WAKE FOREST
UNIVERSITY

GRADUATE SCHOOL *of*
ARTS & SCIENCES

Biomedical Graduate Programs
MS and PhD
2018 Annual Report and
Academic Plan

Andy Kwok – "Patience"

Graduate School of Arts and Sciences
Biomedical Graduate Programs
(Academic Year 2018 and 3 Year Rolling Plan)

I. Narrative analysis

The Graduate School fulfills a unique role among all academic units by bridging the entirety of Wake Forest University, enriching and enabling the very best in post baccalaureate education and research training. The Graduate School biomedical sciences programs have the special responsibility of equipping students with the advanced knowledge and special skills needed to advance biomedical discovery and secure leadership in the knowledge-based economy of the 21st century. Our goals are fourfold: *1) To be the preferred destination for students seeking graduate study in advanced biomedical research methods to develop treatments and cures for human disease; 2) To foster new programs of high value to students, faculty and the University; 3) To be known for advancing the potential of graduates to thrive as independent professionals in highly competitive professional environments; 4) To foster a learning environment that reflects the diversity of our society.*

There were several important accomplishments of the Biomedical Graduate Programs during the past year. The achievements include:

- The Biomedical Sciences graduate programs continue to operate in a financially sound way that allows continued growth. Our sustainable budget model and growth has provided additional resources for graduate faculty and student support.
- Achieving excellent program outcomes as exemplified by granting of 76 degrees, including 20 doctorates and 56 Masters degrees, numerous student and faculty awards in relation to graduate program activities, high levels of student satisfaction, and excellent degree-completion and placement metrics.
- Achieving an average 5.31 years to PhD completion, which is near the duration recommended by the NIH Biomedical Workforce Working Group. Masters students complete their degrees in an average of 1.98 years.
- Maintaining and expanding gains in overall percent of under-represented minorities at a very respectable 31% of incoming graduate student matriculants, a 5% increase over last year. This past year, our biomedical graduate programs have achieved the distinction of matching the overall percentage of black and Hispanic individuals in the U.S. population (https://www.census.gov/quickfacts/fact/table/US/PST045217), to become one of the most diverse academic units of Wake Forest University.
- Supporting postdoctoral fellows with professional development, teaching opportunities, mentoring programs and other forms of service.
- Continuing to develop innovative new programs that are tailored to equip students with the tools needed to solve important problems while improving societal well-being and human health, in alignment with our biomedical mission.
- Approval and launch of a new graduate Masters program in Addiction Research and Clinical Health to prepare specialists in addiction services in a modern healthcare setting (see: http://arch.graduate.wfu.edu/).
- Promoting a sense of community and scholarship through co-sponsoring the annual Graduate Student and Postdoctoral Fellow Research Day.

During the 2017-18 year, the Biomedical Graduate Programs were led by Dean Dwayne Godwin, Assistant Dean Allyn Howlett, assisted by 4 full time and 2 part time staff. Dr. Erik Brady serves as Director, Graduate School.

Overall Strengths, Opportunities, Aspirations and Results are outlined in the chart below and expanded upon in the narrative:

Strengths	Aspirations
• Research and Training in Biomedical science • Leader in combining business and scientific training, career development • Direct connection with human health and well being • Extraordinary scientific resources of the Medical School • Strong NIH funding portfolio for graduate and postdoctoral training • Continuously improving finances • Diversity of student body	1. Diversity matches the diversity of broader society 2. Increase PhD program size 3. Improve development support for teaching, scholarship, fellowship support 4. Achieve teaching and startup support for novel programs 5. Increased tuition revenue for faculty compensation 6. Expand student base and reach
Opportunities	**Results** (Numbered from Aspirations)
• Innovation Quarter expansion • Great potential for growth of programs • Development of MS programs of high student and institutional value • MS as a "sandbox" for joint College, B school and Grad School programs (e.g., 4+1). • Expansion of Professional and Career Development for biomedical science programs • Online and asynchronous education	1. Compare program diversity with census figures, peer institutions 2. Increasing PhD matriculation, marketing and enrollment 3. Increased contacts with Development, internal marketing to represent value 4. New program development cycle 5. Overall increase in enrollment, increased implementation of faculty compensation plan. 6. Pilot online and asynchronous learning.

Strengths

- The Biomedical Sciences Graduate programs provide comprehensive training in basic and translational sciences. All tracks possess integrated core curricula that provide each student a knowledge base and competencies in their chosen field of study. Electives complement and extend student's knowledge base in targeted areas that prepare students to tackle future challenges in human health and disease.

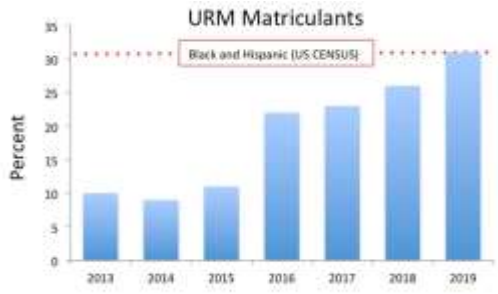
  Our programs have a demonstrated commitment to training students for multiple, diverse career paths in academia and industry. We are a world leader in combined business and scientific training through innovative programs such as our

PhD/MBA program, and other specialized training that combines real world industry experience with advanced degree training. The integration of basic sciences with clinical and translational sciences on the biomedical campuses provides tremendous opportunities for connecting research with human health. Our curriculum emphasizes strong laboratory-based research experiences and opportunities for individualized curriculum and career professional development.

- Traditionally, the Biomedical campus has emphasized education and training, leading to the PhD, as the main terminal degree. Our graduate students contribute directly to the extraordinary success of the Medical School in competing for National Institutes of Health (NIH) funding, which in turn makes a major positive impact on University rankings through enhanced student resources. Student thesis and dissertation projects support both preliminary studies and maintain existing grants. The strong NIH portfolio of the biomedical science campuses is highly dependent on a strong graduate program with highly productive graduate students, who support NIH funding through first authored publications.

  The reputation of Wake Forest University is strong, and new programs at the MS level have drawn competitive applicants. A range of new Master's programs offer new possibilities for students who are seeking advanced training without the commitment to PhD study, provide entry points for interprofessional programs of high value, and for novel programs for graduate level professional training. An excellent working relationship with the Arts and Sciences Graduate Programs enable joint activities and prospects for jointly offered degrees. Moreover, the MS is proving to be a powerful pipeline for PhD recruitment.

- Once one of our greatest traditional weaknesses, our diversity, is now becoming one of our greatest strengths. Thirty one percent of our incoming matriculants arise from diverse groups (up 5% from FY18 and up a remarkable ~21% from FY13). This compares favorably with the proportion of Blacks and Hispanics in the U.S. population (~31%) and in North Carolina (~32%). Our success can be attributed to the incorporation of diversity as a core value, and the considerable success of pipeline summer programs and our biomedical sciences MS program. While our focus has been the biomedical graduate school as a whole (including biomedical MS programs), our aspirational goals are to see concurrent increases in diversity within our PhD programs, and to support the hiring of diverse faculty. We must also ensure that our education environment supports our growing diversity. To this end, we will foster a greater sense of community with near-peer mentoring and improved access to career counseling. Growing diversity will create new opportunities as well as challenges. Our watershed moment in achieving unprecedented diversity in our incoming graduate student demographics confers an obligation to strongly focus on inclusion. Our leadership in this regard among academic units confers an obligation to disseminate applicable best



practices. Our students can help in university-wide efforts to amplify and connect a message of diversity and inclusion to students who we would recruit into our academic programs. One example of this is the formation this year of our WFU student chapter of SACNAS: the Society for Advancing Hispanics/Chicanos and Native Americans in Science (pictured).

- Our demonstrated commitment to diversity and inclusion is especially fitting given our history as being the home of the first woman and minority who earned a PhD through our university. Fifty years ago in 1968, Dolores Garcia Evans (pictured), a native of Mexico, became the very first PhD awarded from what was then called the Bowman Gray Graduate School. She and her husband Doyle worked for many years together on enterotoxigenic E. Coli and Helicobacter pylori. After her death in 2017, her husband Doyle established the first basic Science chair in Microbiology and Immunology in her name. It's therefore especially fitting that in a year designated by the Dean of the Medical School as the "Year of Inclusion", and the Graduate School on celebrating our **golden anniversary**, is poised to both represent the power of diversity as well as to contribute to its success.

Opportunities

- Because of our rich portfolio of both basic and clinically relevant research, we are well-positioned to align with the biomedical mission and to grow in ways that will enhance the strategic research initiatives of the institution, as well as providing for workforce development needs. We anticipate additional growth that aligns with our biomedical mission with an overall strategic goal to transform the health system in which we are embedded into a Learning Healthcare System. In this regard, the Graduate School provides an essential vehicle for building novel programs that advance institutional objectives in clinical research management and healthcare leadership. This is embodied by two new MS programs, the Masters in Clinical Research Management (MCRM) and in Healthcare Leadership (MHL). Leaders have been identified for these programs and strategic program rollouts are currently in development.
- The Wake Downtown initiative will be a future opportunity for collaboration and advanced training. In particular, our successful model of "4+1" BS/MS programs is envisioned to include the new education tracks to be housed downtown. Two are under specific development, including an expansion of the premedical post-baccalaureate program to include both a 4+1 track with the Reynolda campus, and a focus on non-medical school professional tracks. The new program in Addiction Research and Clinical Health (ARCH) follows this model. This program development is highly convergent with the new Addiction Center, and provides additional opportunities for alignment of MS and PhD training. New program collaborations involving Wake Downtown will require reciprocity and leadership from the College in order for this vision to be realized.
- Recent progress in establishing online and asynchronous learning through WFU and WFSOM initiatives will be a tremendous opportunity for the development of new MS

programs in Clinical Research Management as well as the proposed program in Healthcare Leadership. Both of these programs are anticipated to appeal to continuing learners who may be holding full time positions. This focus on executive-level training and clinical trials management that can be accessed and (at least partially completed) through an online platform will expand the student base and global reach of these programs.

- Graduate students often serve as the bridge between research groups, leading to fruitful new research collaborations where one may not have previously existed. Owing to their dispersion throughout the university, both on the Bowman Gray and Reynolda campuses, they often are hidden in the overall structure of our university. This extends to the Graduate School academic offices, which, unlike our peer educational programs do not possess a "front door". This has the unfortunate outcome that the spaces that are dedicated to our students fall short of their needs. The connector space in Innovation Quarter that bridges Wake Downtown and the School of Medicine building presents an incredible opportunity to define a "hub" for graduate students that would allow graduate students across the university to have space reserved specifically for them for small group study, student group meetings, relaxation, etc.

Aspirations and Results

1. ***Diversity that matches the diversity of broader society.*** While it may seem odd to define diversity as an aspiration given the strides the Graduate School has made, it reflects the fact that the achievement of a diverse student body is only the start of the measures necessary to sustain it. Proximally, support for the summer programs and other pipelines that helped realize our current state must be prioritized, as well as new outreach and recruitment initiatives. Insuring that diverse students continue to encounter a welcoming environment, and faculty whose composition also becomes more diverse are important goals. Promoting opportunities for personal and professional development must be enduring commitments. **Results**: Our assessment effort will go "beyond the percentages". While we know how diverse our programs are becoming, we hope to partner with our office of Diversity and Inclusion and Office of Student Inclusion and Diversity to determine best practices in measuring the success of inclusion efforts. We will compare program diversity with census figures, and - where available - data from peer institutions. We will also take a more granular approach to our diversity by assessing recruitment at a program-by-program level, as well as MS and PhD level.
2. ***"Right-sized" PhD programs of high quality.*** Determining the correct size of PhD cohorts each year remains an important and difficult challenge. Some programs desire very large programs, which carry with it risks to students in the event that investigators lose federal funding. The Graduate School has had a rational approach that entails securing estimates of how many students can be supported from each of our constituent Tracks. This approach has kept requests for support beyond the first year stipend to a minimum. However, the disadvantage in such a system is that there is little room to increase stipend support (which we have done to maintain parity with competing programs) or to provide for necessary growth. While we will continue to seek sources for PhD scholarship and support, our major goal is to maintain the proper balance in PhD program size while improving the competitiveness of the programs. **Results:** We have the goal of increasing PhD matriculation, and have hired a

recruitment and enrollment manager to coordinate marketing, and to provide stronger outreach and presence. Our measures in this category will be increased number of contacts, recruitment events and recruitment visits. Student competitiveness will be assessed by typical application metrics, including GPA and prior research experience.

