



**Handbook for  
Graduate Students  
In  
Biomedical Sciences  
at Meharry Medical  
College**

**For Students  
Entering  
Fall 2020**

# The Ph.D. Graduate Program in Biomedical Sciences

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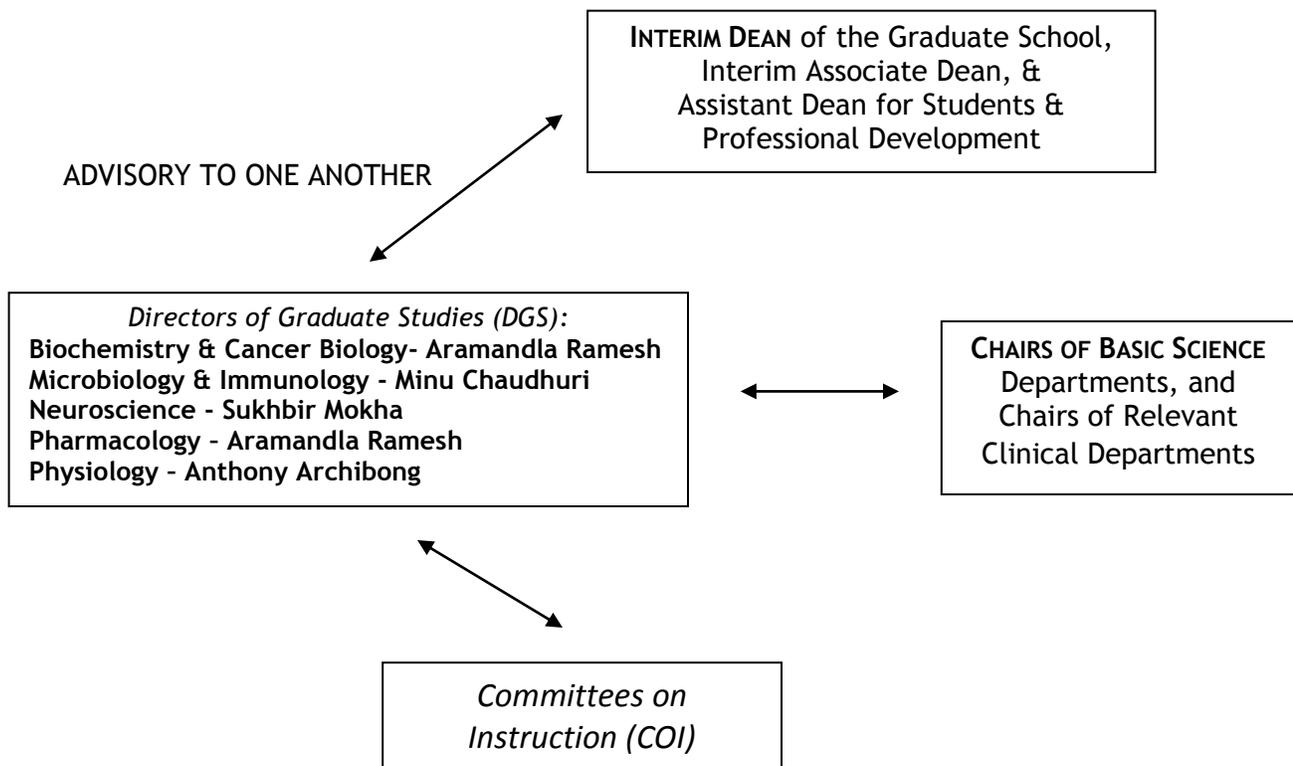
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This Handbook applies to students entering the Ph.D. Graduate Program in 2020.

# ADMINISTRATIVE STRUCTURE OF THE PHD PROGRAM IN BIOMEDICAL SCIENCES



**The Interim Dean of the Graduate School** IN COLLABORATION WITH THE INTERIM ASSOCIATE DEAN AND THE ASSISTANT DEAN FOR STUDENTS & PROFESSIONAL DEVELOPMENT IS RESPONSIBLE FOR OVERSEEING ALL ASPECTS OF THE PH.D. PROGRAM IN BIOMEDICAL SCIENCES, WITH THE ASSISTANCE OF THE DGS LEADERSHIP FOR EACH EMPHASIS AREA. THE DEANS ARE THE OFFICIAL SPOKESPERSONS FOR THE BIOMEDICAL SCIENCES GRADUATE PROGRAM AND SERVE AS REPRESENTATIVES IN MATTERS RELATED TO MEHARRY MEDICAL COLLEGE POLICY AND PROGRAMS. THE DEANS ARE RESPONSIBLE FOR ASSURING HIGH STANDARDS IN THE ACADEMIC PROGRAM, INCLUDING CONTINUALLY EVALUATING THE QUALITY OF THE REQUIRED COURSES, THE QUALIFICATIONS AND DIVERSITY OF THE TRAINING FACULTY, AND THE PERFORMANCE AND DIVERSITY OF THE STUDENTS. THE INTERIM ASSOCIATE DEAN & THE ASSISTANT DEAN, ON BEHALF OF THE INTERIM DEAN, ALSO INITIATE AND COORDINATE STUDENT RECRUITMENT ACTIVITIES AND ARE RESPONSIBLE FOR IDENTIFYING AND ASSISTING OTHERS IN APPLYING FOR INTERNAL AND EXTERNAL SUPPORT FOR GRADUATE TRAINING.

