-cognitive attributes is provided to help guide the interviewer’s assessment of student answers (TK6). Students should be intrinsically motivated and genuinely passionate about the PhD. Students with primarily extrinsic motivations such as wanting to please their family are less likely to succeed (Deci and Ryan, 1991; Deci et al., 1999). We also assess student preparation for the interview, such as researching the program, often indicated by the questions they ask at the end.

The hallmark question of the Bridge Program interview is “Give an example of a time you hit a serious obstacle or failure and how you handled it.” This can be personal, professional, or academic. This one question touches on several of the characteristics described above and provides insight into the student’s approach to challenges. It’s a red flag if the student can’t identify a time of struggle, or reports that they walked away from the situation.

For us, the standardization of questions is helpful in multiple ways. It mitigates our implicit bias so we can better evaluate students based on their responses more equitably. It helps maintain the flow and keep the interview to time. In addition, it means that we have spent time thinking about what matters to us in admissions as a group. There is not the assumption that everyone is looking for similar things, or values similar accomplishments; we have established our baseline as a group. The committee then complements each other during the review and the process of deciding on interviews and subsequent offers takes less time.

Our interview score sheet (TK5) notes the following areas with scales of 1-5: Research Communication Skills, Fire in the Belly/Work Ethic, Engagement/Support, Ability to Address Review Concerns and Non-Cognitive Attributes. However, in practice this score sheet is not used by the admissions committee uniformly and final decisions are often made through discussion of the candidate's entire application rather than an interview score or combined numerical ranking. These conversations typically occur immediately after the interview and then again when all interviews are completed.

Interviews are substantially informative and critical to making offers of admission. We frequently will meet immediately after all interviews conclude, or no more than a day or two later, to make decisions. The interview provides us with an opportunity to assess how well the student understands and can communicate their research. It also serves to align what the student reports as goals and interests in their application and what they describe in person. It is hard to overestimate the impact of the interview. Many times, students that might have not ranked as highly when interviewees were selected, can come to the top when given the chance to express their knowledge and personal history.

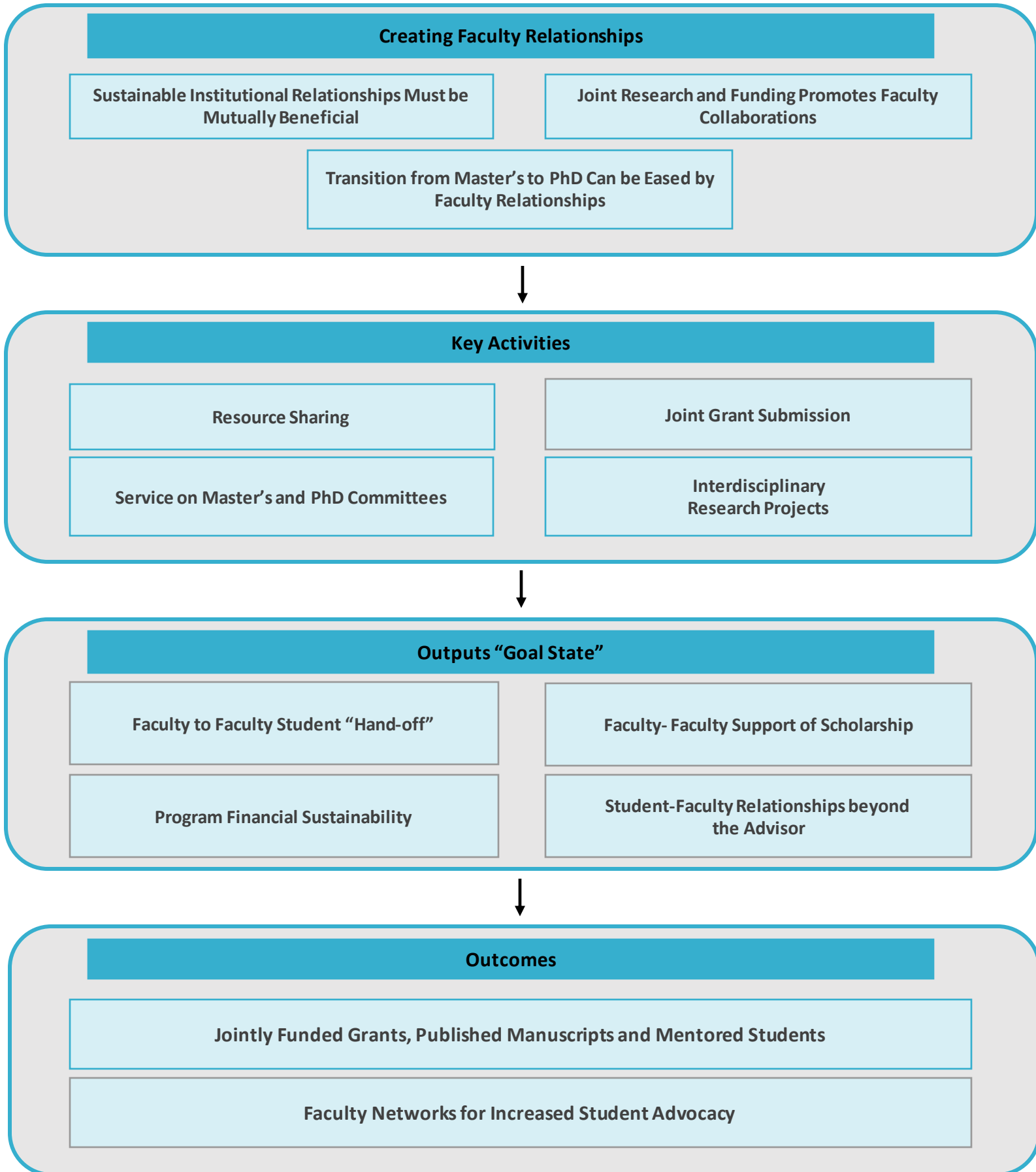
Because we have such a small number of slots and a high yield on offers, we do not make more offers than we have positions available. Students are given a week to respond, though this can be extended in extraordinary cases. The offer letter (TK7) is accompanied by a financial aid letter that outlines our financial commitment to the student and any particular circumstance of the grant that funds their position

It is important to note that we do participate in the Inclusive Graduate Education Network (IGEN) application system. Due to the volume of those applications, one or two people do an initial review of the candidates. Our first pass is based on whether or not we have research aligned with the applicant's interest. Then the full application is reviewed by committee. Because IGEN applications have different requirements, it is sometimes necessary to ask students to supply additional information such as a personal statement.

# Fisk-Vanderbilt Basic Logic Model – Faculty Collaborations

Goal: Establishing faculty scientific and professional collaborations

Rationale: Student matriculation with faculty collaborators allows for ease of transitions. Joint research promotes program sustainability.