3. ***Improve support for scholarships, fellowships and teaching.*** In tandem with increased enrollment, which is beneficial to our tuition base, we must also be mindful of the overall debt burden taken on by students. Of particular note is that according to the National Center for Education Statistics, 54% of first generation college students said they do not continue on to higher degrees because they cannot afford tuition (https://nces.ed.gov/pubs2018/2018009.pdf). An increasingly diverse student body means that larger numbers of students may fall into this circumstance. Thus far, the Graduate School has kept tuition costs controlled through the use of tuition scholarships, but this also reduces available resources to support teaching. We are therefore increasing our engagement with the WFSOM Development office. Recently, the SOM Development office developed contacts with the family of our first PhD student, Dolores Evans, and established a basic science chair within the School of Medicine. While beneficial to the School of Medicine, the Graduate School was not included in this process, our students therefore did not benefit from it. Dean Godwin has also founded the first committee of NIH training grant directors to coordinate best practices and to encourage submission of new and revised training grant applications. **Results:** we will monitor the numbers of contacts with the Development office, increase internal marketing to ensure better coordination, and monitor the number of T32 new and revised applications.
4. ***Achieve teaching and startup support for novel programs.*** Because of our rich portfolio of both basic and clinically relevant research, we are well-positioned to align with the biomedical mission and to grow in ways that will enhance the strategic research initiatives of the institution, as well as providing for workforce development needs. We emphasize development of Masters level programs that will leverage the unique strengths of the biomedical campuses, and improving the quality and rigor of our PhD programs. Increasing demand of companies for scientists well trained in translational research is an opportunity, in areas such as clinical trials management, intellectual property management, informatics/analytics, and drug discovery. Thus, our aspirational goals to expand collaborations, joint programs and teaching (involving all WFU campuses), and internships will enable development of new degree programs in areas of regional and national need. As noted, improved investment is needed to provide initial faculty time for development of these programs. **Results:** Results from these efforts will be realized in two ways: **1)** The appointment of biomedical graduate faculty is held by the WFSOM, with the expectation of significant extramural grant support. The provision of an additional 10% FTE to faculty will, over time, provide the necessary time to engage with graduate programs as a paid contribution of overall compensation. This, coupled with our own efforts to establish a working compensation model will make our program more sustainable, and our progress can be assessed against our financial models each year. **2)** The Graduate School has a well established (and SACSCOC accredited) process for assessment and approval of new programs that includes a financial sustainability plan. We have begun a process of engagement with the Healthcare Education Executive Committee (a committee of healthcare education leaders that includes Dean Godwin) in order to secure additional approval of support and resources for new programs. This group does not have a veto function for

programs, but may provide assistance with programs that align across healthcare programs.

5. ***Increase faculty compensation for teaching.*** The formation of new Masters programs was approved by our graduate faculty contingent on the resulting tuition revenues being returned to faculty in the form of compensation for teaching, a charge we have executed upon since inception of the Biomedical Sciences MS program. The WFSOM has reduced the level of FTE contribution expected of research faculty from .75 to .65, but it is unclear whether faculty will use the additional time to participate in the education mission. It is therefore essential that we continue our efforts to increase support of faculty teaching effort. **Results**: Overall increase in graduate enrollment, staged implementation of the faculty compensation plan, measured by funding more graduate teaching roles and at a higher rate.
6. **Expand student base and reach of graduate programs.** Expansion of our graduate programs are dependent on the capacity of research labs, the capacity of our classroom facilities, the availability of qualified teaching talent, administrative/staff capacity, and the availability of compensation for teaching. We are near those limits for basic science programs with current class structures. For on site programs, our growth aspirations must anticipate consideration of alternative structures for existing programs, recruitment of additional teaching for new sections of existing courses, and new courses and course sequences that serve students bound for PhD programs as well as students in a pre-health (MD, PA, DVM, DO, etc.) curriculum. Additional growth will require adoption of online and asynchronous delivery of programs. We anticipate mounting 3 such programs in the next 3 years: the MHL and CRM programs, as well as a rejuvenated Biomedical Informatics program. **Results**: Pilot online and asynchronous learning. Establish timeline, benchmarks and enrollment targets.

II. Overview

A. Faculty Staffing

- The Biomedical Sciences Graduate Program has not traditionally been in charge of hiring or retention of new faculty. We will continue to provide input to the medical school to encourage that new hires include the needs of teaching within our programs, and will reflect our own increasing student diversity. Our faculty staffing positions are approved by the medical school. Strategic hiring in the area of informatics/analytics is an anticipated future need that will serve multiple stakeholders. The Graduate School had a direct voice in the hiring of the new Bioinformatics Center Director, Metin Gurcan, and has been working with him in the hiring of new Center faculty.
- Graduate faculty members are appointed by the Medical School in traditional medical school departments. Certain roles (such as track directorships and select teaching) are paid through purchased effort. Additionally, some part time graduate staff positions are funded through purchased effort in departments.
- This year, we added two positions: Jennie McGuire, EdD, a curriculum and outcomes manager; and Jennifer Chapman, who leads recruitment and enrollment efforts.
- The Biomedical Sciences Graduate Program MS degree structure has laid the groundwork for several focused MS degrees that we hope to offer in the coming years

that will result in an overall larger proportion of MS students relative to faculty. The increased teaching effort that will be necessary with new MS degree offerings is currently under discussion with program faculty.

Administrative Needs

- Our goal to grow Masters level programs requires additional administrative effort. In the coming years, growth in MS programs will outpace PhD growth. Assessment of expansion into online programs will occur on a program-by-program basis (i.e., not all programs are suitable nor desirable to convert to online formats). New online programs will require new administrative burdens that must be met to administer the large number of applications and the special needs of these programs. An instructional design specialist will be required to provide assistance to faculty teachers, and University resources must be dedicated for administrative and teaching effort prior to program launch during the program development phase. Portions of these may be met through shared services, but others may need to reside in the Graduate School.

B. Student Recruitment, Enrollment, Retention, Placement

Detailed tables related to recruitment and enrollment are listed in the Appendices. Individual recruitment numbers are further related in Track reports. Each Track possesses a recruitment committee made up of faculty who are representative of constituent graduate programs. Overall, student metrics remained stable across different phases of recruitment, acceptances and matriculation. Student acceptances for graduate programs weigh prior research experience and productivity as important factors of student success. GRE scores are still required but generally Tracks place less emphasis on standardized testing that other factors.

- There were 700 total applicants (121, or 17% were from underrepresented groups) to the Biomedical Sciences programs, with average combined verbal plus quantitative GRE of 311 and average GPA of 3.36.
- Of the 700 applicants, 206 (29%) were accepted (46, or 22% were from underrepresented groups) with average combined verbal plus quantitative GRE of 313 and average GPA of 3.42.
- Of the 206 acceptances, 124 (60%) matriculated (38, or 31% were from underrepresented groups – a 5% increase from last year), with average combined verbal plus quantitative GRE of 312 and average GPA of 3.36.
- Recruitment varies somewhat over fields of study. A careful assessment is made each year of funded researchers within each of the multidisciplinary Tracks, and direct queries are made to determine the number of available student positions. These are used to determine appropriate recruitment numbers for each program.
- Student satisfaction based on exit surveys is very high in positive attributes of the student experience, with high marks on the research experience and laudatory comments on faculty engagement in teaching and research.
- Student placement relies on self-report at present. PhD students typically transition to academic postdoctoral positions. MD/PhD students return to medical school to complete their training. PhD/MBA students may transition to academic postdocs or (more frequently) to relevant industries (see Appendix II).

C. Academic and Curricular Initiatives

- The Biomedical Sciences Graduate Programs have continued to pursue faculty recommendations to develop a series of MS programs to provide focus for new research activity and revenue generation. These include Biomedical Informatics, a cross-campus initiative. Informatics has high projected market value for students. We have proposed to launch an MS program and grow a PhD program in parallel. Teaching effort will be covered by coordinating expertise across academic units (Public Health Sciences, Biostatistics, Radiology, Neuroscience and Biomedical Engineering from the Biomedical Programs and Computer Science, Math, Physics and Psychology from the Reynolda programs), and a 4+1 MS option is envisioned by participating departments (e.g., Computer Science; Biology; Math or Physics). Curriculum will receive input from external industry partners to ensure that the skills sets are relevant to employers and that internships are available. This external advisory committee includes representatives from Inmar and Quintiles.
- We will continue to refine and seek expansion of the Prehealth focus in our Biomedical Sciences MS program to increase enrollment numbers after a successful relaunch as a tuition-generating MS program, and to ensure that attention is paid to clinical professionalism. Another variant under discussion is a "Medical Physics" MS training program. A proposal for this new program is in the development stage. We are also carefully considering the curriculum in our Comparative Medicine MS program and are weighing the value of opening the program to post-baccalaureate students.
- Teaching practice and technologies will be assessed in the coming year as we seek to promote excellence in teaching as a core value. Going forward, all courses will be evaluated and revised based on best practices, research rotations will be evaluated, and student performance will be monitored.
- As we reported last year, lecture capture and distance technologies were evaluated for suitability to enhance on-campus experience and to make on-campus time more efficient. We identified Canvas in May of 2015 as a suitable learning management system to replace an in-house developed system. Echo360 was also chosen and evaluated as to suitability for lecture capture, and in collaboration with information technologies staff several new sites will have the required hardware installed by FY19. The choice of Canvas and Echo360 was arrived at in part because it is in wider use across the University, including the Virginia Tech/WFU BME program. We are implementing WebEx as well, to further support our online learning environment.

D. Research Initiatives

- **Programs, including Centers and Institutes, under development.** Control and formation of new Centers is through the Medical School Dean's Office. Biomedical informatics fits perfectly with University needs in analytics and has the potential to enhance research and to generate a sustainable tuition base, and is a new Center. Dean Godwin was a member of the search committee for the new Center director, Metin Gurcan.
- **Strengths and weaknesses of the research programs in your school.** Strengths include opportunities for students to engage in health related and translational research, and basic science programs of national prominence. Weaknesses

include significant external pressures from changes in NIH funding levels, debt burden of the Medical Center and resulting cuts to departments and programs.

- **Opportunities for new research initiatives, especially in collaboration with other schools.** Informatics is a major research initiative that could impact Biomedical, Arts and Sciences, Business and the Library. Discussions should consider whether a cross campus Institute or Center could be built around the MS concept that would result in a PhD program and self-sufficiency. The Graduate School has shared plans to develop informatics with the School of Business and the College and has invited collaboration.
- **Combined B.S/M.S. programs** in areas of strength should move forward – one of these, in the multidisciplinary area of Neuroscience, has launched in Fall 2015. In this program, undergraduates are engaging in research during their Junior and Senior years that will apply toward their MS thesis, completed during a 5th year on the biomedical campus. This program could be a model for similar programs. Wake Downtown is a natural incubator for these programs.
- **New programs in Healthcare Leadership and Clinical Trials Management.** Two programs are anticipated for online launch in the next 3 year period. The MS in Healthcare leadership will prepare students for the complex and dynamic nature of healthcare, and provide the skills necessary to lead strategic change in organizations, ethical governance of programs, and increase effectiveness in their day-to-day management. The MS in Clinical Research Management will prepare students for running large scale clinical trials. Both programs align well with the mission of the WFSOM, but both will require significant investment in the Graduate School for success.