**The Director of Graduate Studies (DGS)** is responsible for monitoring the progress of students' course work and general performance throughout their training, has the most frequent and direct contact with the students and their mentors, and is responsible for explaining the requirements and expectations to the students. The DGS also serves as a student advocate when personal problems arise and in cases of possible faculty irresponsibility or misconduct. In addition, the DGS will meet periodically with new faculty to review program structure and advise them on special needs of developing trainees.

**The Committee on Instruction (COI)** is individualized, overseeing the research and development of an individual student. The activities and responsibilities of the COI are outlined in later sections of this Handbook.

### **How to Use this Handbook**

The purpose of this Graduate Student Handbook is to help trainees make optimal use of the time invested in their graduate training. Thus, this Handbook outlines Program requirements that are currently in place so that students have an understanding of the pivotal events and achievements associated with successful completion of training Meharry Medical College's Ph.D. Program in Biomedical Sciences, and provides students with an estimate of the timing of these events.

## **HOW NOT TO USE THIS HANDBOOK**

This Graduate Student Handbook should not be used as an official and immutable statement of the requirements and timetables for Meharry Medical College's Ph.D. Program in Biomedical Sciences.

The Training Program will be modified over time according to the evolving needs of trainees and to keep the Program at the leading edge of training innovation and excellence. Because the Graduate Student Handbook will be continually updated to reflect Program modifications, the Handbook should be used as a preliminary first step for information about the requirements of the Biomedical Sciences Graduate Training Program.

Always confirm Program requirements with the Director of Graduate Studies (DGS) for each program emphasis area, the Interim Dean, Interim Associate Dean or Assistant Dean of the Graduate School, and consult the Policies and Procedures Manual of the Graduate School.

## **Responsibility, Ethics, and Honor Code**

**Responsibility:** The faculty and staff of the Graduate School and the Biomedical Sciences Training Programs are eager to assist you through the rigors of the Ph.D. Program, to let you know how you are progressing, and to keep you abreast of important deadlines. We will do our best to communicate with you in a timely and accurate manner. Please remember that it is **ultimately the graduate student's responsibility** to know, understand, and meet the requirements established by the Graduate School and the Biomedical Sciences Training Program. Make it your business to be “in the know”!

**Ethics:** Our Training Program is designed to provide you with numerous opportunities to learn, ponder, and discuss the many ethical issues that underlie proper scientific conduct. We take very seriously not only that you are educated in ethics, but also that the practices of all scientists, faculty, staff, and trainees strive for and attain the highest ethical standards. If you have concerns about proper conduct issues, do not hesitate to discuss these with your mentor, your DGS, or with the Assistant Dean, Interim Associate Dean or Interim Dean of the Graduate School.

**Statement of Professional Integrity:** Simply stated, we are honest and trust one another. Faculty members trust that your work is your own. Students make sure that all their work is their own. If your work - be it course work, manuscripts, or research - is the result of a collaboration or utilization of ideas or labor of others, this must be acknowledged. All faculty and students agree to uphold the Honor Code. Violations are taken seriously. If you ever have doubt about your behavior or the behavior of others in upholding the Honor Code, talk to the people mentioned above.

# Goals and Philosophy of the Graduate Program In Biomedical Sciences

There are several inter-related goals in our Training Program. At the scientific level, we seek to provide a didactic curriculum that assures each student has an understanding of the core knowledge in their area of research and training emphasis. In addition to this core body of knowledge (which will be discussed in more detail later), we expect that students become scholars in at least one particular area of biomedical science, likely an area that directly relates to their dissertation research activity. In this way, students learn the rigors as well as the intellectual satisfaction of scholarship. Additional goals in our training program are to:

- 1) Show, by example, how to construct a rational hypothesis;
- 2) Teach, again by example, how to apply the scientific method to test a hypothesis;
- 3) Provide a basic understanding of a broad range of techniques;
- 4) Provide more in-depth training in those techniques that are particularly germane to a chosen research area of a particular student;
- 5) Teach how to communicate effectively their research findings to the scientific community; and
- 6) Instill a scientific ethic and respect for the pursuit of knowledge.

Other aspirations of the Program are:

- 1) To foster the ability of students to learn how to learn on their own for the rest of their lives, a skill critical for continued excellence in scientific inquiry;
- 2) To free students from the fear of failure; and
- 3) To impart to students an appreciation for diversity.

Each of these latter goals is essential for sustained contributions and leadership in any career, and particularly in biomedical research.

Considering that all of goals must be achieved before a student is adequately prepared for an independent career as a research scientist, only a well-balanced, multifaceted approach to graduate education can achieve the desired end. According to this philosophy, our Training Program employs several methods to ensure the successful education of its trainees. In addition, faculty within the program, and its component emphasis areas, continuously monitor the effectiveness of the various components of the training program and make adjustments when deemed necessary, to achieve an optimal balance among the Program's many educational components. Consequently, the training program continuously evolves.

