

Certificate and Masters Programs in Biomedical Sciences

Business Plan 20 December 2007

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Executive Summary

This business plan proposes and describes the plan for adding Certificate and Masters Programs in Biomedical Sciences at Morehouse School of Medicine. The primary goals of these programs will be threefold:

- To close a key gap in the biomedical science pipeline both for educational programs at MSM and for the state of Georgia
- To provide additional support for the institution's biomedical research enterprise
- To provide additional operating revenues for existing Graduate Education in Biomedical Sciences programs at the Morehouse School of Medicine as a way to both grow these programs and make them more fiscally self-sustaining

The programs will provide both Certificate and Masters Degree options in the form of a continuum that will allow students to receive mentoring and demonstrate their academic ability as steps toward further career decisions.

Although in the future extramural tuition and stipend funding may be secured for some students enrolled in master's studies, the programs will be initiated with enrollees paying their own tuition, perhaps with the assistance of financial aid. Annual tuition is recommended to begin at \$10,000 per student based on market comparisons with Georgia State University' MS in Biology (~\$7,000) and the Philadelphia College of Osteopathic Medicine's new MS in Biomedical Sciences Program (\$18,500). PCOM has reportedly enrolled 50 students in its program during its first year of operations.

In the Biomedical Sciences programs, Certificate and Masters Students will take core courses already established for PhD students respectively. No completely new core courses will be needed for either program although minor adjustments to existing courses may be made to tailor them to the different student populations. It is anticipated that with the resulting larger student body in the Graduate Education in Biomedical Science program, additional *elective* courses may be developed that will benefit students in all graduate programs (e.g., targeted research methods courses). Certainly the larger core courses will provide a more cost-effective use of faculty time.

One clear financial prerequisite for the success of these programs is the direct reinvestment of tuition funds both from the Certificate and MS program and from extramural tuition support for the PhD program into the Graduate Education in Biomedical Sciences enterprise of the institution. This will allow measured growth of this enterprise with the least possible impact on the school's existing budget. It is expected that we will need to grow each master's program to at least 10 students per year to move beyond being self-sustaining toward allowing funds from master's

tuitions to provide additional support for the existing PhD program. We hope to achieve that enrollment target within 5 years of program initiation.

Policy oversight for these programs will be through the Graduate Education in Biomedical Sciences Committee as it is for the PhD and MSCR programs. Administrative oversight will be through the Office of Graduate Studies and the Associate Dean for Graduate Studies. Once the program grows to 10 students per year, at least one additional Program Coordinator will be required and it may be appropriate to appoint Faculty Members as Program Directors, providing an administrative salary supplement through program funds. For the first year of implementation, it is reasonable for these duties to be carried out by Dr. Paulsen and current administrative staff (Ms. Powers).

Mission

To grow and enhance the diversity and quality of the biomedical and health sciences workforce in the State of Georgia and nationally by recruiting and training qualified applicants, providing a meaningful credential, and furthering their pursuit of satisfying careers in the biomedical and health sciences.

Vision

The Certificate and Masters Programs in Biomedical Sciences at the Morehouse School of Medicine will be the first choice of underrepresented minority college graduates looking to further explore and better prepare for the wide variety of biomedical and health sciences career and educational opportunities available to them.

Strategic Goals and Objectives

Goals

- Establish a curriculum that optimally utilizes MSM's facilities and graduate faculty and which serves the following constituencies:
 - MSM Students in the Certificate and Master's programs
 - MSM Graduate Faculty
 - MSM PhD in Biomedical Sciences Program
 - MSM MD Program
 - MSM MSCR Program
 - MSM's Research Enterprise
 - Greater Atlanta Biomedical Science Academic and Corporate Research Community
- Close a major gap in the underrepresented minority biomedical science pipeline
- Increase the number and quality of underrepresented minority students entering careers in all aspects of biomedical science
- Establish an effective model program for a continuum of biomedical science education for underrepresented minority students

Objectives

- To establish a fiscal plan whereby funds generated by the Certificate and Masters programs in Biomedical Sciences are returned to the Graduate Education in Biomedical Sciences Program to support and enhance the operations of the following degree programs:
 - Biomedical Sciences Certificate Program
 - Biomedical Research Certificate Program
 - MS in Biomedical Research Program
 - MS in Biomedical Technology Program
 - PhD in Biomedical Sciences Program
- To provide unique programs both drawing on and benefiting our excellent core research facilities
- To identify, evaluate, and enhance the quality and quantity of potential applicants to MSM's doctoral programs (MD and PhD)
- To provide our graduate faculty with additional qualified personnel to help pursue their research objectives
- To maintain core-graduate-class-size critical mass and achieve better economy of scale in terms of graduate faculty time and effort
- To provide an opportunity for medical students, residents, and clinical junior faculty to receive credentialed training in biomedical science in a reasonable period of time, or on a part-time basis
- To provide an avenue for professional advancement and improved job satisfaction for, and long-term retention of, qualified faculty and staff
- To meet a growing need for technical training for Atlanta's expanding academic, government, and corporate biomedical research community
- To establish partnerships with local biotechnology and biomedical science firms to enhance communication on needs, skills, and opportunities to help serve joint and individual interests

Programs and Services

The **Certificate and Masters Programs in Biomedical Science** will begin with five elements:

- (1) Certificate in Biomedical Science
- (2) Certificate in Biomedical Research
- (3) M.S. in Biomedical Research
- (4) M.S. in Biomedical Technology

A fifth element, an M.S. in Biomedical Education is under consideration for the future to contribute to the resolution of other problems in the science education pipeline.

Certificate in Biomedical Science

One year

Tuition: \$10,000

Required Fees: \$6,433 (+\$480 parking optional)

Program Summary: This one-year, post-baccalaureate program will include 18 semester hours of didactic coursework, and 6 semester hours of laboratory coursework, and four clinical preceptorship experiences (1 semester hour) for a total of 26 semester hours of graduate credit. Preparatory training for the MCAT or DAT may be available for an additional fee.

First (Fall) Semester

PHD 517. Graduate Biochemistry: Graduate Cell Biology Sequence, Module 1 (4 credit hours) Course Director: Gary Sanford, Ph.D., Letter Grade, Offered annually, Summer-Fall.

PHD 517L. Graduate Biochemistry Laboratory: Graduate Cell Biology Sequence, Module 1 Lab (3 credit hours) Course Director: Gale Newman, Ph.D., Letter Grade, Offered annually, Summer-Fall.

PHD 521. Cells and Tissues: Graduate Cell Biology Sequence, Module 2 (3 credit hours) Course Director: Brenda Klement, Ph.D., Letter Grade, Offered annually, Fall.

PHD 521L. Cells and Tissues Lab: Graduate Cell Biology Sequence, Module 2 Lab (3 credit hours) Course Director: Brenda Klement, Ph.D., Letter Grade, Offered annually, Fall.

PHD XXX, Gross Anatomy of the Thorax and Abdomen: For Pre-Medical Post-bac students. Portion of medical first-year curriculum (Molecules, Structures, and Mechanisms) covering the anatomy of the thoracic and

abdominal cavities and organs. Includes lectures and laboratories. Course Director: Lawrence E. Wineski, Ph.D., Letter Grade, Offered annually, Fall.

PHD XXX, Gross Anatomy of the Head & Neck: For Pre-Dental Post-bac students. Portion of medical first-year curriculum (Molecules, Structures, and Mechanisms) covering the anatomy of the thoracic and abdominal cavities and organs. Includes lectures and laboratories. Course Director: Lawrence E. Wineski, Ph.D., Letter Grade, Offered annually, Fall.

MEDI 511, Fundamentals of Medicine 1: Combines Clinical Preceptorship, Human Values, Human Behavior, and Biostatistics/Epidemiology into a year-long, interdisciplinary sequence. Course Director: Martha Elks, M.D., Ph.D., Letter Grade, Offered annually, Full year.

Certificate in Biomedical Research

One year

Tuition: \$10,000

Required Fees: \$6,433 (+\$480 parking optional)

Program Summary: This one-year, post-baccalaureate program will include 18 semester hours of didactic coursework, 6 semester hours of laboratory coursework, and two 8-week laboratory rotations (1 semester hour each) for a total of 26 semester hours of graduate credit. Preparatory training for either the MCAT or GRE may be available for an additional fee.

Curriculum details (courses with course numbers are already in place, *course descriptions in Appendix 1*):

First (Fall) Semester

PHD 517. Graduate Biochemistry: Graduate Cell Biology Sequence, Module 1 (4 credit hours) Course Director: Gary Sanford, Ph.D., Letter Grade, Offered annually, Summer-Fall.

PHD 517L. Graduate Biochemistry Laboratory: Graduate Cell Biology Sequence, Module 1 Lab (3 credit hours) Course Director: Gale Newman, Ph.D., Letter Grade, Offered annually, Summer-Fall.

PHD 521. Cells and Tissues: Graduate Cell Biology Sequence, Module 2 (3 credit hours) Course Director: Brenda Klement, Ph.D., Letter Grade, Offered annually, Fall.

PHD 521L. Cells and Tissues Lab: Graduate Cell Biology Sequence, Module 2 Lab (3 credit hours) Course Director: Brenda Klement, Ph.D., Letter Grade, Offered annually, Fall.

PHD 524. Fundamentals of Biostatistics (3 credit hours) Course Director: Ahmad Al-Mahmoud, Ph.D., Letter Grade, Offered annually, Fall.

PHD 518. Fundamentals of Professional Science (FPS) I (3 credit hours) Course Director: Doug Paulsen, Ph.D., Letter Grade, Offered annually, Fall.