E. Budget

Major budgetary and financial restructuring has continued in the past year:

- Budget projections for FY19 project positive revenue, with a total of ~$963,000 being returned to departments in support of the teaching mission. These funds were created by the growth of existing MS programs and have solid projected growth for future years. A tuition claim process was implemented beginning with June 2013 NIH grant submissions. The rate of remission is ~$6364 for each student supported on a NIH R01 research grant. This is in addition to NRSA tuition remission. We also adjusted the discount rate for MS tuition to better reflect the cost of education.
- A compensation model has been revised, and provided support for teaching activities related to graduate programs. As more revenue is accrued from the budgetary restructuring, more full time effort will be funded and directed back to contributing programs. Models insuring a fair distribution of these funds are developed and implemented.
- Breakdown of total FY19 Biomedical Graduate Program overall budget remains stable, but tuition revenues (primarily MS tuition) have steadily increased. Total expenditure by the Medical School has dropped significantly since peaking in 2012. Stipend levels remain relatively stable since last year, but were increased to $29,070 for all PhD programs on the Bowman Gray campus to remain competitive with our peers.
- In addition to reducing the investment in the Graduate School, this year the WFSOM has levied a “corporate overhead charge” of over $500,000 in response to our leveraging of shared services support in the areas of student records, financial aid, student financials, institutional effectiveness, disability services, student affairs

(including wellness and counseling services), financials management, and to support the School of Medicine's Dean office. The Graduate School appealed these charges and suggested that rather than creating overhead from tuition, that indirect cost structures allowable through federal regulations applied to NIH grants would be a more appropriate way to fund administrative and other overhead (particularly for the Graduate School, which directly contributes to these grants) . It was also pointed out that the initial charge by Graduate faculty to develop MS programs was predicated on the WFSOM maintaining investment in the Graduate School. However, total investment had fallen each year and this new "corporate overhead" has not yet been presented to graduate faculty.

Investment from the administration and the Development Office could assist in the goals of enhancing career development and research infrastructure for the Biomedical Graduate programs. New programs of national prominence in informatics should be a focal point for development. Novel programs such as MHL, MCRM, informatics and the successful PhD/MBA program are competitive advantages and serve as pipeline programs to industry, and should be a focal point for student support.

F. Space and Facilities

Growth in Innovation Quarter programs will necessitate expansion of office and student space. Program growth will require providing space for a larger cohort of MS students, many of whom will not be affiliated with a laboratory. Immediate needs for FY19 are met, if currently promised space is provided. Dean Godwin has been in temporary space for over a year, and the Graduate School has been without a "front door" or easily identifiable presence.

Projected growth in MS programs may increase the number of Masters students by FY19. Areas are being provided for MS students for student study, lounge, and conference areas on the E floor of the Hanes Building on the Hawthorne campus. This is sub-optimal space and is consistently sought after by clinical departments. An enormous opportunity exists to imagine a graduate student hub space in the connector between Wake Downtown and the School of Medicine's building in Innovation Quarter.

New expansion of College programs to Wake Downtown should also accommodate graduate program expansion for added value and the addition of 4+1, BS/MS programs. Of all academic units across Biomedical campuses, the Graduate School may possess the most potential for growth as a percentage of current student base – we have proven to be an excellent investment, but accelerated growth in Biomedical Graduate Programs must be accommodated and resourced by the university. Existing space can be used at the Hawthorne campus and at Biotech place for FY19, but new or renovated space in the Innovation Quarter may be necessary to meet the goals of new programs and to facilitate access by Wake undergraduates to our graduate programs.

Appendix I:

Individual Track Reports, Report from the Office of Postdoctoral Affairs

The Biomedical Engineering Track Report

- Dr. Emmanuel Opara is the director of the graduate program.
- Completion of its sixteenth year in the joint Virginia Tech-WFU School of Biomedical Engineering and Sciences (SBES).
- In 2017-2018, it hosted 4MS and 51 PhD students enrolled at WFU, with 22 new (14 Ph.D and 9 MS) students expected to join the WFU campus contingent in the fall 2018. 1PhD and 3-MS degrees were awarded in this academic year.
- 3 students in the BME track of the MD/PhD program are currently engaged full-time in their PhD research.
- SBES strengths include excellent graduate students with strong undergraduate and graduate records, increased external fellowship student support, an excellent coursework curriculum including courses provided from both WFU and VT faculty, and dynamic research collaborations between the VT and WFU campuses.
- A priority for the BME department is to enhance diversity of the graduate program. Towards this goal, in each of the last 4 years, the department has sponsored Dr. Opara, a graduate student and a program staff member to attend the Annual Biomedical Research Conference for Minority Students (ABRCMS) and aggressively make efforts to recruit minority students into the program. We are happy to report that in the upcoming 2018-2019 academic year we have 2 underrepresented minority students matriculating in the incoming class (1 MS and 1 Ph.D.)
- A currently active NSF-sponsored Summer REU grant awarded to Drs. Stitzel and Weaver provides an opportunity to enhance minority recruitment efforts.
- BME has expanded the scope of existing programs that have mostly focused on the medical center's high priority areas of Cancer, Diabetes and Metabolism, and Regenerative Medicine. The BME department continued its expansion of the scope of the BME program and has recently recruited Dr. Jennifer Jordan in Cardiovascular Medicine as an affiliate faculty in the BME track. In addition, the BME Program has recently entered into a partnership with the Department of Physical Therapy and Rehabilitative Medicine at High Point University to enhance the presence of Rehabilitative Medicine within the program.
- The BME program has expanded its tuition-paying MS program with 9 MS students joining the incoming 2018-19 class. We hope that the number of these MS students in the BME program would continue to increase as more students interested in industry-based engineering see it as a mechanism to achieve their career aspirations. This MS program would grow even further with a current plan to add a 4+1 BS/MS program between the Reynolda Campus and the Department of Biomedical Engineering. We

believe that the presence of a Department of Engineering in the Wake Downtown would enhance the growth of the 4+1 dual degree program.

- The department is expanding the biomedical imaging component of its program with the addition of faculty with research interest in biomedical imaging, and as previously mentioned, has recently added Dr. Jennifer Jordan to the existing faculty in this area. We currently offer two courses for our graduate students in biomedical imaging and have recently developed the following 4 new courses currently going through the GCC approval: Physics of Medical Imaging, Medical Health Physics of Radiation, Radiological Physics, and Radiation Therapy Physics. In addition we plan to work with the upcoming joint Reynolda Campus/Medical Center Bioinformatics Program to develop additional courses to meet their imaging course needs if desired.

- Our faculty are also actively developing new courses in other areas including one on entrepreneurship entitled Advanced Commercialization of BME Research (pending GCC approval)

- The Virginia Tech-Wake Forest University SBES Partnership is scheduled for the 5-Year review in the 2018 Summer

- The BME Track has recently completed a new Graduate School initiative of Program Self-Study designed to meet the needs of the next SACS accreditation review

- Our main goals for the next academic year include: 1) Continue to strengthen the linkage with the Engineering department at Wake Downtown and create teaching assistant (TA) opportunities for the BME graduate students at the WFU campus of the SBES. 2) Continue to expose BME program students to different employment opportunities in academia, industry, and government establishments using our distinguished speakers' seminar series, students' continued participation in professional societies, collaborative projects with industry and short-term internship in industry and extramural research centers and institutes. 3) Continue the growth of Cancer Research in the BME program.

- We are gradually making progress in our main challenge of increasing student body diversity in the BME program. We will continue to design strategies that would help us to achieve a good level of ethnic diversity that result in more non-White Hispanics, African Americans, and American Indians among our students over the next 3 years.

Integrative Physiology and Pharmacology Track Report

IPP PROGRAM STRUCTURE, FUNCTION AND INITIATIVES

During the 2017-18 academic year, program leadership remained consistent. Dr. Paul Czoty continued to serve as Director, while Dr. Jasmina Varagic remained Chair of the Admissions Committee and Drs. Hossam Shaltout and Ann Tallant were co-Chairs of the Curriculum Committee. Dr. Jeff Martin remained Chair of the Student Progress Committee. New additions to the membership of the various committees, and several new IPP faculty members, provided fresh perspectives to the committees and to the program as a whole. During the year, one area in which we made considerable progress is the delineation of requirements of non-PhD students (i.e., thesis MS, non-thesis MS, MD/PhD and others). One other item of progress that is likely to increase student satisfaction is a streamlining of the process by which we offer Journal Clubs. The Program took a close look at the journal clubs that were being accepted as credit-granting and raised the bar, eliminating some groups and formalizing the others with distinct course numbers.

IPP PROGRAM S.O.A.R. ANALYSIS

The IPP program's **strengths** have been maintained and strengthened over the past year: the comprehensive training program in the principles and applications of physiology and pharmacology and commitment to training students for diverse career paths in industry, academia, and beyond. We have implemented an approach to training that features individualized curriculum development. Course requirements are limited, with the most of the curriculum consisting of electives that match the student's research interest. This ability to customize electives, journal clubs and other opportunities has proven very popular and effective. Quality control is assured by the inclusion of an "IPP Final Examination" at the end of the first year which covers materials in the introductory classes (IPP 701, IPP 702). The "IPP Final Examination" has replaced the program's long-standing Comprehensive Examination which took place at the end of the second year, prior to Advancement to Candidacy. The IPP Program was the only graduate program to have a written comprehensive (or "qualifying") exam. After a great deal of introspection and discussion, the IPP Executive Committee voted to transition to this new "Final Exam" model, which retains the ability to evaluate students' ability to think in an integrated manner, eliminates some of the negative consequences and carries with it other benefits associated with the move to the end of the first year. After two years of this change, it is clear that the move has resulted in decreased stress for students and an acceleration of their progression to doctoral candidates.

STUDENT ACCOMPLISHMENTS

The Integrative Physiology and Pharmacology (IPP) program trains PhD and MD/PhD students in a broad range of research areas and methodologies, ranging from molecular to human studies. In addition, IPP offers a Concentration in IPP taken by Master's students from various programs. During the 2017-18 academic year the program consisted of 1 MD/PhD and 25 PhD students, with 11 MS students participating in the Concentration; 2 students earned their PhD in this academic year. The Program's research strengths and teaching contributions align perfectly with the domains emphasized in the Wake Forest School of Medicine (WFSM) Strategic Plan. In particular, the Wake Forest Institute for Regenerative Medicine (WFIRM) and the Hypertension & Vascular Research Center have for several years been two of the three pillars of the IPP Program. The third major area of strength, substance abuse research, has

also recently come in line with institutional priorities with the establishment of the Center for Research on Substance Use and Addiction (CRSUA). Beyond these three areas, several IPP faculty and students have been working in the areas of cancer, diabetes and aging.

Productivity and accolades are a consistent characteristic of IPP graduate students. IPP students submitted more than 20 papers for publication in high-quality, peer-reviewed journals during this academic year, with the majority of those the PhD student served as the first author. They also co-authored more than 30 abstracts to professional society meetings, presenting their work as posters or oral presentations. IPP students were supported by a number of sources including NIH F31 grants, NIH T32 training grants and American Heart Association pre-doctoral fellowships, with others being supported by the graduate school (1st year students) and by their participation in R01 and other grants from their research advisors. As of July 1, several students are awaiting word regarding submitted applications for NIH NRSA and foundation-based funding. Students received numerous awards over the past year, including intramural and extramural travel awards that supported their attendance at scientific meetings of professional societies. Other students earned awards for scholarship from scientific societies including the American Society for Pharmacology and Experimental Therapeutics (ASPET), the Radiation Research Society, Research Society on Alcoholism and the Society for Neuroscience as well as NIAAA. IPP students also placed in poster competitions within the WFSM Division of Surgical Sciences and the Cardiovascular Sciences Center, as well as that of ASPET's Division of Neuropharmacology. We are especially proud that third-year IPP student Allison Dyevoich won the Graduate School's "Three Minute Thesis" competition at Graduate Research Day this spring.