### **Chapter 3 Collaborations and Connections**

Deliberate, meaningful, mutually beneficial partnerships between an MSI(s) and a PWI can play a critical part in expanding access to and diversifying doctorate programs, particularly when they center on coordinated activities that both build faculty relationships and collaborations, develop students educational and research opportunities, and foster faculty-student mentoring and peer mentoring networks of support (Andreoli et al., 2017; Jalali et al., 2021). Such partnerships or collaborations may play out in practice as joint research projects where faculty across the two institutions work closely together to bring new and diverse perspectives to the research, while gaining a deeper understanding and respect of the academic and cultural ethos in which they each sit and what they can learn from each other (Lord & Matthews, 2021). These partnerships also help academics at the majority-White institution gain appreciation and respect for their MSI colleagues and the role minority-serving institutions play in developing and training rising talent in the field. For example, a report by the National Academies of Sciences, Engineering, and Medicine (2019) illustrates how MSIs have successfully used initiatives and strategies to tailor and support the academic, financial, and socioemotional needs of students to become some of the largest producers of racial and ethnic minority STEM degree holders. These lessons can be shared with their PWI colleagues and peers to promote new ideas and practices for supporting all students in their doctoral pursuits.

Beyond cultivating stronger faculty relationships and networks, MSI-PWI partnerships can also take the form of dual-enrollment, or student exchange and transfer, providing potential doctorate students with access not just to a wider variety of courses and opportunities to conduct research in more technologically advanced and higher resourced labs, but also to the cultures, expectations, and climate of a PhD program at a PWI; as well as access to cross-institution faculty and peer mentoring and support networks that can ease their academic and cultural transition into a doctoral program (Lord & Matthews, 2021; Jalali et al., 2021).

The FVBP was created by Dr. Keivan Stassun at Vanderbilt and Dr. Arnold Burger at Fisk. Although Dr. Stassun is an astrophysicist and Dr. Burger a materials scientist, they identified a novel avenue of investigation to pursue together. This “interdisciplinary by intention” approach led to joint research funding, publications and co-mentored students for many years. Additionally, Dr. Burger created a connection exploring detectors for medical imaging with Dr. Todd Peterson and radiation effects for space-based detectors with Dr. Robert Reed at Vanderbilt. Later, as the program expanded to biology and chemistry, research connections were made between Fisk Chemistry and Biology with Biomedical Engineering, Biological Sciences and Cell and Developmental Biology. We feel this example of building a relationship between faculty at a primarily white research-intensive school and those at an HBCU, shows how this work should be pursued, together and with an open mind about what each group brings to the table.

#### **3.1 Relationship Building**

If one is considering creating a bridge between an MSI and a PWI, first and foremost must be that the relationship is genuine and mutually beneficial. We have observed that a PWI will engage an MSI as an “on paper” partner for a grant proposal that does not convert into a real partnership



when the grant is funded. It is important for PWIs to approach the MSI with an asset-based mindset, that is recognizing that the MSI culture and practices are something the PWI can learn from rather than “fix” with their resources. Also, it should not be considered as simply a means to funnel underrepresented minority students to the PWI. The vision, mission, and goals of any such program should be developed jointly and again, with the intention of making it mutually beneficial.

As described in Chapter 1, underlying the formation of the FVBP was a previously established Consortium agreement between Fisk and Vanderbilt. Specifically, this states that any Fisk student can take a course at Vanderbilt and will pay the tuition (at Fisk rates) to Fisk, while any Vanderbilt student can do the same at Fisk with tuition to be paid to Vanderbilt. In addition, there is a memorandum of understanding between the two institutions that allows for students who have completed their Master’s degrees at Fisk to transfer up to 24 hours of credit of approved courses (both Fisk and Vanderbilt) to the PhD program.

These agreements are larger than the FVBP but are fundamental for it to function. The program itself is beneficial for both institutions. The program is operationally based at Vanderbilt and it is frequently highlighted as a cornerstone of efforts to promote diversity on campus. Because students are able to complete PhD coursework while they are Master’s students, it is an incentive for the students to matriculate at Vanderbilt for the PhD. Additionally, it has provided opportunities for many Vanderbilt junior faculty to incorporate education activities with clear impacts for their CAREER awards. For Fisk, most grants supporting the program are centered there and provide valuable tuition dollars and overhead. The Fisk Master’s students are able to take courses that are not offered at Fisk and therefore demonstrate their ability to do PhD-level coursework, which is an asset to their graduate school applications.

However, the heavy lifting of our work is done by the faculty. Teaching and mentoring the students as well as writing programmatic and individual research grants for their support is time-consuming and labor intensive. Thus, the program works best when there is collaboration between faculty at both institutions in a way that they each directly benefit. An example of this is resource sharing. The Fisk faculty can take advantage of the research infrastructure present at Vanderbilt in the form of easy access to reagents and extensive core facilities. At the same time, students at Vanderbilt have access to specialized equipment and expertise at Fisk.

### **3.2 Student Connectivity**

Because faculty interaction is so important to student success (Bain et al., 2011; Fries-Britt et al., 2013; Webber et al., 2013; McReynolds et al., 2020), we have identified additional means of connecting Master’s students to the Vanderbilt community. The process works best if it begins in the first semester of the program. We created a connectivity dashboard (TK8) to track grades at Fisk and Vanderbilt, engagement in the Vanderbilt community, the target PhD program and overall status of each student in building a connection.

Students are required to have a Vanderbilt faculty member on their Master’s thesis committee. This can be someone with research expertise in their field, a more general advocate for their

scientific and professional development, or a potential PhD advisor. In this way, they expand their mentor network and may have an opportunity for an additional letter of recommendation.