PHD 519. Fundamentals of Professional Science (FPS) II (1 credit hour) Course Director: Doug Paulsen, Ph.D., Letter Grade, Offered annually, Fall.

Second (Spring) Semester

PHD xxx. Introduction to Methods & Instrumentation (2 credit hours) (*Proposed reintroduction of an old course*), Course Director: *To be named*, Letter Grade, Offered annually, Spring.

PHD 513 & PHD 514. Laboratory Rotation I & II (1 credit hour each) Course Director: Doug Paulsen, Ph.D., Pass/Fail, Offered annually, Fall, Spring.

PHD 526. Fundamentals of Professional Science (FPS) III (1 credit hour), Course Director: Doug Paulsen, Ph.D., Letter Grade, Offered annually, Spring.

PHD 526. Fundamentals of Professional Science (FPS) IV (1 credit hour), Course Director: Doug Paulsen, Ph.D., Letter Grade, Offered annually, Fall.

Program Completion

Students having completed this year of work with at least a **C** average in their coursework will be awarded a **Certificate of Completion** in Biomedical Sciences. Those completing the program with a C average will not qualify to continue on to study toward the M.S.

Anticipated types of students interested in certificate only:

- Students seeking a one-year enrichment program to help them gain entry into MD, Dental, or other postbaccalaureate degree programs.
- Students gaining acceptance into Medical or Dental school, or other postbaccalaureate degree programs after matriculating at MSM.
- Students interested in receiving a credential while exploring research as a possible career option.
- Students supported by the biotech industry to enhance their biomedical science background for advanced job placement.
- Students seeking an additional credential to boost their earning capacity in the biotech industry.

Master of Science in Biomedical Research

Two years minimum

Tuition: \$10,000 per year

Required Fees:

First year: \$6,433 (+\$480 parking optional)

Second year: \$4,083 (+\$480 parking optional)

Program Summary: Students completing the Certificate in Biomedical Sciences Program (above) with at least a B average and submitting official scores from the Graduate Record Examination will be eligible to continue working toward a Master of Science in Biomedical Research Degree. In addition to the Certificate Program, this degree involves elective coursework (4 semester hours of credit) and supervised research resulting in a Master's thesis.

This program is recommended for students anticipating continuing their education to the doctoral level, whether in medicine (M.D.) or biomedical research (Ph.D.).

Curriculum details

Core Coursework: The coursework outlined for the Certificate in Biomedical Science program will serve as the core coursework for the MS in Biomedical Research Degree as well and will be completed during the first year.

Mentor Selection, Preliminary Proposal, and Thesis Committee: During their first year of training, students must complete their laboratory rotations, select a research advisor, and prepare a preliminary thesis proposal outlining the work planned for the thesis. With the advice and consent of the thesis advisor, the student will then select two additional graduate faculty to serve on the thesis committee for the project proposed.

Elective Coursework: Students must complete a minimum of 4 semester hours of approved elective credit to qualify for the M.S. degree. Selections of elective coursework will require advice and consent from the student's mentor. Students may choose from a variety of elective courses covering the basic biomedical sciences both in the graduate and medical curriculum. They will also have access to graduate courses at other accredited Atlanta area schools and universities through the ARCHE program.

Supervised Research: Students must complete a minimum of 12 semester hours of supervised research credit to qualify for the M.S. in Biomedical Research degree. Together with the thesis committee, the student will revise the preliminary thesis proposal into a formal thesis proposal to be presented to the thesis committee as a seminar within 8 weeks of the start of the second year of study. The student may begin experimentation prior to full approval of the proposal, but will only receive credit toward the degree after their formal thesis proposal has been approved by the thesis committee.

By the second (Spring) semester of their second year, M.S. in Biomedical Research Students should be working full time on their thesis research under the direction of their thesis committee. Monthly committee meetings are recommended to assure rapid and consistent progress toward the completion of their project. It is understood that research results on novel problems are unpredictable at best and that research projects often take longer than anticipated. Nevertheless, the committee is charged with developing a research project for the student that targets completion, including thesis submission and public defense, by early April of the second year.

Program Completion: Degree completion involves completion of all didactic requirements with at least a 3.0 GPA and approval of the submitted and defended thesis by the thesis committee.

Master of Science in Biomedical Technology

Two years

Tuition: \$10,000 per year

Required Fees:

First year: \$6,433 (+\$480 parking optional)

Second year: \$4,083 (+\$480 parking optional)

Program Summary: Students completing the Certificate in Biomedical Sciences Program (above) with at least a B average and submitting official scores from the Graduate Record Examination will be eligible to continue working toward a Master of Science in Biomedical Technology degree. In addition to the Certificate Program, this degree involves intensive training and hands on experience in a variety of biomedical technology fields. This is a non-thesis Masters program that focuses mainly on technical training and research skills.

This program is recommended for students seeking advanced training and a credential in biomedical technology to enhance job skills and earning power in a variety of biomedical science careers.

Curriculum details

Core Coursework: The coursework outlined for the Certificate in Biomedical Science program will serve as the core coursework for the MS in Biomedical Technology Degree and will be completed during the first year.

Program Selection: During the summer of their first year of training, students must complete their laboratory rotations, select a program of study, and up to 3 advisors to serve as a mentoring team. The programs of study will focus on areas supported by MSM's core laboratories. Faculty in each program area will develop specialized didactic and hands-on training for students in their program. Students may select from among the programs and core laboratories below or consult with program faculty to design a program of study to fit their specific needs and interests.

Animal Care and Use: MSM's *Center for Laboratory Animal Resources* is accredited by the Association for Assessment and Accreditation of Laboratory Animal Care (AAALAC) and serves as a centralized resource for laboratory-animal care and education for the entire Atlanta University Center consortium. It currently conducts a variety of in-service training programs which could be expanded to include additional practical hands-on training by its experienced staff and relevant faculty.

Cell and Tissue Biology: MSM's Graduate Faculty includes a variety of experts in the use and analysis of cells and tissues in biomedical research. Training in this area will focus on cell, tissue and organ culture, histology and histochemistry for light and electron microscopy, as well as cell fractionation, fraction analysis, and cell sorting. MSM's *Histology and Electron Microscopy Core Labs* will participate in the training of students that select this program of study. There are a number of core tissue culture laboratories for the various research units of the school that can provide a variety experiences in these methodologies.

Clinical Research: MSM's *Clinical Research Center* houses core resources and facilities to provide comprehensive support for clinical investigation. These resources include fully equipped private examination rooms, a Noninvasive Cardiovascular and Hemodynamic Core Laboratory, Analytical and Protein Profiling Laboratory, a Biostatistical and Data Management Core, a Nursing Core, a Recruitment/Retention Core responsible for all study participant enrollment activities, and Bionutrition Core. It also supports the Master of Science in Clinical Research Program for the training of doctoral level professionals to perform clinical research. The Clinical Research training in the M.S. in Biomedical Technology program would focus on training Clinical Study Managers to organize and support clinical trials.

Microscopy and Biomedical Imaging: MSM's *Histology, Electron Microscopy, Confocal Microscopy, and Image Analysis Core Laboratories* house an array of microscopic and bio-imaging equipment that serve as powerful tools in today's biomedical sciences. Our faculty and staff are experts in their use and have provided excellent hands-on training for many students and investigators over the years.

Molecular Biology & Genomics: MSM's *Molecular Biology Core Laboratory* is well equipped to provide DNA sequencing, Single Nucleotide Polymorphism (SNP) analysis, and DNA fragment analysis services and training as well as additional training in related methodologies. MSM's *Functional Genomics* facilities include multiple microarray systems and investigators experienced in applying them to solve difficult biomedical research problems.

Analytical and Protein Profiling: Since the 1996 Olympics in Atlanta, MSM's Analytical Laboratory has operated a facility shared by the Department of Pharmacology & Toxicology and the Clinical Research Center (CRC). In addition, investigators from the NASA Space Medicine and Life Sciences Research Center at MSM also extensively relied on this analytical chemistry laboratory. The CRC has recently realigned and consolidated the analytical core with the proteomics core laboratories (described below) to form the Analytical and Protein Profiling Laboratory. This laboratory analyzes both human and animal samples. Its primary focus is to provide reliable and comprehensive analytical services to basic and clinical researchers. Examples of the services and expertise include:

- SELDI Proteomics
- Mass spectrometry (GC/MS)
- Trace metals analysis
- High performance liquid chromatography (HPLC)
- Sample preparation (derivatization, extraction, purification)
- Reporting of raw data and data analysis
- Technical consultation on analytical methods and assistance with manuscript and proposal preparation

Program Completion: Degree completion involves completion of all didactic requirements with at least a 3.0 GPA. Each student will be required to document a minimum of 1000 hours of hands-on training experience while in the program and pass relevant skills assessments to qualify for the degree.

Needs Assessment

Biomedical Workforce at the National, State, and Local Levels

National Training Diversity Trends: Perhaps more than any other endeavor, science thrives on diversity: diversity of information, approaches to problems, ideas and opinions, and of ethnic, gender, and cultural perspectives. It is thus not surprising that Healthcare and Biomedical Science workforce diversity has been a longstanding concern at both the state and national level. Science is simply not the solitary pursuit it was once perceived to be.

Still, while the scientific training of underrepresented ethnic minorities has gained ground over the past twenty years (Fig 1), only Asian/Pacific Islanders have made sufficient gains to be excluded from “underrepresented” status. Hispanics and African-Americans in graduate training have more ground to cover to reach that milestone. Further, these populations continue to grow at a pace exceeding that of the majority population.