PROFESSIONAL DEVELOPMENT

Workforce development is an important aspect of the program. This year, many IPP students participated in organized teacher-training activities either as lecturers or tutors serving WFU graduate, undergraduate and PREP students. They also participated in workshops designed to enhance teaching skills. With the encouragement of IPP leadership, one student completed an internship with Ardis Pharmaceuticals (San Jose, CA) and others completed extramural training opportunities offered by the NIH. Other career development activities included various techniques courses and workshops. Perhaps the most impressive accomplishment, a current PhD student (Omeed Rahimi) continued his work as Chief Science Officer of EncepHeal Therapeutics, a company launched in 2016 through the NIH-sponsored "Neuro Start-up Challenge." The company was awarded exclusive license to commercialize a cocaine and methamphetamine addiction treatment technology. Its founders raised $300,000 in funding via an SBIR grant and $65,000 via a North Carolina matching grant.

SERVICE

Service is also an important component of membership in the IPP Program. Within the program and Graduate School, IPP students have been critically involved in recruitment and orientation activities. They have served the graduate student body with leadership roles and other participation in the Honor Council and the Graduate School Wellness Committee (of which an IPP student is the current Chair), the Graduate Student Association (of which an IPP

student is Chair of the Career Development Committee), and the Physiology & Pharmacology Graduate Student Committee (of which IPP students are the Chair and Co-Chair). IPP student Zachary Zabarsky is the Founder and Chair of the Peer Mentoring Program. In addition, IPP students serve local academic functions organized by WFIRM, CRUSA, The Department of Comparative Medicine and the Institutional Animal Care and Use Committee. Extending to the medical school domain, an IPP MD/PhD student is the Co-director of special projects at the DEAC ("Delivering Equal Access to Care," a student-run free clinic in Winston-Salem).

Nearly every IPP student participated in some form of extramural volunteer/community service directed towards educating local children, from kindergarteners to high school students. For example, several IPP students were active in the Brain Awareness Council, a highly successful student-run organization that organizes visits to local schools to educate young students about the brain and neuroscience research. Other activities include:

- presentation of their dissertation work to middle school students
- "Rescue to Recovery," which teaches 7th and 8th graders about drugs of abuse and their effects on the brain, Kaleideum North (formerly SciWorks)
- "Program in Community Engagement in STEM," which coordinates volunteers to give presentations on their professional expertise and career paths to 5th graders
- judging elementary school science fairs
- coordinating a "Road Safety Event" that served over 500 students
- the Hugh O'Brian Youth Leadership Seminar for high school sophomores
- the Math Science Education Network, a summer camp geared towards gifted middle and high school students
- "Tune In to Wellness" a program funded by a wellness grant received by WFSM
- the Wake Forest CTSI's Community Engagement Program directed at high schoolers

IPP students also participated in fundraising efforts for organizations such as the American Heart Association and for NC Children's Promise, which funds research on treatments for pediatric cancer.

Other science-related volunteer efforts were directed towards community wellness and education:

- Wake Health Community Ambassadors
- a public outreach day sponsored by the American chapter of TERMIS (Tissue Engineering and Regenerative Medicine International Society).
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Students followed their non-science passions in other ways in service to the community, including volunteering time and assistance at St. Leo the Great Catholic Church, Reynolds High School, the Ronald McDonald House, Jefferson Elementary School, Mt. Tabor Preschool and the Forsyth Court senior living facility.

We have a breadth of potential mentors/topics of research, and our faculty members have strong teaching and mentoring experience and enthusiasm for graduate education. Our students receive individualized attention (no "factory" laboratories) in research areas relevant to public health needs. Because of our diverse biomedical research, we fit well with the areas of research emphasis within the institution. The increasing demand from pharmaceutical/biotech companies for scientists well trained in the fundamentals of systems physiology and pharmacology is an opportunity, as more development is occurring in smaller

companies. Thus, our cross-disciplinary collaborations can lead to workforce development opportunities. The success that our students have experienced in obtaining extramural funding (e.g., NRSAs) and the availability of multiple NIH training grants inspires confidence in our continued ability to support a critical mass of students.

The IPP program has great **opportunities** for students to take their degree into a wide variety of employment niches. We assess student career development plans early in each student's program, and then to enable students to participate in relevant workforce development activities outside the classroom or the laboratory. We are actively building relationships with community and private sector entities to expand internship activities and are seeking sources for support of such activities via organizations outside of the NIH sources. An exciting opportunity for the IPP Program itself is its alignment with the new institutional Center based on substance abuse and addiction, which launched in 2016. Substance abuse research has long been a major strength of IPP faculty; the resources associated with the institutional center will invigorate our research programs which will undoubtedly have a positive impact on graduate education.

The **aspirations** of the program primarily center on enhancing student satisfaction and successes. The director considers it a guiding principle of his approach that individuals do not perform at their maximum capability when under stress. The program has increased the amount of guidance it provides to incoming students. We desire to provide this type of guidance throughout students' time at Wake Forest. For example, the Director will meet with second-year students to describe expectations for adequate progress during the second year. Informing students of expectations throughout their tenure should reduce their uncertainty about their progress and focus on the tasks and milestones appropriate for each stage of their career. Regarding student accomplishments, we plan to continue to encourage and support student participations at annual meeting of scientific societies, submission of publications and, importantly, submission of extramural grant applications.

The program plans to measure **Results** in promoting student accomplishments by tracking (1) success rates in submission of applications for extramural support, (2) numbers of manuscripts submitted and accepted, (3) participation of scientific meetings and (4) year-by-year changes in time to degree. Metrics for student satisfaction are more difficult to construct. The Executive Committee will consider developing a survey to address the degree to which students understand what is expected of them and their comfort with expectations of the program.

Neuroscience Track Report

- Dr. Carol Milligan directs the Neuroscience Track. As of July 2018, Dr. Christos Constantinidis will serve as Associate Director of the Program. The addition of the Associate Director was necessitated by the growth of the program over the past few years.
- Neuroscience PhD training has been a component of graduate student training at Wake Forest University for approximately 28 years.
- The mission of the program is to train students to be able to carry out meaningful and significant research in all areas of modern neuroscience and to give them an appreciation of the importance of all levels of organization, from genetics and molecular approaches to behavioral and physiological aspects, with an understanding of how basic neuroscience research is key to finding treatments for neurobehavioral pathologies and translating this information to the clinic.
- The program serves an important mission and continues to make significant contributions to the research and education missions of Wake Forest University and Wake Forest School of Medicine that exceeds that what might be expected by the absolute numbers of neuroscientists here.

Strengths

Faculty

- Program governance includes an Executive, Recruitment and Admissions, Curriculum and Student Advisory Committees. The committee structure demonstrates faculty commitment to the program and student success.
- There are currently 70 faculty members across 16 departments and all WFU campuses who participate in neuroscience-related research and/or clinical work. The Neuroscience Graduate Program is the administrative clearinghouse for all events related to neuroscience throughout the institution, including the invited speaker programs, Brain Awareness activities, neuroscience symposia and workshops, and the Western North Carolina Chapter of the SfN (WNCSfN).
- Neuroscience Faculty attracted $50 million in federal funding for FY18, with PhD students as the driving engine of research.
- There are three institutional training grants associated with the Neuroscience Program

Students

- There are currently 30 PhD, 4 MD/PhD, 8 MS, 7 HDND MS and 8 4+1 MS students enrolled in the Neuroscience Program (total 57 students).
- During the past academic year 3 PhD students (James Melchoir, Brenna Beckelman, and Rhiannon Mayhugh) earned their degrees. Brenna was the recipient of the Melson Award as well as the Neuroscience Award for outstanding thesis. Brenna has taken a position with Medthink. James was the recipient of the Sundberg Award and is pursuing a postdoctoral fellowship at Vanderbilt University. Rhiannon is finishing up her publications and interviewing for postdoctoral positions.
- Two MD/PhD students completed their PhD training and are continuing with their clinical training: Greg Alberto and Adrienne Adler-Neal.

- Five MS students, 3 HDND MS and our first three 4+1 MS students have completed training and have earned their degrees.
- Josh Seideman and Helena Zimmerman were awarded individual NRSAs. 21% of students earned individual NRSA's. Nationally, our program exceeds the national average of 12% as reported in the Society for Neuroscience Survey of Neuroscience Departments and Programs. Within our institution, according to NIH Reporter, Neuroscience student F30/31s account for 70% of those awarded to Wake Forest Health Sciences.
- For enrollment for Fall 2018 we received 87 applications to the PhD program. For fall 2018 there will be 9 PhD, 5 MS, 9 HDND MS and 1 4+1 MS new students joining the program.

Program Outcomes

- Time to PhD degree completion is currently 4.9 years as compared to a national average of 5.6 years as reported by the Society for Neuroscience Survey on Programs and Departments.
- Average number of publications is 6.5/student, with approximately 30% of Neuroscience faculty publications including a student as first author or co-author.
- 100% of students who earned PhDs from 2007-present have obtained postdoctoral training positions or are employed in research/science positions. Many move onto postdoctoral positions at prestigious centers/universities, including U Penn, Stanford, MIT, Mt. Sinai, Columbia, and Johns Hopkins.
- Neuroscience students and faculty generated in FY18 $360,000 in tuition funds from individual NRSAs, T32 RO1s and other sources.
- Development of MS programs to provide new training opportunities for students. In FY 18 Neuroscience associated MS students generated more than $600,000 in tuition revenue.
- The Neuroscience Program is an excellent return on investment.
- Vigilance on maintaining a state-of-the-art curriculum:
    - New course director for 2018 Neuroanatomy (Dr. Joost Maier)
    - introduction of a new core component of the Introduction to Neuroscience Course Series: Cognitive and Computational Neuroscience (introduced summer 2017)
    - A new Electrophysiology for Neuroscientists course to be offered spring 2019 (course director Sara Jones/Katie Hollerman)
    - Updated Molecular and Genetic Approaches for Neuroscience course to be offered spring 2019 (course director Greg Hawkins)
    - Plans for a new Brain Imaging course to be offered spring 2019 (course director Fadel Zeidan).

Opportunities

- In January 2018 we began a program self-study and submitted the report to Dr. Godwin in June. While there were a group of faculty who helped prepare the self-study, we will now distribute the report to all Neuroscience faculty and begin to meet to

discuss and evaluate the current state of our training program. The executive summary of the self-study is attached.

- Establish a distinct Neuroscience MS program that will continue the curriculum currently in place, but that will allow students to specifically identify the course of study at the application.
- To publicize and recruit students for the program, we will continue the following:
    - Attend the annual ENDURE Program and presented the HDND program at the ENDURE Graduate School Fair in San Diego;
    - Interact with individuals at local HBCUs who helped promote the program to their students;
    - Present the program to faculty and students at the Wake Forest University Undergraduate Campus;
    - Distribute information on the program at the Annual Atlanta University Center Graduate School Fair;
    - Email brochures and information to national HBCUs and undergraduate institutions with Neuroscience majors or minors;
    - Present Materials at the SfN Graduate School Fair, San Diego, 2018;
    - Attend the SACNAS meeting in October 2018;
    - Distribute information at the ABRCMS meeting fall 2018.
- Increase recruitment of URM students.
    - As reported in the SfN Report of Neuroscience Departments and Programs Survey, the number of applicants to individual programs has increased over the past several years. However, in general the number of students who matriculate into programs has remained consistent with an average of 10 new PhD students/year. Similar to our program, the size of the incoming class is dictated by available funding as reported by 50% of programs.
    - For 2016-17, the average GRE score was 316 and undergraduate GPA 3.56 for Neuroscience Programs as reported in the SfN Report of Neuroscience Departments and Programs Survey**.** Our applicant pool is comparable to the average with a GRE average of 309 and GPA of 3.52. Similarly, our acceptance (15% vs 19%) and matriculation (47% vs 52%) rates are comparable to national averages.
    - Our recruitment of URM applicants is an area for improvement as we are somewhat below national averages for applicants (11% vs 17%) and offers of acceptance (4% vs. 22%). Interestingly, 29% of URM applicants offered admission to our program matriculate as compared to the lower national average of 18%.
- Review of the SfN Report of Neuroscience Departments and Programs Survey indicates our female and URM faculty members are lower than national averages (26% female vs SfN 30% and 5% URM vs SfN 10%). Within the Medical School, there are approximately 100-minority faculty, members including approximately 40 who are African-American, Hispanic-American, or Native American. Nonetheless, as noted above, few of these individuals are neuroscientists. We will continue to work with administration to promote new neuroscience positions to recruit more diversity among our faculty. The Neuroscience Program itself has no influence on institutional decisions for faculty recruitment.