## EMPHASIS AREAS OF THE GRADUATE PROGRAM IN BIOMEDICAL SCIENCES

The Graduate Program in Biomedical Sciences, and the office of the Dean for Graduate Studies, organizes the first year training of graduate students who are interested in basic biological and biomedical research. Subsequently, interested students select one of our five current areas of program emphasis:

**Biochemistry and Cancer Biology**  
**Microbiology and Immunology**  
**Neuroscience**  
**Pharmacology**  
**Physiology**

Since student must commit to one of the current programs, they will be allowed to cross-train with faculty in this area as well as well as any other research area as part of our interdisciplinary approach to training.

Graduate students are admitted, uncommitted to a specific Ph.D. program, and take a two-semester Core Curriculum (outlined in more detail later). During the first year of study, students also engage in rotations in three laboratories chosen by the student. At the end of two semesters of coursework and laboratory rotations, first-year graduate students declare their intent to pursue a Ph.D. in a particular emphasis area and choose the laboratory in which they will conduct their dissertation research. Students enter their selected laboratory the summer after their first year of study.

### Graduate Study Focus Areas for the PhD in Biomedical Sciences

**Biochemistry and Cancer Biology: DGS, Aramandla Ramesh, PhD**  
**Phone: 327-6486**  
**Email: aramesh@mmc.edu**  
**Office Location: West Basic Science Building, Room 3010**

Faculty mentors in the **Biochemistry and Cancer Biology** graduate program study the biochemical and molecular bases of cancer and other human diseases. Translational research (i.e. from the bench to the bedside) is highly emphasized. Diseases and tumor sites which disproportionately affect African Americans (such as breast, lung, prostate, ovarian and colon cancer) are of particular interest. Faculty members focus on endogenous mediators of the balance between cell proliferation and programmed cell death (apoptosis) as well as environmental agents that influence disease development and progression. Their studies are conducted using *in vitro* as well as *in vivo* models of human disease.

**Microbiology and Immunology: DGS, Minu Chaudhuri, PhD**  
**Phone: (615) 327-5726**  
**Email: mchaudhuri@mmc.edu**  
**Office Location: West Basic Science Building, Room 4105**

Faculty mentors in **Microbiology and Immunology** graduate program are involved in the study of the molecular bases for pathogenesis in response to viral or bacterial infection, or in response to parasitic invasion, and the immune response of host cells to these infections. One research strength is parasitology, focusing on pathogens that previously ravaged third world countries but now are

also appearing in our country as opportunistic infections of HIV/AIDS. Faculty participating in the Center of Excellence for Health Disparities in HIV/AIDS also serve as mentors for this graduate program, and address bases for HIV entry, replication, and propagated infection, as well as the factors that modulate the immune response to this infection and the efficacy of therapeutic interventions.

**Neuroscience: DGS, Sukhbir Mokha, PhD**

**Phone: (615) 327-6933**

**Email: smokha@mmc.edu**

**Office Location: Meharry-Vanderbilt Alliance Building, Room B47**

**Neuroscience** represents the broad study of the brain and behavior. The areas of particular emphasis in the research laboratories of faculty mentors in this program are degenerative diseases, such as Parkinson's and Alzheimer's Disease; neuronal plasticity, such as occurs in learning and memory as well as in disease, including addictions; neurobiology of pain and analgesia; sex-related differences in pain, analgesia and mental disorders; depression, drug addiction and stress-related disorders. Studies range from quantitative observations on the electrical activity of single molecules to the in vivo behavior in animal model systems and in human beings.

**Pharmacology: DGS, Aramandla Ramesh, PhD**

**Phone: (615) 327-6486**

**Email: aramesh@mmc.edu**

**Office Location: West Basic Science Building, Room 3010**

**Pharmacology** is the study of how chemical agents affect living processes; the chemicals involved include agents such as endogenous hormones, neurotransmitters, and/or growth factors; toxic substances in our environment; or therapeutic agents and potential drug candidates. Faculty mentors in this program are interested in the impact of drugs, including drugs of abuse, and toxicological agents on normal processes and their role in disease initiation as well as the molecular bases for the action of endogenous substances, with the intent of identifying novel therapeutic targets by revealing new insights into critical regulatory steps in signaling pathways that go awry in disease.

**Physiology: DGS, Anthony Archibong, Ph.D.**

**Director of Graduate Studies**

**Phone: (615)327-5714**

**Email: aarchibong@mmc.edu**

**Office Location: 4<sup>th</sup> Floor Old Hospital Room G-400**

**Physiology** is the study of the body and its functions at the level of organs and systems. The faculty mentors in this program study the cellular and molecular basis of cardiovascular pathophysiology, and other sub-disciplines such as neurophysiology, gastrointestinal physiology, reproduction and endocrinology. The goal of the research is to address the diseases of the body that disproportionately affect minorities.