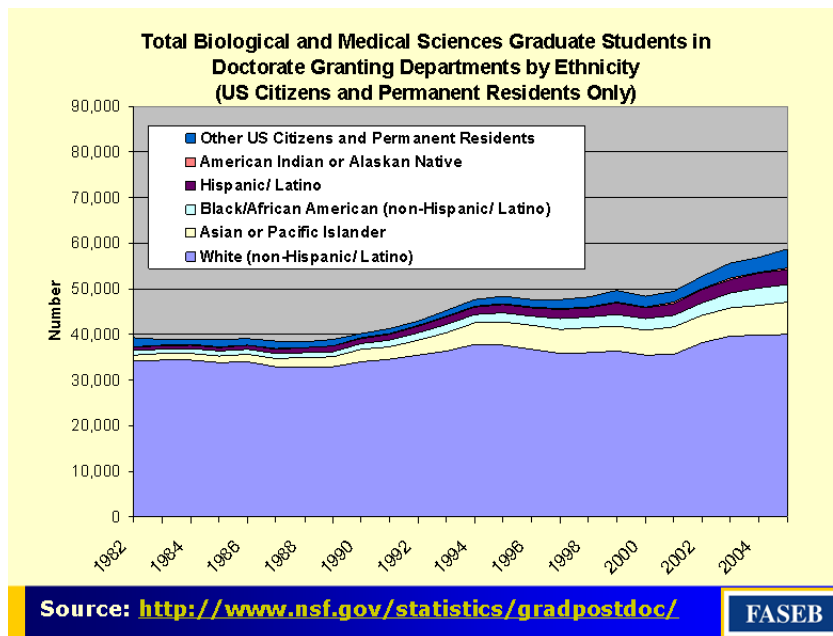


Table 1 shows 2003 National Science Foundation US demographic data for doctoral level scientists (PhDs) in the biological, agricultural, environmental, life, and health sciences along with 2000 US Census population demographics. It reflects the extent to which these population groups are either underrepresented or overrepresented in professional science nationwide.

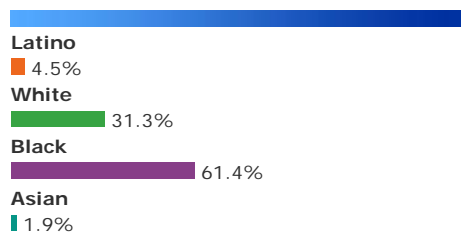
Table 1. Demographic Data on American Scientists

Employed Doctoral Scientists 2003	Total	Am. Ind. / Alaska Native	Asian	Black	Hispanic	White	Other Ethnic
Biol., Agricul., Envir., Life Sci.	45,080 (100%)	1,010 (0.7%)	22,560 (15.5%)	3,550 (2.4%)	3,820 (2.6%)	114,550 (78.6%)	270 (0.2%)
Health Sciences	23,300 (100%)	200 (0.8%)	2,750 (11.8%)	1,180 (5.1%)	620 (2.7%)	18,450 (79.4%)	0 (0%)
US Population 2000 (%)	284,800,000 (100%)	2,475,956 (0.9%)	10,242,998 (3.6%)	34,618,190 (12.3%)	35,305,818 (12.5%)	211,460,626 (75.1%)	N/A

Figure 2 shows the 2000 US Census demographic data for Atlanta. Here the percentage of the population underrepresented in the scientific workforce already exceeds that of the national majority.

Figure 2. Atlanta Demographics

Population - 416,474



2000 U.S. Census data

<http://www.muninetguide.com/states/georgia/municipality/Atlanta.php>

Table 2 shows the trend in Atlanta's demographics from a 2004 publication of the Atlanta city government with projections from the Atlanta Regional Commission and the Bureau of Planning. (Data for other ethnic groups were not available.

http://www.atlantaga.gov/client_resources/government/planning/cdp/2004cdp-03demographics.pdf).

Table 2. Atlanta Demographics by year

Ethnicity	1980	1985	1990	1995	2000	2005	2010
African-American	279,323 (65.7%)	286,310 (66.3%)	289,076 (69.6%)	294,945 (70.0%)	255,689 (61.4%)	316,630 (71.0%)	320,812 (67.0%)
Caucasian	136,500 (32.1%)	136,948 (32.4%)	126,405 (30.4%)	126,405 (30.0%)	138,352 (33.2%)	129,328 (29.0%)	158,011 (33.0%)
Other	9,199 (2.2%)	8,353 (2.2%)			22,663 (6.4%)		
Total	425,022	431,611	415,481	421,350	416,704	445,958	478,823

Years 1990 and 2000 US Census Data

Clearly, reaching a level of diversity in Atlanta's biomedical workforce that reflects its general population is a target that will be difficult to approach for many years to come. Morehouse School of Medicine has proven its ability to train excellent physicians and scientists and now has an opportunity and a duty to increase those contributions to the biomedical workforce of Atlanta, Georgia, and the nation to help bridge this widening diversity gap in the biomedical sciences.

Biomedical Science Workforce Issues: Even without considering the diversity issue, Georgia has acknowledged that it has some catching up to do with other states in developing its biotechnology sector. Although over 100 biotech firms have their home in this state, they comprise only 1% of the biotech firms in the country. Compare this with California which is home to 23% of all firms and Massachusetts hosts 11% (Leigh, cited by Childress in *Georgia's Approach to Biotechnology* www.cherry.gatech.edu/TRP/proceedings/2001/01Childress.doc).

Noting that more than 40 states have biotech initiatives underway, the Atlanta Business Chronicle (Julie Bryant, Oct. 8, 2001) described a statewide initiative, coordinated in part by the Georgia Research Alliance to bring Georgia up to speed and transform it into a

biotechnology hub. That transformation simply cannot and will not take place in the absence of an educational environment that can provide a highly skilled workforce.

In Table 3 below, it's clear just how far Georgia has fallen behind biotech-rich states in developing its scientific workforce. Given that Georgia's population has grown faster than its educational programs in the 10 years since these data were collected, it seems likely that the need for science education programs has increased accordingly. Although Georgia's ratio of science graduates to its overall population approaches that of California, the number of these graduates in Georgia is only approximately 25% of California's total. While Georgia's population is growing, we have a long way to go before we can match the brute-force impact of a population four times our current numbers.

Table 3. Comparison of Graduates in Science and Engineering (1993-1997)*

State	Science & Engineering Graduates (Bachelors, Masters, PhD)	State Population	Ratio Science Graduates : Population
Massachusetts	135,905	6,115,476	1:45
California	330,837	32,217,708	1:97
Georgia	86,384	7,428,672	1:112

*Modified from Childress, 2001. *Georgia's Approach To Biotechnology*
www.cherry.gatech.edu/TRP/proceedings/2001/01Childress.doc (includes data only from University of Georgia, Emory University, Georgia Tech, and Medical College of Georgia).

Even to staff Georgia's existing biotechnology firms, to make them stronger, and to then keep them from being recruited away by other states, additional scientific training opportunities will be needed in Georgia. Yet stop-gap thinking like simply holding onto our current position in the biotech universe should not be our goal. Instead, we should focus attention on what needs to be done to *attract* additional biotechnology firms to our state. In order to reach the kind of critical mass that has allowed other states to grow this sector consistently, Georgia must have in place a strong biomedical science workforce and a dependable educational pipeline to maintain its ranks. Given the current demographics, that will require the training of an increasing number of underrepresented minority role models. Filling a gaping hole in that training pipeline while at the same time addressing workforce diversity issues comprise two of the key reasons for moving forward immediately with this academic initiative at the Morehouse School of Medicine. We have an opportunity here to take the lead in developing a program that will address both goals simultaneously.

Community Needs

The Morehouse School of Medicine has grown consistently stronger since its inception because of its unique mission. It has proven itself willing and increasingly able to make significant contributions to meeting the healthcare needs of the *underserved* and the science and health education needs of the *underrepresented* in our society. Part of its success in the educational sphere has resulted from an intuitive understanding and of the importance of providing educational support at all levels to the community it serves while at the same time meeting each student's needs as an individual and helping that student step up to the next level. The result has been the ongoing assembly of a training pipeline that serves the community, the institution's core educational programs, and each student that crosses our path.

A Leak in the Pipeline or a Bridge to the Future: The Certificate and Master's Programs discussed in this business plan are intended to fill an important gap in the educational

pipeline that supports MSM's doctoral programs and research enterprise and which provides a skilled biomedical and healthcare workforce at many levels.

Although many students finish college with a clear sense of purpose and are well prepared to select and undertake advanced training, many others finish without the requisite academic skills and background either to gain direct entry into doctoral programs or to make difficult career choices from the daunting variety of opportunities in the health and biomedical sciences. From an institutional perspective, the result, in too many cases, is a poor match between a student's interests and abilities and the training program selected. Students may enter programs for which they are poorly suited and negative outcomes may be wrongly interpreted as a failure on the part of the student, the institution, or both.

The programs discussed in this plan are targeted to begin closing that critical gap in the students' understanding of their options and their preparation to find a career in the health and biomedical sciences fields where they can make their optimal contributions and obtain the greatest job satisfaction based on their interests and abilities. These programs will provide a postbaccalaureate bridge to the healthcare and biomedical science professions. By addressing this gap in the pipeline, MSM will have the opportunity to turn what has been historically a stumbling block into a stepping stone for underrepresented minority students interested in careers in the biomedical and health sciences. As these students move into the wide variety of jobs open to them, they will provide a much broader and deeper cadre of role models to inspire and develop the next generation of biomedical and health science professionals.