Aspirations and Results

Our aspirations for continued success include :

- Providing our students with training in the most up-to-date approaches in modern neuroscience in a vibrant and productive training environment that includes engaged and collaborative faculty, visiting speakers, and state of the art research facilities
- Institutional and extramural recognition of Neuroscience Program as premier graduate training program
- Reinstatement of the Jointly Sponsored Interdisciplinary Neuroscience T32
- Development of new training grants (e.g., Alzheimer's and Neurodegenerative Diseases, Brain Cancers)

Our strengths noted above are indications of our measurable results that tell us we've achieved success in our training program. Notably, we are a key contributor to the research mission of Wake Forest University in terms of extramural funding, student contributions to publications, and student placement upon completion of the program. However, as outlined in our Executive Summary of the Program Self-Study, the Neuroscience Faculty believe that we are confronted with several barriers that limit our ability to attain our aspirations. We welcome discussion with University Administration to explore opportunities to help us meet and overcome these challenges.

Molecular and Cellular Biosciences Track Report

Summary

- MCB Program Director is Fred W Perrino, PhD. MCB includes five graduate programs: Biochemistry and Molecular Biology, Cancer Biology, Microbiology and Immunology, Molecular Genetics and Genomics, and Molecular Medicine and Translational Science.

- Thirteen outstanding PhD students joined MCB in August of 2017. The twelve first year PhD students progressed through their laboratory rotations and coursework, taking 3 courses in the core curriculum and three discipline-specific electives. All twelve of the students selected laboratories and are beginning their thesis work. One MCB MS student transitioned to the PhD program. Students have selected labs in Molecular Medicine and Translational Science (4), Biochemistry and Molecular Biology (2), Microbiology and Immunology (1), and Cancer Biology (6).

- Two Master of Biomedical Sciences students joined in the fall of 2017. Both MS students are performing thesis work in Track 4 programs: Cancer Biology (1) and Molecular Medicine and Translational Science (1). Two MD/PhD students are training in MCB programs Molecular Medicine and Translational Science and Cancer Biology.

- MCB plans to maintain a similar class size for 2018-19 by recruiting 12 PhD and 6 Masters students, who will join the program in the fall of 2019.

Strengths: There has been resurgence across MCB programs in faculty recruitment and some movement in the upgrading to facilities that include new buildings and renovation of Hanes bldg. A major strength across programs is that there is a core of faculty who are enthusiastically interested in student training at both the MS and PhD levels.

Opportunities: There are local and regional historically black colleges and universities from which we can more actively engage to increase our underrepresented minority trainees. There is also an opportunity to increase the number of T32's in the programs and track. Another opportunity is to increase the number of opportunities for students away from the bench to enhance their overall training, especially for those students who will choose to not pursue bench science as their career track.

Aspirations: We should aspire to do ground breaking science while providing a supportive environment for our trainees. The supportive environment should include mentors who treat trainees with respect, a curriculum and opportunities for internships and other non-research experiences from which students can draw expertise and develop relationships to outside entities for improved career opportunities as postdocs or research scientists in industry.

Results: Success will be measurable by the traditional aspects like publication numbers, time to PhD, fellowships, etc., but should also include tracking of career paths after completion of PhD, follow-up for 5-10 years to determine % that remain in science-related career. An exit survey should be used to determine how students felt the track and their home program prepared them for their career.

MCB constituent program reports follow:

1. Biochemistry and Molecular Biology

Biochemistry Student Awards:
Ryan Davis, Herbert Cheung Fellowship for outstanding senior biochemistry graduate student. (October 2017)
Theresa Simermeyer, Biochemistry Dept. Cowgill Fellowship. (October 2017)
Sean Simpson, Biochemistry Dept. Cowgill Fellowship (October 2017)
Robert Bayne, Biochemistry Dept. Artom Fellowship (October 2017)

Biochemistry Student Publications:

Bolduc JA, Nelson KJ, **Haynes AC**, Lee J, Reisz JA, Graff AH, Clodfelter JE, Parsonage D, Poole LB, Furdui CM, Lowther WT. (2018) Novel hyperoxidaRon resistance moRfs in 2-Cys peroxiredoxins.
J Biol Chem. 2018 Jun 8, Epub ahead of print

Rogers LC, **Davis RR**, Said N, Hollis T, Daniel LW. (2018) Blocking LPA-dependent signaling increases ovarian cancer cell death in response to chemotherapy. Redox Biol. 2018 May;15:380-386.

Mauney CH, Hollis T. (2018) SAMHD1: Recurring roles in cell cycle, viral restricRon, cancer, and innate
immunity. Autoimmunity. 2018 May;51(3):96-110.

Westcott MM, **Smedberg J**, Jorgensen MJ, Pucke` S, Lyles DS. (2018) Immunogenicity in African Green
Monkeys of M Protein Mutant Vesicular StomaRRs Virus Vectors and ContribuRon of Vector-Encoded
Flagellin. Vaccines (Basel). 2018 Mar 19;6(1).
Mauney CH, Rogers LC, Harris RS, Daniel LW, Devarie-Baez NO, Wu H, Furdui CM, Poole LB, Perrino FW, Hollis T. (2017) The SAMHD1 dNTP Triphosphohydrolase Is Controlled by a Redox Switch.
AnRoxid Redox Signal. 2017 Dec 1;27(16):1317-1331.

Keyes JD, Parsonage D, Yammani RD, Rogers LC, Kesty C, Furdui CM, Nelson KJ, Poole LB (2017) Endogenous, regulatory cysteine sulfenylaRon of ERK kinases in response to proliferaRve signals.
Free Radic Biol Med. 2017 Nov;112:534-543.

2. Molecular Medicine and Translational Science Graduate Program
SECOND YEAR MS STUDENTS

Steven Leung, M.D.

2018 3rd place, Wake Forest Institute of Regenerative Medicine 2018 Retreat Poster Competition

2017 2nd Runner-Up, Committee on Trauma and Acute Care Surgery Resident Paper Competition, American College of Surgeons NC/SC Chapter Meeting

Funding award

Christopher L. Moseley Foundation Grant for Stem Cell Research 2017 – 2018

2017 First Author Publication

SECOND YEAR PhD STUDENTS

Julie Bennington, D.V.M.

Extracurricular & Community Activities

PART-TIME VETERINARY ASSOCIATE, VCA ANIMAL HOSPITAL WEST, WINSTON-SALEM, NC**:** Work 1-2 Saturdays per month

2018 – Present Captain, Civil Air Patrol, North Carolina Wing, Winston Salem Composite Squadron 082

2017 – Present Community Ambassador, Volunteer Services, Wake Forest Baptist Health

2017 – Present Polynesian Dancer, Na'Pualani of Durham, NC

2017 – 2018 Cuban Dance Student Team Member, Messina Dance Company of Greensboro, NC

Brittni Foster

2018 First Author Publication

Daniel Lara, M.D.

2018 First Author Publication

Angelica Riojas

2017 Founding member of 5 to Life: A PhD and Beyond Podcast

Founding member of WFSoM SACNAS Chapter. President and National Liaison.

Samuel Rosas, M.D.

2018 Eastern Orthopedic Association Resident Travel Award Finalist (May 2018)

Southern Orthopedic Association Resident Travel Award (May 2018)

Florida Orthopedic Society Resident Paper Finalist (March 2018)

Resident Award Travel Grant Eastern Orthopedic Association (October 2017)

Lauren West-Livingston (MD/PhD dual degree)

2018 Recipient of Association of Program Directors in Vascular Surgery Travel Scholarship for Southern Association of Vascular Surgeons 42nd Annual Conference – January 2018

Recipient of Society of Vascular Surgery Diversity Medical Student Travel Scholarship for Vascular Annual Meeting – June 2018

THIRD YEAR PhD STUDENTS

Alexander Jinnah, M.D. (PhD Candidate)

2017 **Winner of Tumor Award** at the North Carolina Orthopaedic Association annual meeting. *Creating an in-vivo Bone Metastasis Model in an Immunocompetent Host.*

2017 **Best Basic Science Paper** at the 2017 Orthopaedic Fellow & Resident Summit, Orthopaedic Summit: Evolving Techniques. *Bone Metastasis Model Devolopment in an Immunocompetent Murine Host*

Funding award

Orthopaedic Research & Education Foundation (OREF) 2017-2018
Resident Clinician Scientist Grant ($19,000.00)
The Healing Potential of a Decellularized, Deoxidized Porcine Bone Scaffold.

Principle Investigator: **Jinnah AH**

Co-Investigators: Smith TL (Mentor), Willey JS, Bracey DN, Danelson K, Halvorson JJ

Status: Accepted

Goodwell Nzou (PhD Candidate)

2018 1st place oral presentation. WFIRM Retreat

FOURTH YEAR PhD STUDENTS & ADVISORS

Oula Khoury (PhD Candidate)

2018 Moseley Grant at the 4th Annual Perinatal Stem Cell Society Congress

T. David Luo, M.D. (PhD Candidate)

2018 First Author Publication

FIFTH YEAR PhD STUDENTS & ADVISORS

Hannah Atkins, D.V.M. (PhD Candiate)

2018 Wake Forest School of Medicine, Women's Health Research Day - Best Resident/Fellow Poster

2017 NIH Clinical and Translational Science Institute (CTSI) Ignition Fund

Wake Forest School of Medicine, Winston Salem, NC

P.I. David Caudell, DVM, PhD; Co-I: Hannah Atkins, DVM

“Investigating Mitochondrial Function in Endometriosis Tissue”

$5,000 direct cost

2017 First author publication

Matthew Brovold (PhD Candidate)

2018 First author publication

SIXTH YEAR PhD STUDENTS & ADVISORS

Eleanor McCabe (PhD Candidate)

2017 Travel Award from the American Chemical Society (ACS) Division of Colloids (COLL) to attend the 254th ACS National Meeting and Exposition August 20th-24th, 2017 in Washington, DC

2018 First Author Publication

2017-2018 academic year

Total of 29 students

5 with DVM degrees

7 with MD degrees (six in PhD program, one in MS program)

6 Graduated this year

4 with PhD degree

2 with MS degree

MMTS students started a “5 to Life: A PhD and Beyond Podcast and Blog”

5TOLIFEPOD.COM

ITUNES – 5 TO LIFE: A PHD AND BEYOND @5TOLIFEPOD

MMTS students started a diversity student group to promote inclusion and diverse representation in science. An application has been submitted for national chapter status.

SACNAS – Society for Advancement of ChicanosHispanics and Native Americans in Science

Numerous national and international oral and poster presentations by MMTS students.

Curriculum

Molecular Medicine Journal Club was formalized into an elective for credit so students from MMTS or other graduate program that are required to take a journal club for credit can fulfill their requirement of participating in the MMTS Journal Club. Approved as a course for the fall & spring semesters. MMTS 781/782.

MMTS 715/716 – Clinical Experience continues to attract students from other graduate programs and MMTS students with a DVM degree which is an elective.

MMTS 724 – Scientific Development and Business of Science continues to attract students from other graduate programs as an elective.

MMTS Faculty

John Parks, PhD – Director of MMTS

2017 Established Investigator in Basic Science Awards, Wake Forest School of Medicine.

Charles "Cash" McCall, MD

2017 Byrum Mentoring Award for his ongoing investment in residents, fellows, and junior faculty

2017 Center for Precision Medicine directors joined MMTS Faculty

2018 Donald McClain, MD, PhD accepted role of MMTS co-director after the departure of

Robert Taylor, MD, PhD.