## Summary of Overall Requirements

A minimum of 32 didactic hours of graduate credit are required for a Ph.D. degree in Biomedical Sciences. In most cases, course work will be completed during the first and second years. At the end of the second year, a Qualifying Examination must be satisfactorily completed before the student can be admitted to candidacy for a Ph.D. degree in Biomedical Sciences in their emphasis area of choice. If needed, remaining course electives may be taken following the Qualifying Examination, with the permission of the DGS and the Dean of Graduate Studies. After a student becomes a candidate and completes the didactic coursework, the student's efforts are largely directed towards completion of a dissertation project.

### First Year Ph.D. Core Curriculum

	<u>Course Name</u>	<u>Credit Hours</u>
Fall:	Biomedical Sciences IA	8
	Biomedical Sciences IIA	4
	Scientific Communications (Part I)	0
	Biomedical Sciences IIIB (Laboratory Rotations I)	0
Spring:	Biomedical Sciences IIIB (Laboratory Rotation II & III)	0 (6 hours-S/U)
	Scientific Communications (Part II)	3
	Cell Signaling	3
	Bioinformatics	2

### Second Year Ph.D. Core Curriculum

	<u>Course Name</u>	<u>Credit Hours</u>
Spring:	Foundations in Research	0 (3 hours-S/U)

### Course Descriptions for the Ph.D. Core Curriculum

**ASGS 70001. SCIENTIFIC COMMUNICATIONS.** This two-semester course introduces students to the health sciences library, to scientific literature, to scientific writing and to oral presentation of scientific information. The course provides weekly practice in reading and writing about papers in scientific journals and in discussion of papers before an audience. In addition, students will develop various components of the NIH Ruth L. Kirschstein National Research Service Award (NRSA) F31 fellowship proposal. **3 credit hours, FALL& SPRING.**

**ASGS 70101. BIOMEDICAL SCIENCES IA.** Lectures, problem-solving sessions, and experimental labs designed to give the student mastery of the organization, composition, and function of the cell at the molecular level. The basic concepts in genetics will be introduced. The properties and biological functions of carbohydrates, lipids, nucleic acids and proteins will be covered. Enzymes, metabolic pathways and their regulation, protein synthesis and biochemical genetics will be introduced. The goal is to give the students a full appreciation of the fundamentals of enzymology and biochemical and molecular genetics. **8 credit hours, FALL.**

**ASGS 70301. BIOMEDICAL SCIENCES IIA.** This course provides lectures, problem solving sessions and discussion designed to give the student an understanding of the organization, origin, function and regulation of the cell and its organelles at the molecular level. Major topics covered include

the energetics and thermodynamics of life processes; metabolic pathways and their control; membrane structure and function, protein trafficking, the cytoskeleton, and the cell cycle. The goal is to provide sufficient comprehension of molecular cell biology to enable the student to follow current developments in this fundamental and rapidly expanding area of research. **4 credit hours, FALL.**

**ASGS 70601. BIOMEDICAL SCIENCES IIIB (Laboratory Rotations).** The purpose of this laboratory rotations course is to acquaint first-year graduate students with research in progress in the laboratory of three different faculty. The student is supposed to be a participant in the research and will be exposed to scientific knowledge and techniques at a greater depth than is possible in formal laboratory courses and will participate in the kind of informal discussions which will take place in research laboratories among faculty, students and staff. The first rotation takes place in the fall semester and is eight (8) weeks long. The second and third rotations take place in the spring semester for eight (8) weeks each. It is not intended for students to complete a research project. **2 hours per rotation, 3 rotations (total 6 hours), FALL & SPRING.**

**ASGS 72501. CELL SIGNALING.** This course will cover major cellular receptor signaling pathways, which include the receptor that the signaling molecule binds to and a variety of intracellular signaling proteins that distribute the signal to target proteins, which mediate cellular responses. Cellular signaling in the context of normal cellular activities, disease and/or therapeutic approaches to resolution of disease processes will also be covered. The goal of this course is to ensure that all students have a fundamental understanding of the many cell signaling pathways in a multicellular organism, and how these pathways regulate the behavior of cells with the organism. **3 credit hours, SPRING.**

**ASGS 71001. INTRODUCTION TO BIOINFORMATICS.** This course will introduce students to the fundamentals of bioinformatics and computational approaches towards biomedical research. It will cover topics including DNA and protein sequence alignment, algorithms, genomics, proteomics, graph/network theory, biological data bases, and data-mining of large data sets and repositories. **2 credit hours, SPRING.**

**ASGS 70801. FOUNDATIONS IN RESEARCH.** The goal of this course is for the student to critically review the literature relevant to his/her proposed thesis research. The outcome of the course will be a student-prepared paper that provides a thoroughly documented background that supports the rationale for the proposed research project. The choice of the research problem should be determined by the student in consultation with the preceptor. The student will also develop a hypothesis and specific aims for the research proposal. Each student will be guided by a committee of three faculty members that will include the student's preceptor. **3 credit hour, SPRING.**

#### **ADDITIONAL DETAILS ABOUT THE PROGRAM OF STUDY THAT ARE RELEVANT FOR ALL EMPHASIS AREAS**

##### **SELECTION OF FACULTY PRECEPTOR (RESEARCH ADVISOR):**

A key element in any graduate program is laboratory research. Everything possible is done to speed up the process of choosing a preceptor and getting research projects off to a fast start. To that end, students begin doing rotations in three laboratories of their choice during the fall and spring semesters of the first year. The rotations provide a short laboratory experience, access to a potential faculty preceptor, and the ability to interact with senior (advanced) students to begin to learn the process of balancing class work with lab work. The purpose of the rotations is for the students to sample different research areas and experience the excitement of working in a

particular laboratory.