Institutional Needs

Needs of the Educational Enterprise – Able, Well-Informed, Well-Prepared, and Committed Students: Standard pre-matriculation measures of student readiness for graduate study (e.g., GPA, GRE, and MCAT) are well known to be less reliably predictive of success for minority students than for their majority counterparts. For certain students with gaps in their application credentials, it makes sense to have a program that provides experience and a credential and at the same time assesses and enhances readiness for doctoral level education.

MSM's graduate faculty have for some time bemoaned the absence of the option of a terminal Masters degree for students who proceed through the program for some years and in the end fall short of expectations for the awarding of a doctorate. Yet the proposed programs are not intended to create such a terminal Master's degree. They are intended to provide a novel approach to graduate education that will allow us better to assess student readiness for doctoral study *up front* and direct them toward career options for which they are best suited *before* they enter the PhD or other doctoral programs. This will help minimize the difficulty and disappointment associated with dismissing students with or without a terminal Masters degree. It will also help avoid substantial institutional investment in tuitions, fees, and stipends for students who, in the end, cannot meet the requirements for the degree program into which they were accepted. Essentially, the proposed programs will provide a form of academic and financial risk management for MSM.

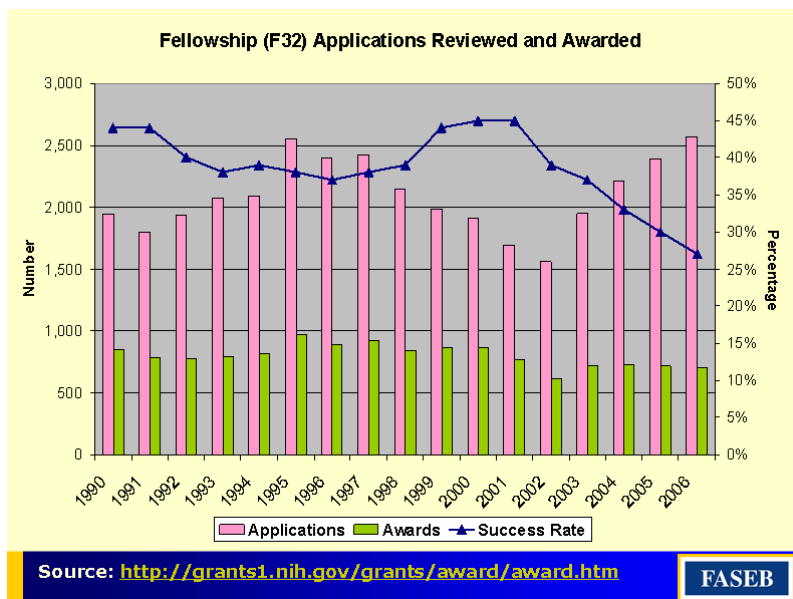
Students in the Certificate and Master's programs will also have an opportunity to develop and refine their research interests, allowing them to develop the kind of commitment to a research area that will improve their motivation and accelerate their progress toward their goals if they do succeed in gaining entry to a predoctoral program.

Needs of the MSM Research Enterprise – Skilled Hands, Fertile Minds: The biomedical and clinical research enterprises at MSM have grown dramatically over the past several years. The Neuroscience and Cardiovascular Research Institutes have pioneered an approach to collaborative research at MSM that has been successful and they continue to serve as excellent models for the development of additional research centers to address glaring examples of health disparities facing our society today. The development of MSM's Clinical Research Center was critical to the institution's preparedness to partner with Emory University and Georgia Tech in establishing a novel city-wide Atlanta Clinical and Translational Science Institute and take advantage of federal funding for this sort of research through NIH's CTSA initiative.

It has however become clear that one obstacle to MSM's ability to reach its full potential for biomedical research is the paucity of skilled hands available to pursue the many important research projects currently underway and the many more now relegated to the back burner. One way that other research-intensive institutions surmount this obstacle is through the availability of armies of PhD students to staff the investigators' laboratories and to work semi-independently on smaller pieces of larger puzzles. Despite the fact that stipend costs for PhD students are significantly less than that for additional faculty, it is difficult to realize those savings if there are insufficient funds at hand to cover the PhD student stipends. The result is that while we do have a PhD in Biomedical Sciences program, it is of insufficient size to meet the current, much less future, needs of our research enterprise. While we have a graduate faculty actively engaged in research approaching 80 members, we have only 30 PhD students. The number of graduate students per active lab at research-intensive institutions averages between 2 and 5. Thus as our past president, Dr. James Gavin once noted, the labor force for our research enterprise is "upside down" with regard to numbers of research students and faculty. We need more skilled hands.

Another benefit of the presence of students is the injection of energy and fresh ideas into the research enterprise. Students are a critical component of the type of research culture MSM's research leadership hopes to cultivate at this institution. Without a critical mass of research students, the kind of research culture required to attract the best and brightest scientists to join our faculty and R01 funding to our institution simply cannot be sustained.

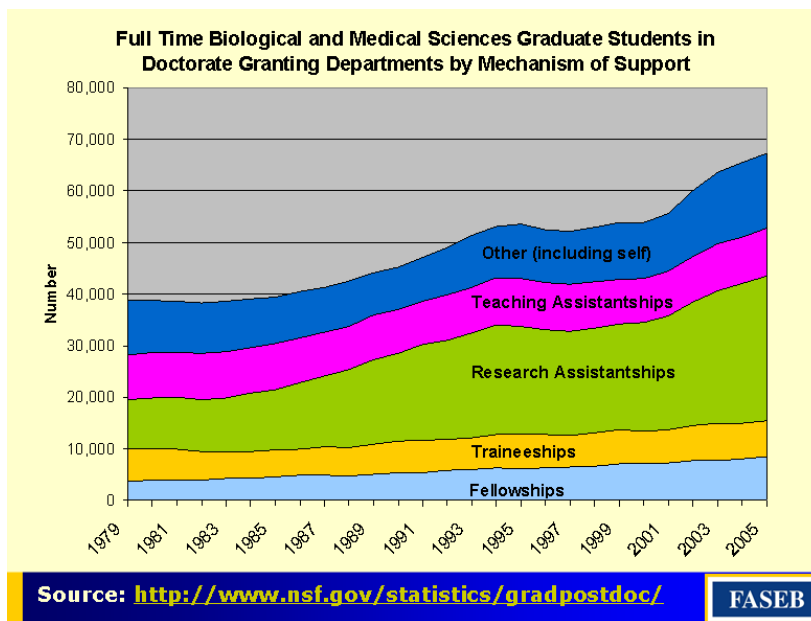
NIH Predoctoral Training Program (T-32) or National Research Service Award (NRSA, F-32) Support are perhaps obvious avenues to try as these are key student-support elements at other research-intensive institutions. Yet this type of funding, which has been obtained for training in Cardiovascular Research (T-32), and which funded one of our recent graduates (F-32), are increasingly difficult to obtain (e.g., success rate in Fig. 3). They typically require at a minimum a solid track record for training PhDs and multiple investigator-initiated awards (e.g., R01 type) in a particular field to receive serious consideration.



MSM still currently has more active PhD students than PhD graduates. Although our graduates have all done quite well (Appendix 3), the numbers are not there to instill the kind of confidence NIH needs to award very limited training funds to our program. Thus we are in a Catch-22 situation in which we are less than optimally competitive for the training funds we need to grow our program in part because we have not yet sufficiently grown our program. We need to find other ways to lay the groundwork.

Financial Considerations:

From this perspective, a reasonable way to address that obvious problem would be to increase the number of institutionally funded studentships in MSM's PhD in Biomedical Sciences program. At most institutions, institutional funding covers tuition, fees and stipends for the students in these programs for at least 1.5 and more often for 2 years of their training, after which the students move onto extramural funding through training grants, research grants, or research contracts with corporations. This means



that the institution must generally supply funding for twice as many studentships as it expects to accept into its PhD or MSCR programs in any given year. Yet it is less clear from which sources those "institutional funds" derive. Based on the data shown in Figure 4, it is clear that the development of a more diversified PhD student-funding portfolio for graduate education in biomedical sciences should be an ongoing goal of the Morehouse School of Medicine.

Given MSM's institutional budget constraints in recent years, meeting the graduate program's strategic planning target of an average entering class size of 10 PhD students per year (which would require 20 institutionally funded PhD Studentship positions) has not been met, or even approached. At the same time, it is important to note that the Dean's Office has consistently endeavored to provide as much institutional financial support to these programs as it could reasonably muster and with that assistance, the PhD program has grown to its largest size ever, 30 students, this year. Still we are struggling to maintain sufficient institutional support to maintain current program size given the tightening of NIH's belt which has had an impact on MSM at many levels.

The development and implementation of the Certificate and Master's programs described in this plan are intended, in part, to provide training programs that have a net positive impact on finances for Graduate Education in Biomedical Sciences at MSM. Specifically, recovery of tuition from the Certificate and Master's programs for application to PhD Student support and overall graduate program operations, especially recruitment, will enhance and accelerate graduate program development at MSM without relying exclusively on internal funds to support program growth. At the same time, these programs can be expected to provide additional skilled hands in our laboratories at little cost to the institution.

Another potential benefit deals more with academic culture than program size. The presence of Certificate and Masters Students in our Biomedical Research training programs, students who are paying their own tuition, will emphasize the privilege and responsibilities of those accepted into the PhD program and are supported by institutional or extramural fellowship funds. It will help our PhD students better appreciate the significant support they sometimes take for granted.

Implementation Plan and Timeline

Accreditation Issues

During the planning for these programs, Dr. Paulsen contacted the Southern Association for Colleges and Schools (SACS) to ask whether and what steps were needed to secure SACS accreditation for these Certificate and Masters programs. In a clear but cordial response we were informed that SACS does not accredit educational programs, it only accredits schools. Because MSM already has SACS accreditation, and because the programs being contemplated are directly related to ongoing educational programs at the school, there is no need to apply for accreditation for these new programs. Although not a requirement, they would appreciate notification once any new programs are implemented.