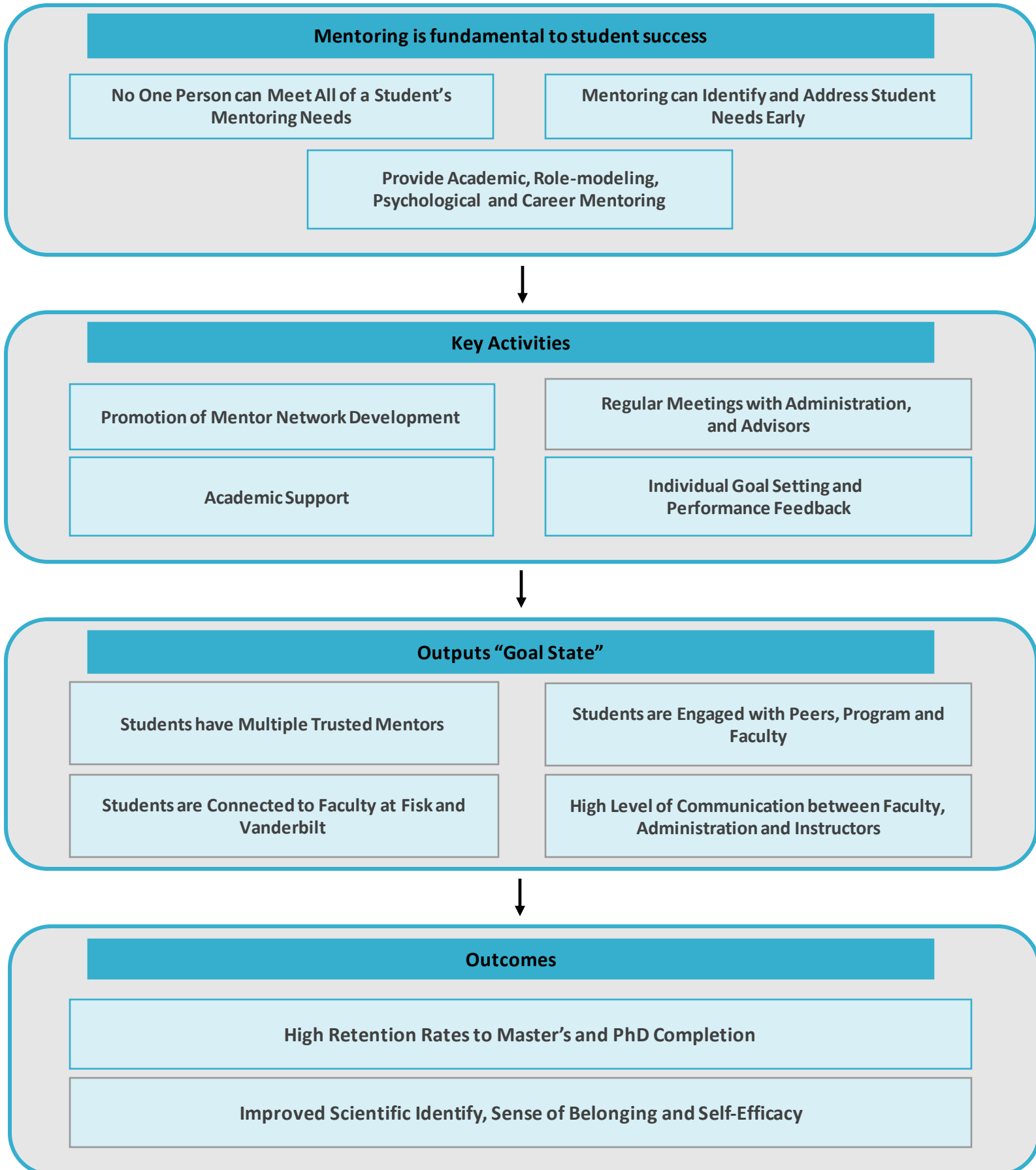
Regardless of who serves on their committee, students are to identify 2-3 potential Vanderbilt faculty that they might want to work with. If there is no one that is a good fit for their PhD research goal, we encourage them to reach out to professors at the schools they intend to apply to generate a connection and to inquire if they learn more about their research or even attend group meetings. We review and advise on this list with preference given to those who are current Bridge mentors or are known to have good mentoring environments. Often, we help by making the initial contact to introduce faculty to the FVBP and how it works, and to determine how amenable they would be to connect with our students. The hope is that the student builds a relationship with the faculty member and research group that allows them to demonstrate their knowledge and intellectual curiosity while becoming more comfortable with the PWI environment.

The students are also encouraged to engage with their Vanderbilt department of interest. This might be by attending their journal club or departmental colloquium. If appropriate we recommend students attend or present at departmental retreats. These are easy ways for the students to learn more about the faculty in the department, expand their mentor networks and establish themselves as part of the larger community.

# Fisk-Vanderbilt Basic Logic Model – Mentoring

Goal: To nurture potential, ease transitions, and promote achievement individual goals.

Rationale: Mentoring can allow for early interventions and build critical mentor networks for long-term success



## **Chapter 4 Mentoring and Community Building**

Mentoring for students in STEM graduate programs has been found to be particularly beneficial to mitigate the effects of institutional racism and implicit biases that marginalize and isolate many students from underrepresented backgrounds from the faculty and peer networks more readily available to their White peers (Herrera et al., 2012). Proactive mentoring is more intrusive, individualized, and student-centered than the typical mentoring relationship, with advisors or faculty taking a strong initiative in the mentoring relationship to regularly check in and monitor students' progress, providing guidance and assistance both academically and personally to help students navigate through important milestones and transitions in their education pathways, as well as to overcome obstacles along the way (Montgomery, 2016). Proactive mentoring can thus serve as one influential mechanism for ensuring that students know about and receive the academic, professional, personal, or financial services they need, for reversing students' feelings of self-doubt that have built over time, and for mitigating experiences of social and academic experiences of bias and racism as students encounter them (NASEM 2019, Schuler et al., 2021). Many studies have documented how mentoring has helped to build underrepresented students' science identity and self-efficacy, broaden their future educational and career opportunities, and realize their academic and career potential (Whittaker & Montgomery, 2012; Alston & Campbell, 2017; Posselt et al., 2017; Arroyo, 2017; Brothers & Knox, 2013; Thiry & Laursen, 2011).

The rise of positive faculty mentoring to support students' pathways through STEM degree programs, for example, is one counternarrative to the unwelcoming STEM environment. Research shows that faculty mentors have helped develop URM students' confidence in their field of study, broaden their future educational and career opportunities, and realize their academic and career potential (Thiry & Laursen, 2011; Brothers & Knox, 2013; Alston et al., 2017; Arroyo, 2017; Posselt et al., 2017).

Many graduate students struggle to balance the stresses and demands of graduate school generally, with one survey of doctoral students finding that close to half experienced psychological distress (Levecque et al., 2017). Students from underrepresented backgrounds are at an even higher risk of experiencing depression and anxiety due to recurring instances of implicit and explicit discrimination, reduced confidence, and imposter-related fears (Cokley et al., 2017; Castro, 2010). Repeated instances of social and academic isolation limit underrepresented students' access to the types of encouragement, support networks, professional networks, and insider knowledge into the unwritten rules of their field's norms and expectations enjoyed by their majority peers, challenging their sense of belonging and ability to efficiently navigate the services, supports, and opportunities that can enable their success (Griffin et al., 2018; Herrera et al., 2012). Further challenging their sense of belonging, students from underrepresented backgrounds can feel like "outsiders" due to having different life experiences than the majority of their peers and faculty in their department (Velasco, 2016). Indeed, as one study showed, "When departments received URM students with indifference, avoidance, negativity, or downright hostility, URM students were likely to feel like outsiders looking in and tolerated instead of truly embraced or welcomed" (Figureroa & Hurtado, 2013, p. 16). These experiences and feelings can derail students' doctoral pursuits if not met with supportive relationships and environments (Velasco, 2016), particularly as students advance through the higher levels of STEM

education and the diversity of STEM departments lessens and students' sense of self-efficacy is most at risk (Charleston & Leon, 2016). Narratives from URM students indicate instances where faculty and students in more highly represented student groups (White students and Asian students) "occasionally used their power in inequitable ways, irrespective of intention, that ultimately led URM students to believe that they received differential treatment from teachers and peers, to feel excluded from peer circles, and to question whether they belonged intellectually and socially in STEM academic spaces" (Figueroa & Hurtado, 2013; p. 23). The creation of a nurturing and collaborative educational environment that strengthens students' sense of belonging and community can be supported through both faculty and peer relationships that provide positive interactional behaviors where individuals from less-dominant groups are affirmed and welcomed; and include the presence of "micro-affirmations" that mitigate risks of decreased self-efficacy and experiences of isolation (Figueroa & Hurtado, 2013; p. 26).