No later than June of the first year, students will have chosen a mentor, entered one of the participating graduate programs, and began their thesis research. The selection of a Faculty Preceptor must be discussed with the DGS for that graduate program, but also is subject for review by the Chairman of the Department for the primary appointment of the mentor and by the Dean of Graduate Studies. Upon selection of a preceptor, the student will inform the DGS who in turn will inform the Chairperson of the potential preceptor's department in writing. The student will then work with the preceptor and DGS to select members of the student's Committee on Instruction (COI). The student must submit a COI form with the appropriate signatures from the committee members, mentor, and Chair of the Department of primary appointment of the faculty mentor or DGS of the program of study to the Interim Dean of the Graduate School for approval.

#### THE FACULTY PRECEPTOR ROLE:

The Faculty Preceptor has the primary responsibility for academically guiding the student through all phases of graduate study. Normally, the student will pursue a research project in an area where the Faculty Preceptor has expertise. A student may elect to change their Faculty Preceptor, provided that the student can find another faculty member in the Graduate Program Faculty to assume that role. Changing Faculty Preceptors will not only entail changing research projects and most probably beginning anew, but will likely involve changes in the membership of the COI (see below) and may involve changes in source of financial support as well.

#### SELECTION OF THE COMMITTEE ON INSTRUCTION (COI)/ DISSERTATION ADVISORY COMMITTEE:

The Faculty Preceptor, in collaboration with the student, designates the proposed members of the COI. The COI must be composed of at least five members. The composition of the COI should be as follows:

- 1) The thesis advisor/preceptor
- 2) At least three members from the graduate program (and this can include the preceptor)
- 3) A faculty member representing another graduate program emphasis area at MMC
- 4) One member from another institution. This member should be a leader in the area of the student's research.

Formation of the COI must be completed no later than the summer of the first year of study.

#### RESPONSIBILITIES AND AUTHORITY OF THE COI:

The COI has broad responsibility to oversee the student's graduate studies, and to aid the Faculty Preceptor in assessing the student's progress. Specifically, the COI monitors the student's progress, provides advice on course selection and research, certifies the student's eligibility to take the comprehensive preliminary examination, certifies to the Graduate School (with a copy to the relevant academic Chair) the student's fulfillment of program requirements for admission to candidacy (course work and preliminary examination) requirements, comprehensive preliminary examination, fellowship/grant applications ...etc.) approves the outline for the student's dissertation, approves the completed dissertation, administers the final oral thesis defense and presents a summary of their evaluation to the DGS of the student's program who then recommends

the approved dissertation to the Graduate School.

**The COI must meet at least once a semester, starting at the time it is first formed. It is the responsibility of the student to make sure that these meetings occur!!!** At the first meeting of the COI, the Faculty Preceptor and the student must submit a plan of study for approval by the COI. This plan should include all the required and elective courses planned for the student. At subsequent meetings the Faculty Preceptor will report to the COI on the student's academic progress. The student must submit a plan of research to the COI for its approval, within the first year of its formation. At least once a semester the student must give a presentation to the COI of his/her research progress; even when there are no new advances in the research project, the COI must meet, as often it is just in these periods of frustration and apparent lack of progress that the advice of the COI can be most helpful.

A **written** summarized report of each COI meeting must be communicated by the Faculty Preceptor to the DGS, with a copy to the relevant academic Chair and to the Graduate School within two weeks after the meeting. Each COI member also receives a copy of each report. Each COI report must include an **Individual Development Plan (IDP)** for the student. COI report form is in the Appendices.

**Individual Development Plan (IDP)** - a tool to assist in the planning of a student's training to help the student reach his/her career goals. This includes developing a mentoring plan that assesses the needs and goals of each student, describes short- and long-term career objectives, and identifies professional development activities needed to reach them. An IDP should be viewed as a dynamic document that is periodically reviewed and updated throughout an individual's training. IDP forms for beginning and advanced students are in the Appendices.

## **REQUIREMENTS FOR THE Ph.D. DEGREE**

### **1. Academic Standing**

To remain in good standing, a student must maintain at least a B grade point average (GPA) in graduate course work. For students who have passed the graduate core curriculum, good standing in the graduate program also includes satisfactory performance in thesis research.

**Transfer of Credit:** Graduate courses taken at other institutions may be evaluated for transfer of credit by the COI, in accordance with Graduate School policies. Courses taken at Vanderbilt University by Meharry Graduate Students will automatically be accepted due to the existing cross registration between Meharry and Vanderbilt.