Program Size

It would be prudent to initiate the programs with an entering class of three to five students. This number can be accommodated along with existing students in our classes without dramatic changes and will allow us to make adjustments to unforeseen concerns without undue disruption. It also provides a critical mass of students at the same level to work together and provide peer support. Growth from this initial level is expected to be gradual for the Masters and Certificate Programs in Biomedical Sciences until they reach a total number of 40 matriculants. That transition is expected to occur over a period of 5 years. Any decision to expand beyond that point will require careful reassessments of institutional facilities and resources based on experience with the program.

Institutional Preparations

There are several issues that should be addressed prior to enrolling students in a new educational program.

Finances: One key financial issue must be addressed prior to implementing the proposed programs. It will be critical during the initiation phase of these educational programs to establish that all tuition monies thereby generated be deposited into a Graduate Education in Biomedical Sciences Program Fund-8 (rolling) account for use in supporting its students and programs. Current institutional graduate program support is insufficient to allow addition of new training programs. Indeed, in this environment, adding new programs would very likely damage the existing MSCR and PhD programs by drawing limited support away from them. Thus it would be foolish to undertake the addition of any new educational programs unless this budget structure requirement is met. Assuring that this budgetary agreement can be reached is thus a prerequisite for moving forward with program implementation.

If that requirement is met, we will be able to proceed with small classes at first and build the program as we gain experience and funding and do so without making additional demands on institutional funds. It is anticipated that as the new programs grow and mature, recovered tuition will gradually diminish the need for institutional funds to operate the school's existing graduate programs in Biomedical and Clinical Research Training Programs. This is an important fiscal goal of the proposed programs for which we hope to achieve a measurable impact within five years of program initiation.

Tuition and Fees: An initial tuition of \$10,000 per year is proposed based on the following market data. Georgia State University, which is just across town, charges approximately \$7,000 tuition for a full year (Fall, Spring, and Summer) of graduate study. However this school offers a biology degree and is not positioned to offer a biomedical sciences degree. The newly established Philadelphia College of Osteopathic Medicine in Suwanee (North of Atlanta) recently advertised a new MS in Biomedical Science program in the Journal/Constitution. A call to their program manager revealed that the tuition there will be \$18,500 plus fees. The fee for first-year PhD students, which will be the same for Master's students, is shown in the table below.

Table 2. Annual Academic Fees for First-Year PhD Students

Item	Annual Charges
Student Dental Plan	\$192.00
Student Disability Health	\$122.00
Student Health Insurance (w/no dependents)	\$2,082.00
Student Health Service	\$154.00
Laboratory Fees*	\$1,000.00
Library Fee	\$88.00
Technology Fee (Laptop & Software)	\$2,350.00
Matriculation/Registration Fee	\$154.00
Microscope Fee	\$191.50
Student Activity Fee	\$75.00
Yearbook Fee	\$25.00
Total	\$6,433.50

*Laboratory Fees would be adjusted based on discussions with core lab directors prior to initiating the Certificate and Master's Programs

Allocation of Tuition Funds:

Tuition funds generated by the Certificate and Masters programs in Biomedical Sciences will be allocated to the Graduate Education in Biomedical Sciences program to support these new programs and the existing PhD in Biomedical Sciences Program. Examples of the application of these funds in order of priority are shown below. The basic principle is to establish self-sufficiency for the Certificate and Masters programs first before providing additional support for the PhD program.

- **Administrative** costs in terms of time and effort will be calculated and projected based on experience in the first year of the program. It is anticipated that one new full-time administrative staff person will need to be brought on board once the program grows to at least 6 students per year.
- **Recruitment of students** for both the Masters and PhD programs requires support for travel, online and print advertising, meeting registration, booth registration, small gifts with logos for recruitment events, and shipping costs for display and booth supplies.

- **Core laboratories** participating in the training will receive per-student-per-semester laboratory support fees derived from tuition. Fee schedules should be negotiated with service providers prior to program implementation.
- **Research Advisors** for Masters students will receive per-student-per-semester laboratory support fees derived from tuition and/or fees. Fee schedules should be negotiated with service providers prior to program implementation.
- **Remaining funds** will be used to supplement existing institutional PhD stipend and fees funds in an effort to grow the PhD program.

Policy:

Program Policies: Academic policies for these programs essentially will be those established for the PhD program already in place with modifications appropriate to the individual Certificate and Masters programs. Still any such modifications must be developed, codified, and approved by GEBSC prior to enrollment of the first class.

Graduate Education in Biomedical Sciences Committee (GEBSC) Approval: GEBSC has long supported, in principle, the development of Masters programs for implementation at MSM. Nevertheless it will be appropriate for this body to review and make recommendations regarding this business plan and relevant academic policies before final implementation. Once GEBSC approval is obtained, it will be appropriate for GEBSC to recommend the implementation of these programs to the School's Academic Policy Council.

Academic Policy Council (APC) Approval: It is appropriate for the APC to review, table for further consideration, and then act on GEBSC's recommendation for program implementation. If approved, the APC may recommend approval by the Dean and the President.

Board of Trustees Approval: Final approval of any new academic programs rests naturally with MSM's Board of Trustees. Students should not be enrolled without prior board approval, or at least the assent of the Executive Committee.

Curriculum Development and Evaluation: The current PhD Curriculum Committee will be renamed the Graduate Education in Biomedical Sciences Curriculum Committee and will oversee development and evaluation of the curriculum for the Certificate and Masters programs in Biomedical Sciences as well as the PhD program. This will allow us to protect and develop curricular synergies among the programs. This subcommittee of the Graduate Education in Biomedical Sciences Committee (GEBSC) receives instructions from and reports to GEBSC on a regular basis.

Program Staffing: With 30 full-time PhD students already and only one administrative coordinator, the PhD program is currently running a very tight ship and simultaneous tasks can be very challenging. Still, it is reasonable to believe that during the first year of program development and up to 5 new students we will be able to get by without adding further staff. This will hopefully allow us to accumulate tuition funding to hire either a temporary or permanent staff member for the second year to assist with Certificate and Masters program expansion and provide support for the PhD program as well. As the programs grow, it will be appropriate to appoint faculty directors for each program to assure adequate stewardship of each. Recovery of tuition costs from the Certificate, Masters, and PhD programs could allow allocation of modest salary supplements for such directorship positions.

Program Faculty:

Faculty Research Mentors: There are currently 45 graduate faculty actively involved in the training of our PhD students (Appendix 4), 28 of whom do not have a graduate student for whom they are serving as the primary mentor. MSM has an additional 10 or more graduate

faculty members who are not participating in the graduate training program but are qualified to do so. Thus the number of available research mentors is sufficient to launch this program.

Core Course Directors and Lecturers: Where we are dangerously thin is in the number of faculty both capable and willing to direct or participate in core courses with a growing student population. Research faculty generally love to talk about their research and are enthusiastic about sharing with young scientists. However, faculty willing to take responsibility for organizing a core course or for teaching the fundamentals assigned by a course director and fitting into the students' schedules are considerably more rare. The two primary core courses for these Certificate and MS programs will be *Biochemistry* and *Cells & Tissues*. In both cases, the same faculty members teach both medical and graduate students much of the same material. Yet the pace and focus of the teaching must be different for these two student groups. The most urgent concern is for the Biochemistry course. Currently, the med students and graduate students attend many of the same lectures. With the planned growth of the MD class size to an interim number of 70 and that for the graduate programs to an interim number of 21 per year, we expect to soon reach a class enrollment that will become unwieldy both in terms of space availability (see space considerations below) and student:faculty ratios. The likely outcome of such growth in student numbers without an increase in the number of core teaching faculty will be a serious erosion the quality of instruction for both student groups. There is a clear need to identify and/or hire additional committed faculty specifically to assume biochemistry *core teaching* duties so that a separate graduate biochemistry course can be delivered. As the medical class size expands, the need for additional teaching faculty for Cells & Tissues will grow to the same urgency that we are already experiencing for Biochemistry.

Admissions Office

Application Revisions: The projected closing date for applications to these programs for the fall of 2008 would be February 2008. Ms. Lewis has indicated that revising the existing PhD application to include a checklist of programs for which the student is applying would be a relatively simple matter, but this modification would have to be made and the revised application posted within the next month or so.

Registrar's Office

Catalog Revisions: The 2007-2009 catalog has been largely completed and will soon go to press. Thus, no catalog revisions would be necessary until the next institutional catalog is published. Catalog information (program and course descriptions) would however be published online in the interim.

Course Numbering: The course numbering for courses in the PhD program contains the prefix PHD before the course number. This was to distinguish between PhD and MD courses. To avoid confusion among MS and PhD students about which courses they should be taking, it would be best to revisit the numbering system and use a more generic prefix (e.g., GBS for Graduate Biomedical Science). It might be worth including the MSCR courses under this generic prefix since students from different programs will be taking many of these courses.

Office of International Program Services: Based on the number of inquiries the Office of Graduate Studies has received from international students about the availability of a Masters program in recent years, we expect there to be significant interest from foreign nationals in these programs. It will be necessary to assure that OIPS is staffed properly to handle an increase in international student enrollees in MSM's educational programs.