As described above, our approach to mentoring is one that is proactive and intentional (Whittaker and Montgomery, 2014; Lane, 2016). Mary James, Dean for Institutional Diversity at Reed College, describes this mentoring style as, 'anything outside these walls that affects your academic progress can be my purview if you want it to be.' We recognize that there are myriad events, both personal and societal, that impact students' lives and well-being and we want them to be able to bring their whole selves to their work. Such mentoring requires extensive communication with the students, as well as their advisors and course instructors. At the same time, sharing information is limited to protect student confidentiality as much as possible. In this way, opportunities and interventions can be offered early, rather than reactively, when a student encounters a challenge.

When we refer to mentoring as intentional, we mean simply that mentoring activities are constructed around known, research supported, student needs (Nora and Crisp 2007; Crisp and Cruz 2009). These are 1) psychological or emotional support, 2) goal setting and career paths, 3) academic subject knowledge support, and 4) the existence of a role model. These include scheduled one-on-one check-ins with students, conference attendance, social events, and other opportunities for students to build mentor networks. We also assist students in understanding what their mentoring needs are through our professional skills course or evening seminars. The planning and execution of these activities represents a large portion of the work of the program administrative team and are fundamental to building inclusive communities and overall student success (Strayhorn, 2018). Everyone that is part of the FVBP has a role to play in the mentoring network of the students. Essentially any of us can be – and are – called on to support in whatever way is needed. That can be powerful as students can decide for themselves who they feel comfortable with.

#### **4.1 Mentoring Support Tools**

Mentor training has been shown to be effective in improving mentoring skill and self-efficacy (NASEM, 2019; Stetler et al., 2020; Trejo et al., 2022). The Center for Improved Mentoring Experiences in Research (CIMER), offers both Entering Mentoring and Entering Research, which we have used at our institutions and in the Professional Skills course. Once mentor training is

completed, an extensive array of materials and modules are available to construct individualized curricula.

Another free training option is provided by the Clinical and Translational Science Institute at the University of Minnesota. There are two versions of their Optimizing the Practice of Mentoring: the first for mentoring graduate students, postdocs, and junior faculty, while the second focuses on undergraduates. Another course, Enhancing Motivation is offered and uses the CARES Mentoring Model. This model is grounded in Social Cognitive Theory (Bandura, 2014) and has tools to enhance mentoring interactions.

Several years ago, we began using basic dashboards (TK8), with students noted in red, yellow or green, a space for a comment and to note action taken. Information regarding the student status came from a variety of sources, including postdoctoral mentors, research advisors, course instructors, program staff and administrators and occasionally from student peers. These were reviewed monthly with the steering committee, however over time the students requested that access to these dashboards was limited to the leadership team only.

Since the program has grown, we recently moved to a web-based system that includes not only dashboards as described above but also detailed information about the student's academic path, research productivity, milestones and other data that allows us to do longitudinal tracking and analysis. The system was customized using the Kintone framework and is maintained by the Assistant and Executive Director. More details will be provided in Chapter 6. What is important is that there is a high level of communication, both formal and informal from as many of the people that interact with the student as possible while respecting confidentiality. That information funnels to the leadership team and is entered in the dashboard. This allows us to see small changes that may indicate an issue and check in with the student before it magnifies. It also notes publications, accolades, and life events and we deliberately celebrate those accomplishments as a community.

We identified formal check in points across the semester (TK9) and during milestones for students in the Master's (TK10) and the PhD phase. As administrators, the tools help establish set times for assessing student progress. For the students, the milestones help to demystify the transition to grad school and clarify the expectations. For example, at the outset of the semester we let faculty know which Bridge students are in their classes, the supports they have available and that we will ask for mid-semester feedback (TK11). This greatly increases the level of communication from the course instructors to the program and has allowed us to intervene if needed. While not strictly a mentoring support, we also keep a programmatic calendar (TK12) and review our tasks for the month at the outset. This might include items as simple as order T-shirts or register students for the GRE. It helps to stay on top of tasks and keep connected with the students.

## **4.2 Academic Supports**

We provide a number of academic supports for students which vary based on academic tracks. Because the physics and astronomy students generally take classes together, and the classes are

the same from year to year, we are able to provide proactive group supplementary instruction. The instructors for these study groups are current PhD students, FVBP alumni, postdoctoral fellows or faculty. All receive compensation for their time. We employ one of the professors from Fisk as an academic math specialist who also typically leads the math refresher course as part of our pre-class bootcamp. To avoid the delay or stigma in students asking for help in their course, this instruction begins shortly after the class starts. It is mandatory and students can test out by getting an 85% or above on an exam. However, regardless of their grade, the students frequently continue attending the sessions and note them as beneficial. This additional time together also promotes the students working together and builds shared experience.

In some cases, depending on a student's level of undergrad exposure to a course, they may need one-on-one instruction. This is also the case for our biology and chemistry students as they are frequently the only one in their advanced Vanderbilt courses. For these, we provide assistance as requested rather than in advance and at times we are unable to find a tutor. In those instances, we try to work with the instructor, making use of office hours and additional meetings if needed.

Because we have such flexibility with our required curriculum, we are able to select courses that either meets a specific academic need of the students or provides exposure to the work they wish to pursue in their PhD. To do this, we meet each semester to ensure that the students are on track with their credits to graduate as well as provide input on their course selections for the next term. These course counseling sessions engage faculty from both Fisk and Vanderbilt to facilitate the process, as well as the Directors of Graduate Study, although the final decisions are between the student and advisor.

#### **4.3 Bridge Path Planning Meetings**

Master's students Bridge Path Planning meetings are held in September, June and February. Each one has a base set of things to cover and then a stage-specific aspect. We always discuss coursework and research as well as touching on program milestones, such as committee meetings. In the initial meeting, there is also time for simply learning more about each other personally. Simple, genuine interest in your students as people helps create the trust that makes the most productive mentoring relationships (Pfund et al., 2016; Haeger and Fresquez, 2016). At this point we also talk about career goals. The second meeting centers on the first committee meeting and building connectivity at Vanderbilt and beyond. Over the first summer, we focus on preparing for fellowship writing and PhD applications.