3. Molecular Genetics & Genomics
Student Publications

Kip Zimmerman

Guillen-Ahlers H, Erbe CB, Chevalier FD, et al. *TMTC2* variant associated with sensorineural hearing loss and auditory neuropathy spectrum disorder in a family dyad. *Mol Genet Genomic Med*. 2018;00:1–7. https://doi.org/10.1002/mgg3.397

James Tucker

Marayati BF, Drayton AL, Tucker JF, Huckabee RH, Anderson AM, Pease JB, Zeyl CW, Zhang K.
Loss of Elongation-Like Factor 1 Spontaneously Induces Diverse, RNase H-Related Suppressor Mutations in Schizosaccharomyces pombe. Genetics. 2018 May 29 PMID: 29844133 DOI:10.1534/genetics.118.301055

Andria Harkey Jones

Harkey et al. (2018) Identification of Transcriptional and Receptor Networks That Control Root Responses to Ethylene. Plant Physiol. 176(3)2095-2118 DOI: 10.1104/pp.17.00907

Hannah Ainsworth

Zubin H. Patel, *et al.*: A plausibly causal functional lupus-associated risk variant in the STAT1-STAT4 locus. Human Molecular Genetics 04/2018;

Elaheh Rahbar, Charlotte Mae K. Waits, Edward H. Kirby, Leslie R. Miller, Hannah C. Ainsworth, Tao Cui, Susan Sergeant, Timothy D. Howard, Carl D. Langefeld, Floyd H. Chilton: Allele-specific methylation in the FADS genomic region in DNA from human saliva, CD4+ cells, and total leukocytes. 04/2018; 10(1)., DOI:10.1186/s13148-018-0480-5

Anne Hinks, *et al.*: The genetic profile of RF-positive polyarticular juvenile idiopathic arthritis (JIA) resembles adult rheumatoid arthritis (RA). Arthritis and Rheumatology 02/2018; 70(6)., DOI:10.1002/art.40443

Hannah C. Ainsworth, *et al.*: Association of Natural Killer Cell Ligand Polymorphism HLA-C Asn80Lys With the Development of Anti-SSA/Ro-Associated Congenital Heart Block. Arthritis and Rheumatology 10/2017; 69(11)., DOI:10.1002/art.40228

Elaheh Rahbar, *et al.*: Uncovering the DNA methylation landscape in key regulatory regions within the FADS cluster. PLoS ONE 09/2017; 12(9):e0180903. DOI:10.1371/journal.pone.0180903

Carl D. Langefeld, *et al.*: Transancestral mapping and genetic load in systemic lupus erythematosus. Nature Communications

Oral presentations

Andria Harkey Jones

Computational and Genetic Approaches to Uncover Ethylene Transcriptional Networks that Regulate Root Development, The XI International Symposium on the Plant Hormone Ethylene
Chania, Crete, Greece
June 20th
***Received NSF travel award ($1250) for conference*

Branching Roots, Branching Networks: Transcriptional Networks Mediating Hormone Effects on Root Development, Research in Progress Seminar Series, Biology Department
Wake Forest University
March 2018

Time Course Transcriptomics to Identify Transcription Factor Networks That Control Development
Center for Molecular Signaling Retreat
Wake Forest University
October 2017

Other Notable Items

Hannah Ainsworth

Illustrated the cover of the 2018 March Issue of the Journal of Bacteriology (American Society of Microbiology). http://jb.asm.org/content/200/5.cover-expansion

Co-illustrated and helped design, the logo for the APOL1 Long-term Kidney Transplantation Outcomes Network (Participating Organizations: NIDDK, NIAID, and NIMHD) https://ajkdblog.files.wordpress.com/2018/03/apollo_logo_final_march-2018.jpg

4. Cancer Biology

Cancer Biology concentration approved by the Graduate Council (Aug 2017)

New course developed and approved by Graduate Council: Approaches to Cancer Prevention and Treatment (CABI720, Course Director, Alli)

New R25 award: Cancer Equity Research Training at North Carolina (CERT-NC) (PI-Watabe, co-PI- Kridel). Training grant for undergraduate URM students from NCA&T, WSSU, and UNC Pembroke to do summer cancer research. The goal of this program is to enable research opportunities for URM students with hope of recruiting into graduate school here. Part of continuing effort to increase URM enrollment in Grad School

Initiated plans with WSSU and perhaps Salem college for a 4+1 MS (with a Cancer Biology concentration)

6 New students joined CABI May 2018: Christina Snyder, Elizabeth Stirling, Kojo Agyemang, Koran Harris (was a summer research program trainee before grad school), Steven Forsythe (Transition from MS), Tiffany Newman. Among these are 2 URM students.

PhD's awarded: 5 students completed their PhD during the AY.
Amanda Davis (joint PhD/MBA)
Yin Liu
Anirudh Sattiraju
Hugo Jimenez
Jeff Chmielewski (joint PhD/MBA)

Student Awards:
Sherona Sirkisoon: Mike & Lucy Robbins Graduate Scholarship Fund Award (2018 - 2019)
NIH Diversity Supplement

Rebecca Anderson: 2017-2018 Alumni Student Award to attend American Society for Hematology (ASH), Atlanta, GA 2017

Career Development Activities:
Sherona Sirkisoon: Wake Forest Comprehensive Cancer Center Clinical Trial Internship (Jan 2018-present)
Tadas Rimkus: Business Development Fellow at Wake Forest Innovations (2017)
Executive Committee, Wake Forest Graduate School Peer Mentoring Program
Volunteer, Venture Café Winston-Salem

Tiffany Newman: Society for Advancement of Chicanos/Hispanics and Native Americans in Science

Wake Up to Science SciComm Club

5. Microbiology and Immunology

New Students: Allison Meyers

Student Awards: Amanda Hyre-Travel Award for American Society of Microbiology Meeting

Microbiology and Immunology T32 grant renewed.

New faculty: Yong Lu, Ph.D.

2018 MCB Track Strengths, Opportunities, Aspirations and Results,

Office of Postdoctoral Affairs
SOAR Analysis and Significant Accomplishments FY 2018

- Allyn C. Howlett, PhD, is Director, Office of Postdoctoral Affairs (OPA) and Assistant Dean of the Graduate School (Biomedical Sciences). Dr. Howlett worked with the Post-Doctoral Association (PDA) officers Co-presidents Stephen Rego and Russel Sequeira; Media and Photography Sunil George; Academic Teaching Affinity Group Co-chairs Bita Nickkholgh and Katherine Holleran; Research Intensive Affinity Group Chair David Klorig; and Industry & Science Support Affinity Group Co-chairs Tabitha Rosenbalm and Mary E Smith. Other significant program contributors included Linda Whited, Graduate School Career Counselor.

1. Strengths:
    - Our research faculty who support postdoctoral trainees as primary personnel to work on their NIH and other federal or foundation grants.
    - Our faculty who are committed to the next generation of researchers by submitting training grants to support stipends or salaries of postdoctoral trainees.
    - Wake Forest Innovation staff, who support hands-on experience and networking in careers in innovation and commercialization (2 postdoctoral participants in AY2017-18 WFI Internship program).
    - The Teaching and Learning Collaborative staff, who train postdocs in instructional methods and best practices in education (>15 postdoc participants in AY2017-18 workshops and book discussion groups).
2. Opportunities:
    - Wake Innovations community to support programs that integrate postdocs with the wider world of employment, home-life, and local/regional community.
        - Innovation Quarter support of health and wellness through recreational activities for co-mingling with others and to establish work-life balance.
        - Programs to integrate postdocs with professionals
            - Current networking (e.g. Venture Café)
            - Future development of an IQ ToastMasters Club.
3. Aspirations:

The PDA Survey Jan-Mar 2018 identified many topics about which postdocs would like greater coverage in their training: Grant-writing, Publishing research papers, Data analyses, Leadership and Management skills, Experimental design, Building a career network, Developing an independent Research Program, Communicating effective research presentations. Many of these skills come with experience in the laboratory and are expected to be covered by interactions with the laboratory research advisor. Others may require programming from outside the research laboratory. The OPA plans to address these via the following aspirations:

- Develop a Postdoctoral Leadership Program which upon completion provides a credential that postdocs can include on their CV or resume. There are several successful workshops that the OPA has offered in the past three years which, when combined into a package, can be completed over the course of a postdoctoral experience. Key topics to be included could be: 1) Strengths-finders self-assessment; 2) Mentorship; 3) Dealing with difficult situations: conflict resolution; 4) Diversity and Inclusion; 5) Communicating science to the public.

- Provide a means of communicating orientation materials that are relevant to postdoctoral needs. The Orientation offered by the Human Resources (People) office is not directed at postdoctoral researchers, and leaves many topics uncovered. The OPA needs to have a better means to distribute information relevant to the research environment, the community and work-family balance, and career development services. Suggestions by the PDA officers (open Q&A via social media, a "speed mentoring" orientation session, many links on website) should be implemented.

- Facilitate career-directed internships in science support offices at the institution. These experiences could be paid or unpaid internships patterned after the Wake Forest Innovations internship such that the experience would not compete for research effort. Examples of administrative offices could include: the IRB, ACUC, Sponsored Programs, Clinical Trials management, Medical Education, various Dean's offices, and others.

4. Results:

If programs are implemented (see item 3), then the outcomes of success would be measured in:

- Increased numbers of Training Grants and numbers of positions supported.

- Increased participation in on-going professional development workshops, seminars and other programs.

- Increased opportunities for science support and industry employment.

- The postdoctoral population at the start of the AY2017-2018 numbered 176, comprised of 155 WFSM and 21 Reynolda trainees. Of the WFSM postdocs, 31 were supported as trainees by T32, F32, R25 or K12 training grants, 99 were supported as full-time staff members on NIH or other federal or foundation research grants to the institution, and 25 were volunteers supported from outside the institution. Of the Reynolda postdocs,

10 were Teacher-Scholar fellows or hired under a teaching job title, 5 were research trainees, and 6 were mixed or other university activities. The demographics of the postdocs were (self-identified primary affiliation): 42% female, 57% male; and 52% Asian, 5% Black, 7% Hispanic and 36% White non-Hispanic.

- At the start of the 2017-2018, there were 4 T32, 1 K12 and 1 R25 NIH grants that support the postdoctoral training of PhD, DVM or MD researchers.
- New Program Initiatives
    - Postdoc Orientation to disseminate information on research support services including grant-writer review, research cores, CTSI On-line training seminars, and Action Health opportunities.
    - Postdoc Orientation to develop a career-oriented Individual Development Plan (AAAS MyIDP services) and how to find a mentor/mentoring opportunities for career guidance (beyond the research advisor).
    - Strength-finders- identifying personal strengths to guide career choices (12 participants).
    - ToastMasters Clubs- introduction to communications training and practice offered by local ToastMasters Clubs (22 participants).
    - Rigor and Reproducibility in Research- Participants viewd and discussed a series of web-bits targeting frequently-identified sources of pitfalls in research design and communication. This series of three 60-minute sessions was initiated in response to the requirement for ongoing training in Research Rigor and Reproducibility within submitted applications for federally-supported training grants.
    - Introduction to Diversity and Inclusion at WFSM.
    - Provide a program on "Looking for a Postdoc Position" for advanced graduate students at both WFSM and Reynolda campuses (with Linda Whited).
- Leadership and Career Development Workshops/Symposia and Meetings
    - Natl Postdoc Association Annual Meeting (Cleveland OH, Apr18), 3 participants
    - Grant-Writing Training, 4 participants
    - NIEHS Job Fair (Nov17), >5 participants
    - EPA Career Symposium (May18), 2 participants
- Significant research and curricular initiatives
    - Goal 1 for the AY2017-18 was greater engagement with the National PostDoc Association and other working groups in support of postdoctoral training.

- Wake Forest University is an institutional member of the National PostDoc Association. All AY2017-18 postdocs have been listed as affiliate members, allowing them access to activities, website, job listings, and other benefits.

- Dr. Howlett and PDA officers are listed with the Burroughs Wellcome Fund-sponsored Postdoc Career Workforce Development Network to foster interactions with comparable administrators and PDA officers at neighboring institutions including Duke University, UNC-CH, NCState University, NIEHS and EPA. This network meets two to three times per year and has a monthly Postdoc Workforce Development journal club for discussing best practices in postdoctoral training.