Consultation with Dr. Roark Miller in our OIPS revealed that some of the work load specific to international students will need to be handled by Admissions. For international admissions, it is required that a school certify financial resources and English language

ability (the latter at whatever standard, decided by the individual program) in addition to academic admissibility assessed of any applicant, prior to issuance of an I-20. These criteria will need to be certified by the admissions office, adding to their workload. According to Dr. Miller, this is something that currently is not being handled very effectively or efficiently—probably because of the small number of international applicants we process each year. Any increase in international admissions to our programs would require more attention to this issue. It also would require that student budgets for the new degree/certificate programs be determined sufficiently in advance (e.g., by Financial Aid) to allow such financial resources for the upcoming term to be identified and verified in a timely fashion. This is particularly important for students coming from overseas, as visa applications can take months, and students must have their I-20s in hand to even apply for a visa. Such budget figures for student degree programs commonly become available during the summer of the enrollment year. This is entirely too late for overseas admissions. On the other hand, international students already in the United States in F-1 status in other schools' baccalaureate programs would not face the same scheduling issue.

Dr. Miller indicated that he will need to modify our I-17, the official federal document that the INS has on file certifying us to host F-1 students on our specific degree programs. The issues to be clarified on that document include the type of certificate program and requirements for full- vs. part-time enrollment in the certificate program.

Each semester, the students' SEVIS records will need to be updated with upcoming term-start and -end dates, so this will require more communication between the Registrar and OIPS. F-1 students are required to pay a SEVIS fee of \$100 prior to applying for a visa (in addition to visa application fees). Schools can pay this for the applicants, let the prospective students deal with it, or pay for it and charge the students for reimbursement.

With Karen Lewis' departure, Dr. Roark is our only MSM employee any knowledge of F1 regulations. Any increase in our international student population will require consideration of identifying and training another individual person as a fall back.

Finally, F-1 status confers on-campus employment authorization for international students up to 20 hours per week. We will need to consider the potential for employment of part-time, international, certificate or MS students on campus (e.g., as research assistants). F-1 status also allows for off-campus curricular practical training if required in the curriculum. These issues will require lead time for consideration prior to international program implementation.

In summary, the resource burden for our Office of International Program Services would be:

- Modifying our I-17 (one time event)
- Time to issue I-20s
- Cost of FedEx-ing I-20s to each overseas student (not necessary if transferring from a US undergraduate program)
- Time to meet with incoming students individually/small groups during orientation sessions to counsel them regarding immigration status and regulations.
- Time to meet with international students throughout the year to advise them about travel, employment, immigration status, etc.
- Time to manage SEVIS records of additional students and complying with regular SEVIS reporting requirements (term completions, change of addresses, etc.).
- Time to develop policy regarding curricular requirements for any on- or off-campus employment in the curriculum.

Based on these considerations, it seems prudent to focus first on establishing the program for U.S. citizens and permanent residents and only then to consider the cost-benefit ratio for making the program available for international applicants. Even then, it would make sense to begin with students already in the U.S. on F1-Visas at their undergraduate institutions.

Financial Aid: Because the Certificate and MS students will have to pay tuition for these academic programs and because they will be eligible for financial aid, it will be necessary to assure that MSM's Financial Aid Office is adequately staffed and equipped to handle an increased number of financial aid applications. Based on discussions with Ms. Cynthia Handy, our Financial Aid Office would not be able to handle this additional load without additional staff. International and especially overseas applicants would require substantial increases of effort on the part of MSM's Financial Aid Office and should only be considered after substantial enhancement of Financial Aid staffing.

Division of Information Technology:

Website Modifications: A new Graduate Education in Biomedical Sciences Portal will need to be added to the MSM website that provides access to pages covering the new program as well as MSM's PhD in Biomedical Sciences and MS in Clinical Research program pages. MSM's new website management system will make this a relatively straightforward process with only minor assistance from the Division of Information Technology Services (DITS) once the content is decided upon. The ability to edit even after publishing will facilitate site management once it is published. Dr. Paulsen currently handles all the web-editing for the PhD Program and there is already a need for a skilled assistant in the Office of Graduate Studies to handle some of these duties.

Student Laptops: We anticipate requiring these students to buy laptops like those used by the MD and PhD students. It will be necessary to assure that the DITS is adequately staffed to provide support for student computer issues associated with an increase in students needing these services.

Wireless Access: There are ongoing problems with regard to wireless access to the internet in MSM's research laboratories. Since graduate students do a considerable amount of their learning within these laboratories, it is crucial that they have wireless access in these locations. It will be important to have a systematic analysis of wireless dead-spots in and around the research intensive areas of the institution and to take measures to provide the necessary access.

Library: The Library is located on the first floor of the Medical Education Building on campus. Open 105 hours per week, the Library has areas for group and individual study, and eight public workstations with Internet and Intranet access. The Library collection includes over 80,000 print volumes and subscriptions to 430 print journal titles. In addition to housing open stacks of books and journals, the Library subscribes to over 250 full-text electronic books and 6,000 full-text electronic journals. As mentioned above, wireless access to the library's fulltext online resources will be critical to all graduate students in pursuing their degrees. The cost of databases is associated with the size of the user base. Increased funding to assure access to online collections with sufficient depth and breadth to support the MSBR will be an important factor in the success of the graduate program for years to come.

Teaching Facilities

Teaching Laboratory Renovations and Staffing: The Certificate and Masters programs in Biomedical Sciences will substantially increase the need for a teaching laboratory to allow students to learn research methods before entering investigators' laboratories. Funds have been requested (\$130,000) to refurbish a space on the second floor of the Hugh Gloster Basic Biomedical Sciences Building that has been allocated for this purpose. Existing plans

will accommodate approximately 20 students. With our near-term target class size for the PhD program at 10 students per year, this would leave room for only 10 MS students. It seems likely that we would target that number of MS students in the first year and hope to grow from there. Dividing laboratory courses into two sections would allow for 40 students (30 MS & 10 PhD) to be trained each year, but this approach could increase demands on the faculty. Alternatively, laboratory teaching assistants could be recruited from upper-level PhD students to handle or assist with lab sections for a modest fee derived from MS tuitions. We have already been using graduate teaching assistants for some PhD lab courses and it has worked well.

Classroom Space Considerations: Most of the PhD lecture-based classes currently are held in the Graduate Education in Biomedical Sciences conference room in HG209. This space can reasonably accommodate 12 students and an instructor and is expected to suffice during the initial stages of MS program development. However, while this will remain an effective teaching space for small elective courses, it will be outgrown for use in most core courses well before we reach our interim targets for entering class sizes (and thus core course rosters) of 6 PhD and 15 Master's students (i.e., a total student body of 30 in each program). At that point, a larger space will need to be allocated to the graduate program for classroom purposes. It is recommended that HG202 be allocated to the Graduate Education program in the near future to accommodate the larger classes of graduate students.

If our graduate students continue taking biochemistry classes along with the medical students, once we reach our interim target for entering class sizes that will result in 21 graduate students in addition to the medical students. With the medical class size targeted for 70, there will be a need for seating for 91 students in the first year MD classroom (with no repeaters) and 101 students during the summer session when 10 postbaccalaureate students are generally added. Currently the first-year classroom has seating for 120 students and Ethernet hookups for 72 students. While this may suffice for lecture delivery, the spacing may be too tight for effective and secure examination delivery for so many students (even for the medical students alone). This situation could be relieved by offering a separate biochemistry lecture course for the graduate students, however, the biochemistry faculty have so far resisted this duplication of effort which they view as unnecessary and unreasonable considering the number of available faculty and other demands on their time. Another alternative would be administering examinations in the NCPC auditorium, although that would likely require administrative intervention at the level of the President. Administering the exams in two shifts would raise significant issues of exam security.

Recruitment and Program Marketing

Applicant Pool: The applicant pool is expected to consist of potential students from a wide variety of backgrounds. Some examples of populations to be targeted for recruitment are listed below.

- College and post-baccalaureate students seeking graduate credit to enhance their credentials for application to graduate or medical school.
- College and post-baccalaureate students seeking graduate experience at a medical school to assess their interest in pursuing a career in research vs. clinical medicine.
- College and post-baccalaureate students seeking to increase their confidence in their ability to pursue a career in biomedical research.
- Research technicians or staff seeking credential enhancement to enhance job performance and increase their earning power.
- Research technicians seeking to update their training and credentials in preparation for applying to a PhD program.

- Pharmaceutical and Biotechnology company managers, technical staff, or sales staff seeking credential enhancement to enhance job performance and increase their earning power.
- International science students and professionals seeking a US credential to demonstrate their ability to function in an American academic setting.
- Intellectual Property lawyers or paralegals seeking credential enhancement to enhance job performance and increase their earning power.
- Secondary-school science teachers seeking credential enhancement to increase their earning power.
- MD students at MSM interested in obtaining a Masters level research credential.
- Residents at MSM interested in obtaining a Master's level research credential.
- Junior clinical faculty at MSM interested in obtaining a Master's level research credential.