In the Fall of the second year, we revisit career goals and connectivity. The students have many demands on their time in this semester and so it is important to discuss plans for completing these tasks and identifying where FVBP administration can be supportive. In the Spring, we spend more time discussing options for PhD programs as well as plans for completing research and thesis writing. In the summer, we are focused on degree completion and transition to the PhD phase.

A good sign that a student is engaged in the program is the interactions that occur between these meetings. Is the student coming to events? Have they provided updates on action items or

general progress? Have they dropped by to just check in or chat? This is also the time to check in with the advisor and hear their perspective on student progress. Additionally, we ask: how can we serve you better or how can we engage you more? This can help understand student needs and allow for productive changes in the mentoring approach.

#### **4.4 Feedback Opportunities and Tools**

For students to remain in the program they must maintain a 3.0 GPA and maintain adequate progress in research. Our expectation is presented to the students as part of the FVBP handbook (quote below) given out at Orientation (TK13).

“There are basic Bridge standards for adequate progress in research. Your project should address a knowledge gap or test a clear hypothesis that you can explain to a general scientific audience. **The most fundamental expectation is that you will produce publication quality data that could contribute to a manuscript or grant proposal.** Publication quality data must be reproducible, contain appropriate controls and be understood by those in your field as presented. There is no requirement that you publish your Master’s work, though this should be goal for all students. Further expectations for research progress are established with your advisor.”

We also ask faculty to prepare individual research group expectations and commitments to be included in the handbook. These are important mentoring tools to smooth transition to graduate work and reduce conflict through enhanced communication.

To assess research progress and the student’s development as a scientist, we adapted a research rubric (TK14) from Newell et al., 2002 and created a feedback form (TK15). The rubric is used at least once a year by the student and their advisor, or more frequently if there is an issue with research performance. There are three categories: below expectations, approaching expectations and meeting expectations. It is made clear at the start that the students will be in all three categories as they start and should be fully in approaching and meeting expectations as they move toward degree completion. Topics addressed by the rubric include core competencies such as understanding basic concepts, technical skills, and independent thinking. It also touches on items such as professional conduct, communication skills, and data analysis and interpretations.

For regular usage, the student and their advisor review the rubric independently and then meet to compare. The student will frequently rate themselves lower than the faculty advisor and it can give them a boost to see where they are doing well. It also ensures expectations are being communicated, as faculty are meant to give specific, actionable feedback on where the student can improve. This is especially true if there is a situation that needs to be addressed that may involve the student being given a formal warning or put on probation from the FVBP.

We have recently created an additional feedback form to be used in committee meetings (TK16). This form allows for the committee to indicate the student’s progress in the following areas: verbal communication, project rationale and significance, attention to detail, ability to organize scientific data, familiarity with research literature, and progress toward thesis. There is space for



comments or a justification of the score given, with a section for specific goals. Having this form filled out at the committee meeting can also assist the faculty member, who might need input on how best to mentor the student and confirm that their expectations are realistic and appropriate.

#### **4.5 Community Building**

While it could be viewed as a component of building mentor networks, our intentional activities to build community are some of the most significant things we do to promote retention and success. Our research indicates that students are attracted to the sense of community and genuinely feel it a familial space. Students indicated that the relationships helped with retention and developing sense of belonging (Roby et al., in preparation).

We begin with events that build community among the incoming cohort of students. While it isn't always possible due to personality differences, the literature supports our hypothesis that integrated cohorts have improved outcomes (Tompkins et al., 2016; Stadtfield et al., 2018; Maudlin et al., 2022). We start by setting the tone that the Bridge is a Family. Offers of admission (TK7) welcome the students to this family and we continue to use this language at all events, acknowledging that families can be messy and not always get along but there is sincere caring and a deep commitment on the part of the program to support the student's wellbeing.

Once the incoming cohort has been selected, well before they arrive, the students are provided with a Welcome Packet (TK17) and introduced to the Welcome Committee. This is a group of student volunteers that introduces themselves and is on hand to answer any questions they might have about moving to Nashville, setting up their new place, or transitioning to grad school. These students are then also present at Orientation, meet with the students at least once in the following weeks and frequently lead the campus tours.

##### **4.5.1 Orientation and Bootcamp**

During Orientation (TK18), students are given FVBP swag to help build their identity as "Bridgers" and we talk about our personal lives as well as the programmatic requirements described in our handbook (TK13). There is breakfast as well as lunch provided and then a large student-only meet-up following the day's events. All students, as well as their friends and significant others, are invited and it might be an arranged happy hour in town or a catered, on-campus gathering with an ice cream truck. As long as there is free food, and no agenda, the students enjoy catching up with their classmates and meeting the new students.

Then over the course of the next 8-10 days, the students participate in Bootcamp. There are two Bootcamp tracks, one for biology and chemistry and another for physics and astronomy. For biology and chemistry, this will include beginning work in the lab, lab safety, lectures giving overviews of the research at Fisk and statistical tools for data analysis. Astronomy and Physics spend the morning doing a math refresher course and the afternoon learning coding skills.

However, one of the most important parts of the day are the supplied bootcamp lunches. It is important to note that we try to feed our students whenever we can and provide take home

boxes, understanding that money is particularly tight when beginning the program. The lunches have a dual purpose; we have short meetings in those times to cover things such as mental health services, logistics of getting around campus, etc., but also time for the cohort to relax and get to know each other with no other faculty or administration present.

#### **4.5.2 Wellness Mentoring and Supporting the Bridge Learning Community**

In an effort to provide more support for student mental health we have partnered with a licensed psychologist and PhD, with lived experience with HBCU and PWI STEM culture as well as a specific focus on barriers to mental health care access for minoritized students. Starting in 2020, this pilot program has two components. One-on-one Wellness Mentoring and an 8-week Supporting the Bridge Learning Community. Both programs are introduced at Orientation and again during Bootcamp.

Wellness Mentoring is intended to be short-term, connecting students to mental health professionals and other resources. For some, it may include exploration of personal and professional goals, investigation of cognitions, emotions, actions and social support toward these goals, navigating graduate school, and any combination of these factors. Each “chat” lasts one hour, and includes documentation of the encounter, follow up emails, provision of additional resources, referrals if indicated, as well as other between-visit supports.

The Supporting the Bridge Learning Community is an 8-week, 1 hour per session curriculum that finds creative ways to explore and share resources for students matriculating through the FVBP. This Learning Community is open to current Bridge students regardless of their primary institution. The overarching intention is to improve sense of balance & wellness through graduate studies, enhance stress management skills, and cultivate introspection through mindfulness practice. Each class involves mindful practice, psychoeducation, and resource sharing. Each class is offered virtually. They are:

- Introductions and Defining Mindfulness
- Exploring differences between stress, trauma and wellness
- Improving balance through mindful practice
- Food, stress, and depression
- Skills for sleep
- Finding balance in graduate school
- Setting boundaries and creating healthy relationships
- Sustaining Balance and Support, Sharing resources and Class Feedback

Success in this project would include, improved sense of student well-being, increased understanding of mental health resources and how to access them, and reduced stigma around mental health care. The majority of the feedback to date has been positive but the number of students engaged is still small. We are currently assessing the impacts of the program and look forward to its further development.