### **2. Journal Clubs, Works-in-Progress**

All graduate students must fulfill the requirement of attending journal clubs (JC) and works-in-progress (WIP) in the area related to their research. The students are expected to take a proactive role (asking questions, sharing insights etc.) in JC & WIP. Occasionally, the research of a student will align with the intellectual activity of more than one Department. In that instance, the DGS will work with the student and their mentor to establish which WIP and/or JC are required to attend. Students will receive a satisfactory (S) grade if they attend 80% of the WIPs and JCs and actively participate.

### **3. Basic Science Research Department Seminars**

Attendance at Departmental seminars is required of all graduate students. The Department invites a number of scientists from universities throughout the United States, and occasional visiting international scientists, as speakers at the seminar series. Seminars on wide-ranging topics by visiting faculty help affirm for students the realization that bodies of knowledge are accrued through incremental additions to our understanding that result from well-defined experiments testing hypotheses that are critically developed. Students will be invited to lunch with the visiting speakers based on their areas of research interest. However, these lunches also provide an opportunity to query the visiting scientists about issues other than science, including how they made career decisions, how they chose the research problems that have engaged them for so many years, how they know when to change directions in their research activities, how they maintain a high level of information and scholarship in their area, and how they integrate career with other aspects their lives. Graduate students in the Ph.D. Program are encouraged to recommend speakers to their mentor or the DGS of their program for these seminars.

### **4. The Preliminary (Candidacy) Examination Requirements**

The preliminary examination will consist of the preparation of a research proposal that conforms to the NIH format for pre-doctoral NRSA fellowship applications and should not exceed 10 pages. The research proposal should be on a topic approved by the student's COI, and may be identical to the thesis project of the student. The identification of potential topics is the responsibility of the student; the student is expected to work in consultation with his/her mentor to identify potential topics. The members of the COI may provide guidance to the student in the preparation of the written proposal. This may involve asking the student to modify their central hypothesis or simply explain to him or her, the difference between central hypothesis and working hypotheses which normally accompany the specific aims. The extent of the guidance is left to the discretion of the COI. Obviously too much help would be counterproductive.

After the written proposal is developed, the student must orally defend the proposal, as adjudicated by an Examination Committee who will examine the scientific merits of the written proposal and ask appropriate questions during the defense. These questions will examine the candidate's scientific development and overall knowledge related to the proposal and also knowledge of the course material and scientific knowledge in general. At the end of the presentation, members of the Examination Committee will provide the candidate with an assessment of his/her performance.

A student who fails the preliminary examination will be allowed to retake the examination a second time within 6 weeks. The same Examination Committee will administer the second examination, which is in the best interest of the student because this committee will be able to fairly assess improvements from the first take of the examination. If a student is unable to pass the examination the second time, the student will be expected to proceed to a terminal M.S. degree under the supervision of the COI.

### **Guidelines for the Ph.D. Candidacy Examination**

1. Students will be required to take the Ph.D. candidacy examination by the end of the student's second academic year. The examination may be scheduled outside this time period because of extenuating circumstances if such a variation is recommended by the DGS of the program and approved by the Dean of the Graduate School.

2. The prerequisite for taking the Ph.D. candidacy examination is that the student has an overall GPA of at least 3.0 with at least a B in Biomedical Sciences I, Biomedical Sciences II, and advances in Molecular Biology Research.
3. The Ph.D. candidacy examination will consist of two parts: written and oral. The examination will be based on the student's proposed dissertation research project, which must be approved by the student's preceptor and the COI in a formal COI meeting.
4. The Examination Committee will be formed before the end of the student's second year and will meet with the student to setup a timeline for completion of the exam within the time frame established in point 1. This committee will be set up for each student by the DGS of the program in which the student is enrolled and by the Chair of the respective department. The committee will be composed of five faculty members. Three members will be selected from the student's COI and two will be faculty members who do not serve on the student's COI. Of these two members of the Examination Committee, at least one member may be from institutions other than Meharry Medical College. The DGS and Chair will determine which member will serve as Chair of the Examination Committee. The Chair of the Examination Committee will be responsible for scheduling meetings between the student and the Examination Committee.
5. The format of the written exam will be as follows:
  - a. The student will write a research proposal on their proposed dissertation research. This proposal will be written based on the instructions for the Specific Aims and Research Strategy sections of a NIH F31 fellowship application.
  - b. The student will engage in scholarly dialogue with his/her faculty preceptor and reach agreement on the Research Hypothesis and Specific aims, but the faculty preceptor is to provide NO assistance in the actual writing of this document except for minor editing.
  - c. When the proposal has been written, the student will distribute it to the faculty members of the Examination Committee, four weeks prior to the scheduled oral exam. Each member of the Examination Committee will read the proposal and provide comments to the student within two weeks after receipt of the proposal (i.e. two weeks before the scheduled oral exam). The student will revise the proposal in accordance with these comments prior to the oral exam or be prepared to rebut the recommendations during the oral exam. The revised proposal should be distributed to each member of the Examination Committee at least 48 hours prior to the exam.
6. The oral part of the exam will consist of a closed defense of the research proposal to the members of the Examination Committee. The objectives of the examination are to:
  - a. Evaluate the student's knowledge in his/her general area of interest, to test the student's ability to integrate didactic information into research design, to test the student's understanding of experimental design and the student's ability to connect related concepts.
  - b. Evaluate the student's ability to think creatively and clearly.
  - c. Evaluate the student's ability to effectively communicate the project to the members of the Examination Committee.