- Dr. Howlett, other WFSM faculty, and at least 12 postdocs are enrolled in the National Research Mentoring Network (NRMN) as mentors in a pool of available online matches. This membership permits the mentor to also become a mentee matched with a mentor, and access to webinars and training programs.

- Goal 2 for AY2017-18 was to develop support group structures for grant writing, job seeking and other career level-appropriate activities engaged in by postdocs.

    - The Academic Teaching Affinity Group sponsored Teaching and Learning Center two afternoons of three workshops each, toward completion of the Teaching and Learning Collaborative credential in College Level Teaching. Postdocs participated in teaching activities at neighboring Winston-Salem State University, Salem College, NC A&T. One postdoc judged student oral presentations at the Annual Meeting of the North Carolina Academy of Science (NCAS) in April, 2017, and advertised their availability as seminar speakers at a booth that also served in recruitment for the Graduate School programs.

    - The Research Intensive Affinity Group included a program for postdocs on the NIH grant review process, which included a Mock Study Section (K awards), and a program on RTI International as a contract research institution. Four postdocs from Wake Forest were selected to attend a day-long grant-writing workshop at NIEHS, resulting in one postdoc submitting a K99/R00 application.

    - The Industry and Science Support Affinity Group included a program for postdocs with Wake Forest Innovations (WFI), via seminars and workshops which included topics of commercialization of research, the story of the WFSM VAC, resume preparation and application process for government jobs.

- Goal 3 for AY2017-18 was to assist with training grant applications that include research training of postdocs, transitioning from postdoc to junior faculty, or a role for postdocs in the training of students. Dr. Howlett has worked with PIs of the following AY2017-18 grant submissions, and provided a letter of support with commitment to participate in an advisory capacity.

- PRIME K12 renewal (Howlett)
- NIMHD U54 MACHE (Bertoni and Rodriguez); Investigator Development Core (Diz and Howlett) new
- NHLBI T32 renewal (Shively)
- NCI P20 collaborative partnership (UNCG) new (Deep)
- NIAAA T32 renewal (McCool)
- NIGMS Science Education Partnership Award new (Gwathmey-Williams and Sandberg)

Appendix II

Data Tables

Table 1. Application Summary
Academic Year 17-18

Degree Program	# Applications	# Accepted	# Enrolled
Biomedical Engineering MS - WFU campus only	61	13 (21%)	6 (46%)
Biomedical Engineering PhD - WFU campus only	161	52 (32%)	24 (46%)
Biomedical Sciences MS (Research Track)	66	39 (59%)	23 (59%)
Biomedical Sciences MS (Pre-health Track)	82	23 (28%)	22 (96%)
Clinical and Population Translational Sciences MS	7	7 (100%)	7 (100%)
Health Disparities in Neuroscience-related Disorders MS	9	7 (78%)	5 (71%)
Integrative Physiology and Pharmacology PhD	29	14 (48%)	7 (50%)
Molecular and Cellular Biosciences PhD	198	29 (15%)	13 (45%)
Molecular Medicine and Translational Science PhD	6	5 (83%)	5 (100%)
Neuroscience PhD	81	17 (21%)	12 (71%)
TOTAL	**700**	**206 (29%)**	**124 (60%)**

Table 2. Applicant Demographics
Academic Year 17-18

Degree Program	TOTAL	Male	Female	American Indian/ Alaska Native	Asian	Black or African American	Hispanic/ Latino	Pacific Islander	White	Two or more races	Not Reported
Biochemistry & Molecular Biology PhD	0										
Biomedical Engineering MS - WFU campus only	61	36	25		5		2		23		31
Biomedical Engineering PhD - WFU campus only	161	97	64		10	3	9		73		64
Biomedical Sciences MS (Research Track)	66	24	42		9	13	6		22		16
Biomedical Sciences MS (Pre-health Track)	82	31	51	1	4	22	13		25	1	6
Clinical and Population Translational Sciences MS	7	4	3			1	1		2		3
Comparative Medicine MS	0										
Health Disparities in Neuroscience-related Disorders MS	9	1	8			2	1		5		1
Integrative Physiology and Pharmacology PhD	29	15	14		5	2	1		15		6
Molecular and Cellular Biosciences PhD	198	83	115		16	17	11	1	89	1	63
Molecular Medicine and Translational Science PhD	6	3	3		2		4				
Molecular Medicine and Translational Science MS	0										
Neuroscience PhD	81	35	46		7	6	7		48		13
TOTAL	**700**	**329**	**371**	**1**	**58**	**66**	**55**		**302**	**2**	**203**

Table 3. Applicant Average Test Scores and GPA
Academic Year 17-18

Degree Program	GRE Verbal	GRE Quantitative	(V + Q)	GRE Analytical	GPA	TOEFL	MCAT
Biochemistry & Molecular Biology PhD							
Biomedical Engineering MS - WFU campus only	155	161	316	3.7	3.35	105.08	
Biomedical Engineering PhD - WFU campus only	155	162	317	4.0	3.50	101.30	32
Biomedical Sciences MS (Research Track)	153	154	307	3.9	3.15	105.71	
Biomedical Sciences MS (Pre-health Track)	152	152	304	4.0	3.21		31
Clinical and Population Translational Sciences MS	164	156	320	4.0	3.70		24
Comparative Medicine MS							
Health Disparities in Neuroscience-related Disorders MS	154	148	302	3.8	3.40		
Integrative Physiology and Pharmacology PhD	154	156	310	4.0	3.49	85.00	28
Molecular and Cellular Biosciences PhD	154	156	310	3.9	3.48	98.12	30
Molecular Medicine and Translational Science PhD	154	159	313	3.5	2.77	105.00	
Molecular Medicine and Translational Science MS							
Neuroscience PhD	156	155	311	4.1	3.53	98.17	30
AVERAGES	**155**	**156**	**311**	**3.9**	**3.36**	**99.77**	**29**

Table 4. Accepted Student Profile
Academic Year 17-18

Degree Program	TOTAL	Male	Female	American Indian/ Alaska Native	Asian	Black or African American	Hispanic/ Latino	Pacific Islander	White	Two or more races	Not Reported
Biochemistry & Molecular Biology PhD											
Biomedical Engineering MS - WFU campus only	13	8	5		1				9		3
Biomedical Engineering PhD - WFU campus only	52	27	25		2		2		34		14
Biomedical Sciences MS (Research Track)	39	12	27		4	8	4		14		9
Biomedical Sciences MS (Pre-health Track)	23	8	15		1	12	2		5	1	2
Clinical and Population Translational Sciences MS	7	4	3			1	1		2		3
Health Disparities in Neuroscience-related Disorders MS	7	1	6			2	1		4		
Integrative Physiology and Pharmacology PhD	14	9	5		1	1			8		4
Molecular and Cellular Biosciences PhD	29	7	22		2	5			15		7
Molecular Medicine and Translational Science PhD	5	3	2		1		4				
Neuroscience PhD	17	9	8			1	2		12		2
TOTAL	**206**	**88**	**118**	**0**	**12**	**30**	**16**	**0**	**103**	**1**	**44**

Table 5. Accepted Student Average Test Scores and GPA
Academic Year 17-18

Degree Program	GRE Verbal	GRE Quantitative	(V + Q)	GRE Analytical	GPA	TOEFL	MCAT
Biomedical Engineering MS - WFU campus only	156	161	316	3.9	3.52	106.00	
Biomedical Engineering PhD - WFU campus only	157	162	320	4.2	3.63	101.33	
Biomedical Sciences MS (Research Track)	155	156	311	4.2	3.22	106.50	
Biomedical Sciences MS (Pre-health Track)	154	154	308	4.2	3.28		30
Clinical and Population Translational Sciences MS	164	156	320	4.0	3.70		24
Health Disparities in Neuroscience-related Disorders MS	154	149	303	3.9	3.40		
Integrative Physiology and Pharmacology PhD	156	146	313	4.0	3.53	85.00	32
Molecular and Cellular Biosciences PhD	155	156	311	4.2	3.49	102.00	28
Molecular Medicine and Translational Science PhD	154	159	313	3.5	2.77	105.00	
Neuroscience PhD	160	159	318	4.5	3.61	112.00	29
AVERAGES	**157**	**156**	**313**	**4.1**	**3.42**	**102.55**	**29**

Table 6. Matriculant Student Profile
Academic Year 17-18

Degree Program	TOTAL	Male	Female	American Indian/ Alaska Native	Asian	Black or African American	Hispanic/ Latino	Pacific Islander	White	Two or more races	Not Reported
Biomedical Engineering MS - WFU campus only	6	3	3		1				4		1
Biomedical Engineering PhD - WFU campus only	24	16	8						14		10
Biomedical Sciences MS (Research Track)	23	11	12			5	3		11		4
Biomedical Sciences MS (Pre-health Track)	22	8	14		1	12	1		5	1	2
Clinical and Population Translational Sciences MS	7	4	3			1	1		2		3
Health Disparities in Neuroscience-related Disorders MS	5	1	4			2	1		2		
Integrative Physiology and Pharmacology PhD	7	3	4			1			3		3
Molecular and Cellular Biosciences PhD	13	5	8		1	3			7		2
Molecular Medicine and Translational Science PhD	5	3	2		1		4				
Neuroscience PhD	12	5	7			1	2		7		2
TOTAL	124	59	65	0	4	25	12	0	55	1	27

Table 7. Matriculant Average Test Scores and GPA
Academic Year 17-18

Degree Program	GRE Verbal	GRE Quantitative	(V + Q)	GRE Analytical	GPA	TOEFL	MCAT
Biomedical Engineering MS - WFU campus only	153	157	310	3.7	3.20		
Biomedical Engineering PhD - WFU campus only	157	163	320	4.1	3.71	101.00	
Biomedical Sciences MS (Research Track)	155	155	310	4.1	3.11	98.00	
Biomedical Sciences MS (Pre-health Track)	154	155	308	4.1	3.29		30
Clinical and Population Translational Sciences MS	164	156	320	4.0	3.70		24
Health Disparities in Neuroscience-related Disorders MS	155	150	305	4.0	3.32		
Integrative Physiology and Pharmacology PhD	157	156	313	4.1	3.46		
Molecular and Cellular Biosciences PhD	153	155	308	3.9	3.43		31
Molecular Medicine and Translational Science PhD	154	159	313	3.5	2.77	105.00	
Neuroscience PhD	158	158	315	4.4	3.56	112.00	29
AVERAGES	**156**	**156**	**312**	**4.0**	**3.36**	**104.00**	**29**

Table 8. Student Enrollment by Program and Degree
Academic Year 17-18

Degree Program	Total	PhD	PhD/MD	MS	BS/MS	Unclassified
Biochemistry and Molecular Biology (BAMB)	6	5	1			
Biomedical Engineering - WFU campus only (BMES)	53	46	3	4		
Biomedical Sciences MS Research Track (BMSC)	43			43		
Biomedical Sciences MS Pre-health Track (BMSC)	26			26		
Cancer Biology (CABI)	15	14	1			
Clinical and Population Translational Sciences (CPTS)	19			19		
Health Disparities in Neuroscience-related Disorders (HDND)	12			12		
Integrative Physiology and Pharmacology (IPP)	26	25	1			
Microbiology and Immunology (MICR)	4	3	1			
Molecular and Cellular Biosciences (MCB)	12	12				
Molecular Genetics and Genomics (MOGN)	7	7				
Molecular Medicine and Translational Science (MMTS)	31	27	2	2		
Neuroscience (NEUR)	53	35	6	8	4	
Unclassified (UNCL)	11	3				8
TOTAL	318	177	15	114	4	8