#### **4.5.3 Social Events**

As described above, social events are an important part of setting the tone of community at the outset of the program. We try to keep that momentum going with planned social activities approximately every month. We seek student input on what they are interested in doing and the events might be open to the entire FVBP community or just the students and their guests.

Faculty or staff hosted outdoor picnics and games are appreciated. Game nights, movie nights, bowling, pumpkin carving, kayaking, talent shows and trivia are just some examples of activities. We also might do 5k races or a service event to benefit the local community. These can be important not only to generate important shared experiences but also to reconnect with the larger FVBP community. We recognize not every program has a budget for such events but it can be kept simple, like a pot-luck picnic or a hike. The more important aspect is consistency in engagement and recognition that rest and fun is important to academic and programmatic success. These events further demonstrate a genuine care for the well-being of our community, that time is taken to nourish ourselves and our relationships.

#### **4.5.4 Mentor Mixer**

We frequently talk with the students about the importance and basic structure of a mentoring network. We provide them with a template to reflect on different mentoring roles, identify their current mentors as well as their mentoring needs (TK19). Shortly after we have our annual Mentor Mixer event. The Mentor Mixer has as its intention to bring together students, alumni, faculty and post-doctoral fellows who are either looking for mentorship, interested in mentoring, or both. Participants are invited from both institutions and they do not need to be formally associated with the FVBP. This is an unstructured event where everyone is strongly encouraged to interact with new people. The students consistently report that they enjoy this activity and find it valuable. However, we have yet to see any significant impact on developing mentor-mentee relationships. Our next steps are to test the hypothesis that it enhances their understanding of and need for mentoring networks or boosts self-efficacy in making mentor relationships.

#### **4.5.5 Bridge Research Celebration Day**

Envisioned by a FVBP PhD alumna while earning her PhD, the Bridge Research Celebration Day is a half-day event that takes place in August at the end of bootcamp and as a kick-off to the academic year. It is put together by a student committee and facilitated by the Assistant Director. Starting with a lunch keynote from a Bridge Program alum, it is followed by six to eight 10-minute student talks. These presentations start with an About Me slide to help us get to know each other more on a personal level and to recognize the importance of the whole person. After a group photo, we then enjoy a happy hour poster session and finally a welcome dinner. It is our biggest event of the year and serves to introduce the new students and remind everyone of the breadth of research across our academic tracks. Cash prizes are given for best talk and poster.

This is not your typical research symposium for two main reasons. First, it truly is organized by the students. They set the agenda, solicit and select abstracts for talks, participate in talk practice and physically help set up and break down as needed for the event. Second, it is a party atmosphere. Because students already have institutional and department symposia and conferences at which to present, we simply request a recycled abstract or poster. The oral

sessions are intended for a broad audience and stress the big picture of the research. It is a low-stress, positive atmosphere that allows people to build their self-efficacy, reaffirm their scientific identity, connect, celebrate each other's accomplishments and enjoy themselves.

# Fisk-Vanderbilt Basic Logic Model – Promotion and Professional Development

Goal: To prepare students for transition to and completion of the PhD with employment

Rationale: Student promotion coordinated with stage-specific professional development improves enhances skills growth, promotes self-efficacy and scientific identity

## Preparing students with a view toward individual goals

Need to Align Ppportunities and Skills Development with Individual Goals

Help Students Develop Professional Relationships

Establish Expectations and Promote Understanding of STEM Academic Culture

Provide Opportunities for Career Development and Job Placement



## Key Activities

Bootcamp, Professional Skills Course and Evening Seminar Series

Conference Attendance and External Research Opportunities

Achievement Recognition and Community Building Activities

Written and Oral Communication Skills Development



## Outputs “Goal State”

Increased Self-efficacy to Accomplish Individual Goals and Complete Program

Development of Internal and External Professional Networks

Sense of Belonging in Bridge and Broader STEM Community

Improved Research and STEM- related Professional Skills



## Outcomes

Completion of Master’s and Transition to PhD or Employment in STEM+ Spaces

Completion of PhD with Employment in STEM+

## **Chapter 5- Promotion and Professional Development**

According to Spivey-Mooring & Abbey (2014), graduate students who are situated in spaces and atmospheres where their professional development is integral to their overall success, generally outperform their peers. Acknowledging how the navigation of graduate school presents unique challenges for those transitioning from undergraduate studies (Meyers & Pavel, 2011), the FVBP's efforts to ensuring the promotion and professional development of participants is not an extracurricular endeavor, but a central one. As such, the program has sought to employ practices that reflect an inclusive and just STEM community where participants present in a myriad of ways and in spaces that hold their full identities.

Historically, how this worked for students in STEM has centered merely on conference presentations and organization affiliations (Thompson et.al., 2016). Graduate students who present at conferences and participate in their disciplinary organizations are provided valuable resources and opportunities to network (Duranczyk et.al, 2015). Given the importance of such participation to students' networking and overall professionalism (Termini et.al, 2021), the FVBP provides support for conference attendance. This looks like providing poster printing services, opportunities to present in a safe setting, as well as financial support to attend meetings.

The core of our professional development plan is to provide stage-specific offerings and whenever possible to align opportunities with the student's goals and interests with an eye to employment. Part of this, of course, occurs at admissions in the sense that we try to ensure that we can serve the students based on their desired research and long-term goals. However, once a student has arrived, we make an effort to understand their motivations, academic and professional development needs and career goals. The aim for us is not to transition to the PhD, it is degree completion (Master's or PhD) with a STEM related job and each of those students is viewed as success.

Our graduates are employed in a variety of roles, including industry, national labs, administration and education. Four students have secured research based tenured track faculty positions. It's a hallmark of the program that students remain members of the Bridge Family indefinitely. This means we will assist not just with securing their first position following the Master's or PhD, but further employment as well, helping with resumes, connecting people to the alumni network, practicing job talks and reviewing application materials. As our alumni move through their careers, we continue to advocate and champion them.

### **5.1 Professional Skills Course**

The central component of our professional skills planning is the year-long course held at Fisk, *Professional Skills for Graduate Students* (TK20). The one hour, one day a week course has multiple objectives. First, it is a community-building opportunity, as it is the only course all students across all tracks take together. Second, since the course is led by the Assistant Director, with support from the Executive Director, students become familiar with them as mentors and have weekly access to talk about concerns without having to come by the office. Third, it is used

to provide responsible conduct in research training in addition to online training. Fourth, it is designed to facilitate discussions of project goals, expectations and progress between students and their advisors. Fifth, it develops oral and written communication skills. Finally, it helps the students prepare for the transition to PhD. At the end of each semester, we review the syllabus with the students and use their input on the organization and topics of the course.