The Chair of the Examination Committee may request that Examination Committee members submit their questions at least 24 hours prior to the exam. The Chair may also convene the Examination Committee ~30 minutes prior to the start of the exam to discuss the questions.

7. The exam will be graded as follows: Each member of the Examination Committee will grade both parts of the exam and their scores will be averaged for each part. In order to pass, a student must obtain an **average score of at least 40 out of a maximum of 50 points on each part of the exam**. If a student does not pass the exam, he/she must repeat the part that they did not pass. The student will be informed of the outcome of the exam immediately after the grade has been tabulated at the end of the exam.

The written grade will be based on the following (Form in Appendix - page 40):

- a. Hypothesis/Specific aim—15 points
  - i. Do the aims test the hypothesis?—5 points
  - ii. Do the aims test a causal relationship (not descriptive)?—5 points
  - iii. Why test this hypothesis?—5 points
  
- b. Background and Significance—15 points
  - i. How will the work advance the field?—5 points
  - ii. Are the preliminary data/information relevant?—5 points
  - iii. Are the references from primary literature or mostly from review articles?—5 points
  
- c. Experimental design—20 points
  - i. Is the rationale for each aim provided and is it based on valid reasoning?—5 points
  - ii. Are expected results provided and are they based on valid reasoning?—4 points
  - iii. Are potential limitations and alternate experiments adequately discussed for each aim?—4 points
  - iv. Are techniques explained?—4 points
  - v. Specific aim 1 will be emphasized more than subsequent aims as it is the one in which the student will be addressing first. However, questions appropriate for other aims are expected.
  - vi. Are statistical analyses described and are they appropriate?—3 point

The oral grade will be based on the following (Form in Appendix - page 41):

- a. In the introduction, did the student present sufficient background material?
- b. How clearly did the student convey the originality or novelty and significance of the proposed research?
- c. How well were the preliminary data/information presented?
- d. How clearly did the student explain the scientific approach (including use of statistics) and scientific rigor of the proposed study?
- e. How clearly did the student explain expected results, potential problems and alternative approaches?
- f. How well did the student field questions and answer them clearly and informatively?
- g. How was the student's overall knowledge base regarding the subject matter?

- h. How was the student's overall knowledge base regarding understanding theory of experimental techniques?
- i. How well did the student integrate his/her basic science knowledge into his/her project?
- j. What was the overall quality of the presentation [include in your assessment 1) the quality of the slide design and organization, 2) how well the student "make and keep eye contact" with the audience and 3) did the student speak clearly and in a confident, professional manner]?

The point value for each question above will range from 1 to 5 for a maximum of 50 points.

1=Completely unacceptable

2= Noticeably less than average

3= Average, strengths and weaknesses are equal

4= Very good

5= Excellent

- 8. Within one week after the exam, the Chair of the Examination Committee will inform the DGS of the program in which the student is enrolled, the Chair of the respective department, and the Graduate School Dean of the outcome of the exam in writing.
- 9. If a student's performance on the candidacy examination is NOT satisfactory, the Chair of the Examination Committee will meet with the student within one week after the exam and advise the student on how to prepare to retake the exam. If a student fails only the written part of the exam, he/she must rewrite and submit the document within 60 days of the exam. If a student fails only the oral part of the exam, he/she must retake the oral portion within 60 days of the first attempt. If a student fails both written and oral parts, he/she must retake the whole exam within 60 days of the first attempt. A student is permitted only one re-examination.
- 10. If a student is unable to pass the candidacy exam after the second attempt, yet has maintained a B course average, the student's COI will establish conditions for awarding a terminal Master's Degree. The conditions must be submitted to the DGS of the program in which the student is enrolled. The DGS will present the conditions to the Chair of the respective department and the SOGSR Dean. Both the Chair of the respective department and the Dean of the SOGSR must approve the conditions.
- 11. If a student fails to follow these guidelines, including adherence to the time frame established for taking the exam, the student will be referred to the Evaluation Committee of the SOGSR for appropriate action.

## 5. Thesis Research

Upon successful completion of the preliminary examination, the student will be admitted into candidacy for the Ph.D. degree. A Ph.D. candidate is essentially involved in research that will culminate in the completion of a dissertation research that is acceptable to the COI. The data obtained should be deemed sufficient to advance the field of endeavor, and to be publishable in a peer-reviewed journal. The final defense is in the form of a public seminar, immediately followed by oral examination administered by the COI, followed by questions from the audience.