Table 9. Registered Student Profile
Academic Year 17-18

		American Indian		Asian		Black or African American		Hispanic/ Latino		Native Hawaiian/ Pacific Islander		White		Not Reported	
Degree Program	TOTAL	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Biochemistry and Molecular Biology (BAMB)	6											4	2		
Biomedical Engineering PhD - WFU campus only (BMES)	53			2	1		1					22	13	9	5
Biomedical Sciences MS Research Track (BMSC)	43					1	7		2			14	9	6	4
Biomedical Sciences MS Pre-health Track (BMSC)	26		1	1		5	8					3	5	2	2
Cancer Biology (CABI)	15				2		1					3	5	2	2
Clinical and Population Translational Sciences (CPTS)	19			1			2		1		1	8	1	2	3
Health Disparities in Neuroscience-related Disorders (HDND)	12					2	3	1					5		1
Integrative Physiology and Pharmacology (IPP)	26			1	2		1					7	8	2	5
Microbiology and Immunology (MICR)	4												4		
Molecular and Cellular Biosciences (MCB)	12				1	1	1					2	5	2	
Molecular Genetics and Genomics (MOGN)	7							1				2	3	1	
Molecular Medicine and Translational Science (MMTS)	31	1		2	2	2	4					5	7	5	3
Neuroscience (NEUR)	53		1	2	1		3		1			13	19	5	8
Unclassified (UNCL)	11				1	1	1					1	3	1	3
TOTAL	319	1	2	9	10	12	32	2	4	0	1	84	89	37	36

Table 10. New (1st Year) International Student Enrollment by Country
Academic Year 17-18

Degree Program	TOTAL	Canada	China	Colombia	Ghana	India	Jordan	South Korea	Mexico
Biomedical Engineering MS - WFU campus only	1		1						
Biomedical Engineering PhD - WFU campus only	3					2			
Biomedical Sciences MS (Research Track)	2		2						
Biomedical Sciences MS (Pre-health Track)	1	1							
Clinical and Population Translational Sciences MS	1					1			
Integrative Physiology and Pharmacology PhD	1						1	1	
Molecular and Cellular Biosciences PhD	2				1				1
Neuroscience PhD	1						1		
Neuroscience 4+1	2		1	1					
TOTAL	14	1	4	1	1	3	2	1	1

Table 11. International Enrollment by Country
Academic Year 17-18

Degree Program	TOTAL	Brazil	Canada	China	Colombia	Denmark	India	Iran	Israel	Jordan	Lebanon	Russian Fed'n	Rwanda	Saudi Arabia	South Korea	Zimbabwe
Biomedical Engineering - WFU campus only (BMES)	12			2	1		3	3	1			1			1	
Biomedical Sciences MS Research Track (BMSC)	6			4									1	1	1	
Biomedical Sciences MS Pre-health Track (BMSC)	1		1													
Cancer Biology (CABI)	1						1									
Clinical and Population Translational Sciences (CPTS)	3			1			2									
Integrative Physiology and Pharmacology (IPP)	6	1		1		1				2			1			
Molecular Genetics and Genomics (MOGN)	1						1									
Molecular Medicine and Translational Science (MMTS)	3						1				1					1
Neuroscience (NEUR)	6	1	1	2	1					1						
TOTAL	40	2	2	10	2	1	8	3	1	3	1	1	2	1	2	1

Table 12. Financial Support Summary
Academic Year 17-18

		Institutional Support				External Support				
Degree Program	Total	Graduate Fellowship	Non-Grad Institutional	Tuition Scholarship	Teaching Assistantship	Individual Award	Research Grant	Training Grant	Self-Pay	Other
Biochemistry and Molecular Biology (BAMB)	6	3		7	1	2	3			
Biomedical Engineering PhD & MS - WFU campus only (BMES)	53	13	25	52	1	1	19	2	7	
Biomedical Sciences MS Research Track (BMSC)	43			35				1	34	
Biomedical Sciences MS Pre-health Track (BMSC)	26			25					25	
Cancer Biology (CABI)	15	3	9	11		1	6	1	1	
Clinical and Population Translational Sciences (CPTS)	19		7	12		2	2	4	7	
Health Disparities in Neuroscience-related Disorders (HDND)	12			10			10		12	
Integrative Physiology and Pharmacology (IPP)	26	10	4	23		1	11	4	2	
Microbiology and Immunology (MICR)	4	1	2	3			2			
Molecular and Cellular Biosciences (MCB)	12	12		12						
Molecular Genetics and Genomics (MOGN)	7	4		7	1		5			
Molecular Medicine and Translational Science (MMTS)	31	4	9	28		1	11	8		
Neuroscience (NEUR)	53	29	12	42		9	9	9	1	
Unclassified (UNCL)	11		1	5		1	13		1	
TOTAL	318	79	69	272	3	18	91	29	90	0

Table 13. Class of 2017/2018: Degrees Conferred by Program and Degree

Degree Program	Total	PhD	MS
Biochemistry and Molecular Biology (BAMB)	1	1	
Biomedical Engineering (BMES)	6	3	3
Biomedical Sciences (Research Track)	25		25
Biomedical Sciences (Pre-health Track)	18		18
Cancer Biology (CABI)	4	4	
Clinical and Population Translational Sciences (CPTS)	3		3
Health Disparities in Neuroscience-related Disorders (HDND)	5		5
Integrative Physiology and Pharmacology (IPP)	2	2	
Molecular Genetics and Genomics (MOGN)	1	1	
Molecular Medicine and Translational Science (MMTS)	7	5	2
Neuroscience (NEUR)	4	4	
TOTAL	76	20	56

Table 14. Class of 2017/2018: Average Years to Degree Completion by Program

Degree Program	PhD	MS
Biochemistry and Molecular Biology (BAMB)	6.34	
Biomedical Engineering (BMES)	5.97	2.39
Biomedical Sciences (Research Track)		1.71
Biomedical Sciences (Pre-health Track)		1.07
Cancer Biology (CABI)	5.20	
Clinical and Population Translational Sciences (CPTS)		2.15
Health Disparities in Neuroscience-related Disorders (HDND)		1.82
Integrative Physiology and Pharmacology (IPP)	4.77	
Molecular Genetics and Genomics (MOGN)	4.35	
Molecular Medicine and Translational Science (MMTS)	5.18	2.73
Neuroscience (NEUR)	5.35	
TOTAL	**5.31**	**1.98**

Table 15. Class of 2017/2018: Placement by Program, Undergraduate Institution, Degree, and Plan

Program	Undergraduate Institution	Degree	Future Plan
BAMB	Wake Forest University	PhD	Research Associate, Wake Forest School of Medicine
BMES	North Carolina State University	PhD	Postdoctoral Fellow, Wake Forest Baptist Health
	Wake Forest University		Postdoctoral Fellow, MD Anderson Cancer Center
	Technion-Israel Institute for Technology		Postdoctoral Fellow, UT Southwestern Medical Center
	Pennsylvania State University	MS	PhD student, Wake Forest Graduate School
	University of South Carolina		PhD student, Wake Forest Graduate School
	Illinois Institute of Technology		PhD student, Wake Forest Graduate School
BMSC	University of North Carolina, Chapel Hill	MS	MD student, Wake Forest School of Medicine
(Pre-health)	Wake Forest University		MD student, Brody School of Medicine
	Rochester Institute of Technology		MD student, Applying for 2019 Admission
	North Carolina A&T University		MD student, Applying for 2019 Admission
	George Washington University		Associate Project Manager, Unknown Company
	The Ohio State University		HIRREM Technologist, Wake Forest School of Medicine
	Georgia State University		MD student, Wake Forest School of Medicine
	University of North Carolina, Chapel Hill		MD student, Brody School of Medicine
	University of North Carolina, Chapel Hill		MD student, Wake Forest School of Medicine
	Harvard University		Data Management Coordinator, Atrium Health
	University of North Carolina, Charlotte		MD student, Applying for 2019 Admission
	University of North Carolina, Greensboro		MD student, Applying for 2019 Admission
	University of North Carolina, Greensboro		MD student, Wake Forest School of Medicine
	North Carolina State University		CAN, The Well Spring Group
	Wake Forest University		Project Manager, Wake Forest Baptist Medical Center
	Howard University		MD student, Applying for 2019 Admission
	University of North Carolina, Pembroke		MD student, Applying for 2019 Admission
	University of North Carolina, Pembroke		Middle School Science Teacher, Charlotte-Mecklenburg Schools
	Emory University		MD student, Applying for 2019 Admission
BMSC	Wake Forest University	MS	Associate Project Manager, Wake Forest Baptist Health
(Research)	Fayetteville State University		Associate Program Manager, Syneos Health
	University of North Carolina, Chapel Hill		Research Analyst, Womble Bond Dickinson
	Austin College		PhD student, Wake Forest Graduate School
	Wake Forest University		Medical Scribe, ProScribe
	Bucknell University		PhD student, University of California, San Diego
	University of North Carolina, Greensboro		Research Technician II, Wake Forest Baptist Medical Center
	University of Wisconsin, Madison		PhD student, Wake Forest Graduate School
	Virginia Polytechnic Institute		PhD student, Wake Forest Graduate School
	Florida Atlantic University		Research Associate, Unknown Company
	University of Wisconsin, Madison		Associate Project Coordinator, Covance

Program	Undergraduate Institution	Degree	Future Plan
BMSC	Elizabethtown College	MS	Quality Assurance Coordinator, CorneaGen
(Research)	Michigan State University		PhD student, Wake Forest Graduate School
	Spelman College		MD student, The Ohio State University
	Duke University		Legal Assistant, Americans for Immigrant Justice
	Wake Forest University		BSN student, Applying for 2019 Admission
	Appalachian State University		Laboratory Technician, Unknown Company
	University of Pittsburgh		PhD student, Wake Forest Graduate School
	Winston Salem State University		Research Regulatory Specialist, Wake Forest Baptist Health
	Wake Forest University		PhD student, Wake Forest Graduate School
	Clemson University		Research Coordinator, Wake Forest Baptist Medical Center
	Nanjing University		PhD student, Wake Forest Graduate School
	Wake Forest University		Laboratory Technician III, Wake Forest School of Medicine
	North Carolina A&T University		MD student, Applying for 2019 Admission
CABI	University of North Carolina, Greensboro	PhD	Research Analyst, Unknown Company
	North Carolina State University		Research Project Manager, Almac Group
	Benedictine University		Postdoctoral Fellow, Wake Forest Baptist Medical Center
	Wuhan University		Postdoctoral Fellow, Wake Forest Baptist Medical Center
CPTS	Louisiana State University	MS	Instructor, Wake Forest Baptist Medical Center
	Wake Forest University		Hospitalist, Wake Forest Baptist Medical Center
	University of Georgia		MD Vascular Surgery, Wake Forest Baptist Medical Center
HDND	University of Evansville	MS	PA student, Unknown University
	University of Michigan, Ann Arbor		MD student, University of Washington School of Medicine
	Wake Forest University		Research Associate, Wake Forest Baptist Medical Center
	Tennessee State University		Independent Contractor, Mind Body Institute Beyond
	Appalachian State University		Clinical Research Coordinator, DJL Clinical Research
IPP	Soochow University	PhD	Research Statistician Developer, SAS Institute
	Mashad University of Medical Science		Unknown
MOGN	Manipal Academy of Higher Education	PhD	Innovation Associate, Wake Innovations
MMTS	University of California, San Diego	PhD	PhD student, Wake Forest Graduate School
	The Penn State University		Veterinary Pathologist, Wake Forest School of Medicine
	University of North Carolina, Charlotte		Medical Writer Fellow, Impact Pharmaceutical Services
	Wake Forest University		Senior Research Associate, Omnicom Health Group
	DePauw University		MS student in Computer Science, Unknown University
	Appalachian State University		Research Fellow, Wake Forest Baptist Health
	University of Illinois, Urbana-Champaign		Pharmaceutical Sales, Unknown Company
NEUR	University of Pennsylvania	PhD	MD student, Wake Forest School of Medicine
	East Tennessee State University		Postdoctoral Fellow, University of Chicago

Program	Undergraduate Institution	Degree	Future Plan
NEUR	Wake Forest University	PhD	MD student, Wake Forest School of Medicine
	Davidson College		Medical Communications Intern, MedThink Communications
	University of Central Florida		Postdoctoral Fellow, Unknown University
	Western Michigan University		Postdoctoral Fellow, Vanderbilt University