The first semester of the course begins with discussions on challenges in the STEM research environment, including discrimination in STEM higher education, stereotype threat and imposter syndrome. This includes a values affirmation exercise that is indicated to have a long-term positive impact on grades (Peters et al 2017; Jordt et al 2017). We then turn more to fundamentals of professional skills, such as setting goals, building self-efficacy, mentor networks, and forming a committee. The students are then tasked with giving a 3-minute presentation on the big picture of their Master's thesis project with a focus on the overall question, its importance, and how it will be addressed. They are not required to have any data, but should have discussed and practiced with their advisors who are invited to attend the final presentation. We find that encouraging this type of conversation early helps resolve project plans and bring advisors and students onto the same page about research.

The second semester focuses on responsible conduct of research, as well as writing skills, with a particular eye towards PhD and NSF GRFP applications. Essentially, we help the students prepare for the heavy workload of the first semester of the next year when they will be taking courses, doing research, and applying for fellowships and graduate programs. Students learn about and draft personal statements, CVs, abstracts, and Individual Development Plans. We have found the students respond well to advice from their other students (Lorenzetti et al., 2019) and so we have two student panels: one focusing on the graduate school application and interview process and another discussing the first year PhD experience. Reviewing the course at the end of the year has allowed us to refine the topics to what is needed and valued, as well as offer them in a more stage-specific manner.

## **5.2 Evening Seminar Series**

Once a month during the academic year, we host an evening seminar that is primarily professional skills topics but can also be role-modeling talks or social events. We begin these events slightly earlier than the formal program will start, so that we can gather for dinner and fellowship. This is an excellent informal way for the administration to check in with students.

The most popular of these events are the student research talks given in Bridge Research Celebration Day style. As of August 2022, we have 52 PhD alumni, and are now able to have career panels. The panelists talk about their work, their path to finding employment, and opportunities in their organizations. These happen once or twice a year, sometimes as a part of the Celebration Day itself.

We also try to feature post-docs or faculty of color both from Fisk and Vanderbilt as well as locally. This year in our work with our student activism committee, we have decided to have a special seminar featuring a panel of representatives from local social justice and community

organizations to highlight ways students can be involved. We keep this series at a consistent time of the month but are flexible and open to student ideas as to the presentations. It's yet another opportunity for us to strengthen our Bridge Family relationships.

### **5.3 Scientific Communication Skills Development**

From the above chapters it becomes clear that helping develop general and scientific communication skills is inculcated throughout our program. In addition to those activities and in response to PhD advisor feedback, Fisk created two new one-credit writing courses. These are both offered in the Spring semester and the first course results in a completed draft of the first chapter literature review needed for the Master's thesis. The second course is focused on drafting a manuscript from the student's own research data that then comprises the majority of their thesis. This serves to not only help the student's build self-efficacy in writing but to also promote the scholarly activity of their research group.

We offer assistance with all writing projects, in particular personal statements, Master's theses and grant proposals, including drafting realistic timelines for completion. We will review CVs, fellowship applications etc. Though not incredibly well attended, we have offered regular writing sessions (with snacks) and can both facilitate a group or serve as an accountability partner. Those students who do attend report that it has made a genuine impact on completing the Master's thesis and PhD dissertation.

Beyond the mentoring from a student's research group, it is important to obtain feedback from knowledgeable non-experts (Grieve et al., 2021). The Bridge Administrations provide extensive mentoring in oral presentations. They are available for any talk the student might be giving, for a conference, qualifying exam, Master's or PhD defense or job interview. For Master's students, mock interviews to prepare for PhD programs visits have helped improve the student's confidence and ability to discuss research.

### **5.4 Conference Attendance and External Research Opportunities**

Engaging with the larger scientific community promotes scientific identity and belonging (Museus et al 2017; Quayle et al 2019). Based on student's individual goals, we attempt to align opportunities or connections that will help them to build networks outside Fisk and Vanderbilt. During the Master's phase we financially support students to go to at least one conference. This might be to present their research but it may also be a more specialized professional conference if the students are pursuing a PhD program or job that might not be well-represented at a general scientific event. We will also provide support for conference attendance to help identify postdoctoral positions or employment opportunities for students that are close to completing their PhD.

Students may do a portion of their work at another institution or National Lab. This might be summer research that becomes the focus of their Master's thesis. It could take place at NASA, The Harvard Smithsonian Center for Astrophysics, Oak Ridge or the Y-12 Security Complex, for example. The best outcomes occur when those projects can be continued over the academic year and students are co-mentored by a Fisk or Vanderbilt faculty member along with the external



advisor. In many cases, this can turn into PhD research, either conducted as Vanderbilt students or at another University. Of course, these opportunities are limited based on the grant funding of that student at Fisk or what funds are available externally. In all cases, extending the student's mentor network is a benefit to them professionally (Montgomery, 2017; McReynolds et al., 2020).

## **Chapter 6- Data Collection, Evaluation and Longitudinal Tracking**

Being able to adequately self-evaluate a program begins with data collection. For a program that is just starting out, it will save considerable time in collection and analysis to develop a comprehensive and longitudinal system. Be sure to include any information that is requested or required for grant reporting and note how long tracking must continue. We find that it helps to have one person be the primary data manager to assure the quality of the data and to quickly access information. Below we describe the types of data we collect, as well as evaluation needs.

### **6.1 Types of Data Collected**

The data we collect falls into approximately the following categories, Recruitment Data, Application and Admissions Data, Basic Student Information, Academic Pathway, and Transition Data.

#### **6.1.1 Recruitment Data**

To better understand how students hear about the program, we added a link to a small, three question survey to the letter of interest (TK1) that students receive when they reach out to us either directly or through our website. The answers are time-stamped and stored in a Google spreadsheet. We ask; 'how did you hear about the Bridge Program; what national or regional scientific meetings did you attend this year and; did you speak to a Bridge representative at one of those meetings?' Recent analysis of the data showed the majority of student found us through internet searches and the major conferences they attended were SACNAS and ABRCMS. We also see a significant increase after we send the letter to McNair directors in March. We have used this information to decide where to attend conferences, boost our social media use and better engage faculty in recruiting.

#### **6.1.2 Application and Admission Data**

We only recently began assembling data regarding our pool of applicants. This helps us demonstrate in grant proposals that we have the demand to meet our requests for student funding. We record their undergraduate institution, racial and ethnic demographics, incoming GPA and GRE if provided. The information has been probed to investigate bias in our selection of students during the application review and selection process. As we do not use the GPA in deciding who is asked to interview, we examined 3 years of data, showing no significant difference between those we interviewed and those we did not. This supports the notion the GPA is truly not a driving factor in our selection process. We also collect GRE data if provided but do not use it for admissions decisions. Rather, we employ this information to demonstrate quite clearly the lack of correlation between the GRE and degree completion and employment. Once students are admitted they go into our formal data collection system.