Recruitment Strategies:

- **Annual Recruitment Events:** These are major events at which undergraduate students present their research and look over available graduate training programs. They each provide an opportunity for contact with literally hundreds of minority students interested in a career in science or medicine from around the country. Costs include booth reservation; shipping of materials, literature, and display; and registration and travel expenses for faculty and student recruiters.
 - Annual Biomedical Research Conference for Minority Students (ABRCMS)
 - Society for the Advancement of Chicanos and Native Americans (SACNAS) Conference
 - Local Undergraduate School and HBCU Recruitment Fairs: We would like to have a rotating schedule of visits to southeastern HBCUs and other local colleges and universities during their annual recruitment fairs, returning to each school every few years, to spread the word about MSM's graduate programs and recruit potential applicants. Costs include transportation, meals, lodging, and literature and display shipping costs to more distant venues.
 - Annual Mailings of Program Literature: Providing posters, brochures and catalogs both to science departments and libraries of potential targets for recruitment.
- **Graduate Program Website:** Increasingly, program websites are the initial point of contact for students interested the possibility of entering a particular school or program.
- **Online Advertising:**
 - GradSchools.com
 - Petersons.com
- **Undergraduate Advisor Visits:** We would like to invite faculty advisors of science students from a variety of HBCUs to visit MSM, tour our research facilities, and learn about the research underway here. Direct interactions with MSM research faculty may yield faculty collaborations and applicants to our training programs from among the visitors' advisees. We haven't even done this with the AU Center schools. That would be a great place to start. Costs include travel, lodging, transportation, and meals.
- **Biotechnology Company Visits:** We would like to invite supervisors and HR directors from various Georgia Biotech Companies to tour our facilities and consult with us about their staffing needs and relevant skill sets. We would like for their representatives to speak with our students about career opportunities while they are here as well. Some of these visits may help establish institutional relationships that

extend beyond training to corporate support. Local companies often do this at no cost to us and sometimes even feed our students while they're on campus.

Timeline for Key Milestones

November 2007:

- Approval of revised Business Plan by Educational Programs Team
- Provisional announcement of program to solicit applications (ABRCMS Meeting)

December 2007:

- Final Revision and submission to Academic Policy Council

January 2008:

- APC and Dean Approval
- Dean forwards to President for approval and routing to the Board of Trustees

March 2008:

- Board approval and official program announcement

May 2008:

- Application deadline, review of applications, offers of admission

July 2008:

- Entering class of up to 10 students

Appendix 1: Course Descriptions

First (Fall) Semester

PHD 517. Graduate Biochemistry: Graduate Cell Biology Sequence, Module 1 (4 credit hours) This course includes lecture material in the first portion of the Medical Biochemistry course (MEDI512) described for the first year medical students. It includes additional journal club sessions and essay exams for graduate students. Prerequisite: Enrollment at MSM, Course Director: Gary Sanford, Ph.D., Letter Grade, Offered annually, Summer-Fall.

PHD 517L. Graduate Biochemistry Laboratory: Graduate Cell Biology Sequence, Module 1 Lab (3 credit hours) This course introduces students to theoretical and practical issues in the isolation and manipulation of DNA, RNA, and protein from eukaryotic cells. Technical instruction in the laboratory will be supplemented with lectures on innovative approaches to genomic and proteomic investigation. The course will provide a basis for using these powerful molecular methodologies to solve complex biomedical research program. Prerequisite: Enrollment at MSM, Course Director: Gale Newman, Ph.D., Letter Grade, Offered annually, Summer-Fall.

PHD 521. Cells and Tissues: Graduate Cell Biology Sequence, Module 2 (3 credit hours) This course surveys cell and tissue structure and function. It provides a rapid, intense review of the methods and basic concepts of cell biology and histology as a foundation for biomedical research. Prerequisite: Enrollment at MSM, Course Director: Brenda Klement, Ph.D., Letter Grade, Offered annually, Fall.

PHD 521L. Cells and Tissues Lab: Graduate Cell Biology Sequence, Module 2 Lab (3 credit hours) This course includes demonstrations and hands-on experience with studies of cell and tissue structure and function. Prepared slides will be examined with microscopes and virtual microscopy to introduce basic concepts and students will complete independent projects involving histological examination of one organ of their choice. Prerequisite: Enrollment at MSM, Course Director: Brenda Klement, Ph.D., Letter Grade, Offered annually, Fall.

PHD 524. Fundamentals of Biostatistics (3 credit hours) Introduction to biostatistical concepts and tools used in the design and interpretation of experimental studies. Prerequisite: Enrollment at MSM, Course Director: Ahmad Al-Mahmoud, Ph.D., Letter Grade, Offered annually, Fall.

PHD 518. Fundamentals of Professional Science (FPS) I (3 credit hours) The first FPS module introduces laboratory safety, basic lab methods, and scientific writing, including the organization and analysis of research papers. It also covers many aspects of scientific integrity and professionalism, and introduces research opportunities at the institution. Prerequisite: Enrollment at MSM, Course Director: Doug Paulsen, Ph.D., Letter Grade, Offered annually, Fall.

PHD 519. Fundamentals of Professional Science (FPS) II (1 credit hour) The second FPS module continues coverage of research papers in a journal-club format, as well as additional research opportunities. Prerequisite: Enrollment at MSM, Course Director: Doug Paulsen, Ph.D., Letter Grade, Offered annually, Fall.

Second (Spring) Semester

PHD xxx. Introduction to Methods & Instrumentation (2 credit hours)

(Proposed new course) This is a resurrection of a course previously discontinued from the PhD curriculum in a form more appropriate for MS – level students. This course will provide a survey of the methods and instrumentation in use in the institution's various core and investigator laboratories. The course will include both informal lectures and hands-on experience. Prerequisite: Enrollment at MSM, Course Director: To be named, Letter Grade, Offered annually, Spring.

PHD 513 & PHD 514. Laboratory Rotation I & II (1 credit hour each) The objective of these rotations is to provide students with experiences that will allow them to make an informed choice with respect to the focus of their research and their research advisor. Two 8-week rotations are required of each student and must be carried out in a laboratory in which the student has not previously worked. Rotation sites may include laboratories of MSM graduate faculty, or off-campus sites with the permission of the GEBS Committee. Students must complete a write-up of their progress in each lab rotation in the format of a standard scientific paper. Prerequisite: Enrollment at MSM, Course Director: Doug Paulsen, Ph.D., Pass/Fail, Offered annually, Fall, Spring.

PHD 526. Fundamentals of Professional Science (FPS) III (1 credit hour) The third FPS module continues coverage of research papers in a journal-club format. Additional sessions are scheduled to introduce various career opportunities in professional science. Prerequisite: Enrollment at MSM, Course Director: Doug Paulsen, Ph.D., Letter Grade, Offered annually, Spring.

PHD 526. Fundamentals of Professional Science (FPS) IV (1 credit hour) The fourth FPS module continues coverage of research papers in a journal-club format, introduces research proposal writing, surveys funding agencies, and includes sessions on professional science career options. Prerequisite: Enrollment at MSM, Course Director: Doug Paulsen, Ph.D., Letter Grade, Offered annually, Fall.

Appendix 2: Lab Rotation Options (16 weeks required)

Technology Areas Available at MSM

Animal Care and Use

IACUC
Animal care
Euthanasia
Knockouts
Genotyping
Small animal surgery
Transgenic animals

Biostatistics

Cell & Tissue Biology

Cell fractionation and analysis
Cell & organ culture
Apoptosis & proliferation assays
Histology, histochemistry
Immunohistochemistry
FACS analysis*

Microgravity modeling

Hind-limb suspension
NASA Bioreactor

Clinical Research

Institutional Review Board
Human studies
FACS analysis
ELISA

Microscopy & Biomedical Imaging

Brightfield microscopy
Confocal microscopy
Electron microscopy
Fluorescence microscopy
Immunohistochemistry
Laser dissection microscopy
Nomarski optics
Phase contrast microscopy
Biophotonics
Image Analysis Software

Gene Expression

RNA isolation, purification, quantitation
iRNA, sRNA
RT-PCR, QPCR
Laser dissection microscopy
Microarray analysis – Agilent & Affymetrix
Transfection
Bioinformatics

Genomic Studies

DNA isolation, purification, quantitation
PCR, QPCR
Mutation analysis
Cloning and mutagenesis
Affymetrix SNP chip
Pyrosequencing
WAVE technology
Bioinformatics

Microbiology

Bacterial, viral & parasite isolation & cultivation
Cloning techniques
Transfections

Proteomics

Protein isolation, purification, quantitation
Gene transfection
Gel electrophoresis
2D gel electrophoresis
Western blotting
ELISA
Receptor Analysis - Radioimmunoassay
Bioplex bead analysis
HPLC
SELDI
LC/MS
Bioinformatics
SELDI Proteomics

Appendix 3: PhD in Biomedical Sciences Graduates, Morehouse School of Medicine

Graduated	Name	Mentor	Current Position	Institution	Location
1998	Jose Rodriguez, PhD	Ward Kirlin, PhD	Assoc. Professor	Central Univ. of the Caribbean	Baymon, PR
1998	Chad Womack, PhD	V. Craig Bond, PhD	Co-Founder, Pres., Chief Scientific Officer	Nano-Vec, LLC	Bethesda, MD
			Asst. Professor	Howard Univ.	Washington, DC
1999	Miller Ogidigben, PhD	David Potter, PhD	Senior Scientist	Merck & Co.	West Point, PA
2000	Angela Sroufe, MD, PhD	Gary Sanford, PhD	Radiology Resident	Univ. S. Florida	Tampa, FL
2002	Adalyn Harris, PhD	Holly Soares, PhD	Clinical Science Liaison	Merck & Co.	Huntersville, NC
2002	Kecia Echols-Harris, PhD	Jonathan Stiles, PhD	Health Communications Specialist	Centers for Disease Control & Prevention	Atlanta, GA
2003	Tajah Blackburn, PhD	Gale Newman, PhD	Microbiologist/Science Advisor	US Environ. Protection Agency	Washington, DC
2003	Agaba Ganafa, MD, PhD	Mohamed Bayorh, PhD	Chair, Dept Clinical Pharmacol. & Therapeut.	Mbarra University	Uganda
2003	Terri Moore, PhD	Joseph Igietseme, PhD	Forensic Mitochondrial DNA Biologist	US Federal Bureau of Investigation	Quantico, VA
2004	Barbara Jacob, MS, PhD	Gale Newman, PhD	Medical Science Liaison	Abbott Renal Care	Atlanta, GA
2004	Cleve James, PhD	V. Craig Bond, PhD	Medical Student	Howard University	Washington, DC
2004	Eugene Joseph, MS, PhD	Brenda Klement, PhD; Douglas Paulsen, PhD	Asst. Professor	LaSierra Univ.	LaSierra, CA
2004	Rosaline Odum, MLS, PhD	Ward Kirlin, PhD	Head, Information and Research Services	Robert W. Woodruff Library (Atlanta Univ. Center)	Atlanta, GA
2004	Jacqueline Powell, PhD	Gerald Sonnenfeld, PhD	Instructor, Medical Education & Physiology	Morehouse School of Medicine	Atlanta, GA
2005	Lesa Miles Black, PhD	Michael Powell, PhD	NRSA Post-doctoral Fellow	Vanderbilt University	Nashville, TN
2006	Ceilessia Clement, MS, PhD	Byron Ford, PhD	Post-Doctoral Fellow	National Inst. Environ. Health Sciences	Research Triangle Park, NC
2006	DaJoie Croslan, PhD	Byron Ford, PhD	Post-Doctoral Fellow	Georgetown University	Washington, DC
2006	Teri Larkins, PhD	Gary Sanford, PhD	ORISE Post-Doctoral Fellow	Centers for Disease Control & Prevention	Atlanta, GA
2007	Brandi Brandon, PhD	Gary Sanford, PhD	FIRST Post-Doctoral Fellow	Winship Cancer Ctr., Emory University	Atlanta, GA