### **6.1.3 Basic Student Information**

Before the students begin the program, we acquire the basic information such as racial and ethnic demographics, preferred name and personal pronouns, active email and phone, emergency contact and dietary restrictions. Also included is an anonymous survey that asks about other underrepresented categories such as gender identity, first generation status, veteran status, disability and economic disadvantage. The decision to keep it anonymous was to give us a fuller picture of the student body and provide more information in our grant reporting without making the students feel uncomfortable revealing the information.

In response to student concerns about how their information is shared, we developed a permissions questionnaire that is administered before students arrive. It asks if we can post or use pictures of them or talk or post on social media regarding their accomplishments. We further clarify the breadth of which we can share information. For example, we may have permission to share their accomplishment internally among the FVBP network but not externally such as in a presentation or with the news media (TK21). As a general practice, even with the permissions, we check with the student before sending anything out publicly on social media.

### **6.1.4 Academic Pathway Data**

Once students arrive, we begin to establish their academic pathway data with attention paid to transitions, discussed further in the following section. We establish their basic information such as track and primary research advisor, then add information and documentation. For the Master's students, we record their committee members and the times of their meetings to ensure they are staying on track. This is particularly important as delayed or missed committee meetings are a clear indication that we need to check in with the students and advisor. We keep copies of the summaries and feedback forms for the meetings. We note any external advisors or research locations.

To ensure fairness when it comes to supporting conference travel for students, we record travel that we financially covered, as well as if it was a poster or oral presentation. If we pay for the GRE, – general or subject – we record those scores. This is solely as a means to see if scores change significantly with retaking the exam and for further analysis of scores related to outcomes. Once students complete the Master's, we record their final Fisk GPA as well as retain a copy of their unofficial final transcript. For all students we collect their publications and record any fellowships they were awarded.

### **6.1.5 Transition Data**

In agreement with our theory of action (Stassun et al., 2010), we pay close attention and provide increased support at transition points. We also use these points for self-evaluation and reporting of student outcomes over time. As they apply for PhD programs, we ask students to report where they applied and any acceptances. Their competitiveness for PhD programs speaks to their work in preparation and it is best when students have options when choosing a program.

We track Master's completion and transition to PhD, that is the percentage of students accepted from those that applied. This is what we consider our "retention to the PhD" rate. Preliminary and Qualifying exam dates are collected, as well as Dissertation Defense and official graduation dates. Tables on PhD completion and attrition are used to determine time to degree and 8 and 10-year completion rates for comparison to the national average. The data can be parsed by track, self-identified gender and racial and ethnic demographics. Finally, we track Master's and PhD alumni employment. For employment we note the work sector and the current and past positions.

## **6.2 Data Collection Systems**

As the program was so small when it began, initial data collection was sparse and on various word documents and excel spreadsheets. Over time, as the program grew it was critical to have the capability to do more detailed analysis, so our data collection grew but our system was still unevolved. Thus, we missed the opportunity to collect important information for program evaluation and efficacy reporting, especially in understanding the effects of programmatic changes over time. As part of our drive to build a more robust system we created a number of Excel spreadsheet templates (TK22) that may be useful for those both just starting out or seeking to improve their outcomes tracking.

Now that the program has admitted over 150 students and is actively tracking more than 50 at a time, we invested in a web-based and customizable platform called Kintone. It is easily queryable and can produce tables and graphs to visualize the data analysis. To minimize data corruption and increase privacy, only one or two people are responsible for data entry, and access is managed such that only a few users can see the data. The platform allows us to upload and store documents such as feedback forms, IDPs, Master's theses and publication documents. Within this platform we created student dashboards that allow us to get basic information about students at a glance. There, we add notes about student well-being and performance and can color code the file to red, yellow, or green depending on if the student needs attention or is solidly on track. Overall, whatever system you build, it should be thoroughly adaptable and serve both the program and the students, by not only looking at outcomes but also supporting and improving mentoring practices.

## **6.3 Self-Evaluation**

The FVBP functions on a continuous improvement model, meaning that we are routinely introspective, questioning if we are providing what students need for success, and being responsive to students' wants and needs. We use quantitative data, but actively seek out the opinions and reflections of both the administration, faculty and students in formats from Town Halls, to Internal Advisory Boards, to Steering Committees, to anonymous surveys. Because the FVBP funding is generated from several grants with different objectives and reporting requirements, our evaluation has been largely fragmented and done with more than one evaluator at the same time. It would be beneficial to create a formalized self-evaluation plan that is reflective of our theory of action and the programmatic logic models shown throughout the Guide.

Such a formal evaluation would include an annual survey that has slightly different sets of questions based on the student's current stage. For example, we would inquire more or less about scientific identity, self-efficacy and program engagement based on if the student is in the Master's or PhD phase. There might be questions regarding Orientation that are only directed at first year students. Again, given the attention to transitions, there would at minimum a Master's to employment/PhD transition, First year PhD, and PhD to employment interview protocols. Some of this already takes place in one-on-one meetings with FVBP administration but the information is not recorded or centralized for analysis. Optimally, we would create these with the input of an external evaluator, so we use validated questions or are doing cognitive interviews for our own validation. We encourage the use of the literature as well, to adapt and adopt evaluation instruments that have already withstood rigorous quality tests and produced useful, actionable data.

### **Conclusion**

It is important to reiterate that a program can always be better, and to become better, it is vital to listen to your students. It can be hard to invite critique, but it is too valuable to ignore. This brings us back to the fundamental take-away of the FVBP, that its strength is the creation of mutually beneficial and genuine relationships between all stakeholders. We are proactive and intentional and that is a mindset that can be brought to any program, department or institution. More than our individual research-based activities and tools, a sense of care for our students and the feeling of belonging in our community is what sets us apart from more traditional models of graduate education.

However, these practices only address diversity and inclusion. They do not confront the policies and culture of STEM and academia that are racist, discriminatory, marginalizing and excluding (McGee, 2020; McGee, 2021). We have had limited success with institutionalizing our methods at Vanderbilt even though the interest in the FVBP model remains high nationally. Real cultural change will be a challenge to all of us to make a difference, but the time for staying silent is long past.

If you use the materials and tools provided in this Guide, please note they are adapted from the Fisk-Vanderbilt Master's-to-PhD Bridge Program. We would like to thank the many agencies, that have funded the FVBP and our LSAMP Regional Center of Excellence in Broadening Participation (NSF HRD 1826755) for making this Guide possible. If you want to learn more about our program you can reach us through the Contact Us link (<https://www.fisk-vanderbilt-bridge.org/contact>) on our website.

### **Please cite as**

**Stroud, D., Tanenbaum, C., Roby, R., Campbell, E. P. C., Holley-Bockelmann, K., & Burger, A. (2022). Fisk-Vanderbilt Master's-to-PhD Bridge Program: A guide to building bridges Fisk-Vanderbilt LSAMP Regional Center of Excellence**

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