Appendix 3: PhD in Biomedical Sciences Graduates, Morehouse School of Medicine (update since 2007)

Graduated	Name	Mentor	Current Position	Institution	Location
2008	Erica Johnson, Ph.D.	James Lillard, PhD	Postdoctoral Fellow	Emory University School of Medicine	Atlanta, GA
2008	LaReese Thomas, PhD	Gary Gibbons, MD		US Food & Drug Administration	Atlanta, GA
2008	Tamika Campbell, PhD	Michael Powell, PhD	Director of Science & Research		Atlanta, GA
2008	Crystal Johnson, PhD	James Lillard, PhD	Postdoctoral Fellow	CDC	Atlanta, GA
2009	Alicia Branch, PhD	Winston Thompson, PhD	Postdoctoral Fellow	CDC	Atlanta, GA
2009	Wendell Fortson, PhD	E. Shyam Reddy, PhD	Postdoctoral Fellow	University of North Carolina	Chapel Hill, NC
2009	Catherine Lewis, MD, PhD	Veena Rao, PhD	PGY1 Resident, Surgery	Morehouse Sch of Med	Atlanta, GA
2009	Don Ricardo Miller, PhD	Kelwyn Thomas, PhD	Postdoctoral Fellow	Georgia Inst. Technology	Atlanta, GA
2009	Patrick Campbell, PhD	Vincent Bond, Ph.D.	Medical Student		Trinidad/Tobago
2009	Talib Saafir, PhD	Gianluca Tosini, PhD	Postdoctoral Fellow	Emory University School of Medicine	Atlanta, GA
2009	Tiffany Brunson, PhD	Qing Song, PhD	Postdoctoral Fellow	CDC	Atlanta, GA

Appendix 4: Graduate Faculty Currently Participating in the PhD Program

Name	Department	Graduate Course(s)
Felix Aikhionbare, Ph.D.	Medicine	Cells & Tissues
Mukaila Akinbami, Ph.D.	Medicine	MolecMechCardiovascSci
Ahmad Al-Mahmoud, Ph.D.	CHPM	Fundamentals of Biostatistics
Leonard Anderson, Ph.D.	Medicine	Biomedical Genetics, Biomedical Genetics Lab, MolecMechCardiovascSci., Lab Rotations, Fundamentals of Professional Science I, Supervised Research, Dissertation Research
Methode Bacnamwo, Ph.D.	Medicine	MolecMechCardiovascSci, Supervised Research
Jorge Benitez, Ph.D.	MBI	Bacteriology
Daniel Blumenthal, M.D., M.P.H.	CHPM	Fundamentals of Professional Science I
Vincent Bond, Ph.D.	MBI	Biochemistry, Biomedical Genetics, Dissertation Research, Supervised Research
Margaret Colder-Stanfield, Ph.D.	Physiology	MolecMechCardiovascSci, Colloquium, Cells & Tissues, Dissertation Research, Organs & Systems, Sci Professionalism
Francis Eko, Ph.D.	MBI	Supervised Research
Adel Elmoselhi, M.B.B.S, Ph.D.	Physiology	Organs & Systems, Organs & Systems Lab
Byron Ford, Ph.D.	Anat/Neuro	Cells & Tissues, Dissertation Research, Lab Rotations, Cell & Molecular Neuroscience., Special Topics in Neuroscience, Biomedical Genetics, Biomedical Genetics Lab
Sharon Francis-David, Ph.D.	Medicine	MolecMechCardiovascSci
Minerva Garcia-Barrio, Ph.D.	Medicine	MolecMechCardiovascSci, Fundamentals of Professional Science I-III, Lab Rotations, Supervised Research
Shawn Garrison, Ph.D.	Psychiatry	Fundamentals of Professional Science I
Beatrice Gee, M.D.	Pediatrics	Biochemistry, Cells & Tissues
Gary Gibbons, M.D.	Medicine	MolecMechCardiovascSci, Fundamentals of Professional Science I, Supervised Research, Dissertation Research, Lab Rotations, Organs & Systems, Organs & Systems Lab
Sandra Harris-Hooker, Ph.D.	Pathology	Fundamentals of Professional Science IV & V, Lab Rotations, Dissertation. Research.
Jacqueline Hibbert, Ph.D.	MBI	Graduate Biochemistry Lab, Fundamentals of Professional Science I
Ward Kirlin, Ph.D.	Pharmacology	Colloquium, Fundamentals of Professional Science I, Supervised Research, Dissertation Research
Brenda Klement, Ph.D.	Med Ed	Cells & Tissues, Cells & Tissues Laboratory
Woo-Kuen Lo, Ph.D.	Anat/Neuro	Cells & Tissues, Cells & Tissues Laboratory
Deborah Lyn, Ph.D.	MBI	MolecMechCardiovascSci, Biochemistry, Advanced Molecular Biology, Biomedical Genetics
Peter MacLeish, Ph.D.	Anat/Neuro	Fundamentals of Professional Science I, Dissertation Research., Special Topics in Neuroscience, Cell & Molecular Neuroscience
David Mann, Ph.D.	Physiology	Fundamentals of Professional Science I, Dissertation Research., Organs & Systems
Julian Menter, Ph.D.	Medicine	Biochemistry, Fundamentals of Professional Science I & II

Name	Department	Graduate Course(s)
Gale Newman, Ph.D.	MBI	Lab Rotations, Dissertation Research, Supervised Research, Concepts in Immunology., Fundamentals of Professional Science II, Biochemistry Lab, Biomedical Genetics, Biomedical Genetics Lab
Jacqueline Powell, Ph.D.	Physiology	Organs & Systems, Organs & Systems Lab
Michael Powell, Ph.D.	MBI	Fundamentals of Professional Science I & II, Lab Rotations, Dissertation Research, Supervised Research, Virology, Biomedical Genetics,
John Patrickson, Ph.D.	Anat/Neuro	Cells & Tissues, Organs & Systems, Organs & Systems Lab
Doug Paulsen, Ph.D.	Anat/Neuro	Cells & Tissues, Cells & Tissues Lab, Lab Rotations, Seminar, Biomedical Science Presentations, Dissert. Research, Organs & Systems Lab, Fundamentals of Professional Science I-IV
Alexander Quarshie, M.D.	CHPM	Fundamentals of Biostatistics
Veena Rao, Ph.D.	Medicine	Fundamentals of Professional Science I, Lab Rotations, Supervised Research, Dissertation Research
E. Shyam Reddy, Ph.D.	Medicine	Fundamentals of Professional Science I, Lab Rotations, Dissertation Research, Supervised Research
William Roth, Ph.D.	MBI	Biochemistry
Gary Sanford, Ph.D.	MBI	Biochemistry, Cancer Biochemistry, Dissertation Research, Fundamentals of Professional Science I
Qing Song, Ph.D.	Medicine	Biomedical Genetics, Biomedical Genetics Lab, MolecMechCardiovascSci, Supervised Research, Dissertation Research
Jonathan Stiles, Ph.D.	MBI	Biochemistry Lab, Biomedical Genetics, Biomedical Genetics Lab., Fundamentals of Professional Science I, Dissertation Research, Lab Rotations,
Myrtle Thierry Palmer, Ph.D.	MBI	Biochemistry, Fundamentals of Professional Science I
Kelwyn Thomas, Ph.D.	Anat/Neuro	Fundamentals of Professional Science I, Cells & Tissues, Biochemistry, Dissertation Research, Supervised Research
Winston Thompson, Ph.D.	OB/GYN	Biomedical Genetics., Lab Rotations, Fundamentals of Professional Science I, Dissertation Research
Gianluca Tosini, Ph.D.	Anat/Neuro	Fundamentals of Professional Science I-IV, Lab Rotations, Dissertation Research, Special Topics in Neuroscience, Cell & Molecular Neuroscience
QingLin Yang, Ph.D.	MBI	MolecMechCardiovascSci, Biochemistry, Lab Rotations, Supervised Research, Dissertation Research, Special Topics in Cardiovascular Biology, Dissertation Research, Supervised Research
Xuebiao Yao, Ph.D.	Physiology	Cells & Tissues, Cells & Tissues Lab, Organs & Systems, Organs & Systems Lab, Supervised Research