To allow for adequate review, a draft of the thesis must be submitted to members of the COI at

least two weeks before the proposed public defense. Prior to scheduling the public defense, the COI must certify (to the Department or DGS and the Graduate School) the candidate's eligibility to proceed with the thesis defense. If the student is successful in the dissertation defense, the COI then makes a recommendation to the DGS and the Department Chair to accept the approved dissertation, and to request the School of Graduate Studies to confer the doctor of philosophy degree on the student, at the earliest possible date. **Every student is required to have one first authored full-length manuscript of their dissertation research either published or accepted for publication in a peer-reviewed journal aligned with their area of specialty and indexed in Pub Med before scheduling their PhD thesis defense. There is no EXCEPTION TO THIS RULE.**

## **OTHER ELEMENTS OF THE GRADUATE PROGRAM**

Throughout graduate training, students are expected to engage in scholarly activities, such as studying the scientific literature with the goal of integrating this new information into their own research questions, and attending lectures, journal clubs, and scientific meetings in order to keep abreast of the most recent scientific achievements. Meeting these and other expectations will foster a student's professional development, establishing a scientific life-style of learning that will persist throughout the professional career.

## **OTHER ISSUES**

### **Length of Training**

Students and advisors should aim for completion of graduate studies within a period of five to six years of uninterrupted participation in the curriculum. Most students will be able to graduate within this period (See Ph.D. Program Milestone Timetable for Completion of Degree in 5 Years in the Appendices). All students are expected to graduate within four years of passing the Qualifying Examination. **Prior to the seventh year of study, the student MUST submit a formal petition to the Dean of Graduate Studies requesting an extension of the doctoral training period, via the DGS, with an explanation for the inability to complete training within the allotted time, an outline of the remaining training with a projected timeline, and a date for the Dissertation defense, approved by the COI and endorsed by the DGS and Department Chair.**

### **Extended Absence from Meharry Medical College**

The PhD Program in Biomedical Sciences requires continuous registration. **It is required that any absence of 2 weeks or longer at anytime during the calendar year be reported.** Students who wish to interrupt their graduate study must apply for an authorized Leave of Absence. Those without authorized leave who do not register for one semester are dropped from the rolls of the Graduate School and are not considered students. A student who withdraws from graduate school without an authorized leave and later wants to resume graduate study at Meharry Medical College must submit a formal application for reinstatement to the Graduate School Dean. However, there is a time limit associated with resuming graduate study. See the *Student Academic Policy and Procedures Manual* for rules on *Leave of Absence*.

Candidates who have passed the qualifying examination or completed 72 or more hours of credit toward the Doctor of Philosophy degree are not usually granted leaves of absence, except in special circumstances (e.g., maternity or medical leave).

Under some other circumstances, Graduate Students may spend extended periods of time performing experiments or undergoing specialized training at sites distant from their mentor's laboratory or the immediate confines of Meharry Medical College. If this is required of a particular Graduate Student, it is essential that the DGS and the Graduate School be notified as soon as such an undertaking is planned. It is the responsibility of both the mentor and the student to ensure that the DGS and the Graduate School are informed of this proposed research leave of absence. A form is provided in this Graduate Student Handbook that outlines the proposed period of absence, mechanism for support of the student during this time, and the goals to be obtained during this absence. In addition, the student must complete the official *Leave of Absence* Form from the College and secure all signatures. This information must be provided at least 1 month prior to the beginning of the student's absence. If for any reason the research leave of absence extends beyond the limit originally reported, it is the responsibility of both the mentor and the student to inform the DGS, Department Chair and the Graduate School of this change.

***What follows are the specific expectations for each emphasis area that go beyond the above general guidelines.***

## Graduate Program in Biochemistry and Cancer Biology

### ADMISSION OF STUDENTS TO THE PROGRAM IN BIOCHEMISTRY AND CANCER BIOLOGY:

In addition to the requirements of the Graduate School, participants in the Graduate Program in Biochemistry and Cancer Biology are recommended to also have taken the following undergraduate courses:

- General Chemistry, one year
- Analytical Chemistry, one semester
- Organic Chemistry, one year
- Physical Chemistry, one year
- Physics, one year
- Biology, two years
- Mathematics through Integral Calculus

### Course Requirements for the Program in Biochemistry and Cancer Biology

DR: Departmental Required Course

DE: Departmental Elective Course

#### First Year: Core Curriculum

Semester	Name of Course	Number of Credit Hours
<b>Fall Semester</b>		
	Biomedical Sciences IA (Core)	8
	Biomedical Sciences IIA (Core)	4
	Scientific Communications Part I (Core)	0
	Biomedical Sciences IIIB (Core)	0
<b>Spring Semester</b>		

Biomedical Sciences IIIB (Core)	6 (S/U)
Scientific Communications Part II (Core)	3
Cell Signaling (Core)	3
Bioinformatics (Core)	2

**Second Year:**

Semester	Name of Course	Number of Credit Hours
<b>Fall Semester</b>		
	Cancer Biology I (DR)	3
	Cytokines (DR)	2
	Elective Course(s) (DE)	
	Seminar Course (DR)	1 (S/U)
	Research (DR)	1-12 (S/U)
<b>Spring Semester</b>		
	Membrane Biochemistry (DR)	3
	Foundations in Research (DR)	3 (S/U)
	Elective Course(s) (DE)	
	Seminar Course (DR)	1 (S/U)
	Research (DR)	1-12 (S/U)
<b>Summer Semester</b>		
	Research (DR)	6 (S/U)
	Ph.D. Candidacy Exam	

**Subsequent Years:**

Semester	Name of Course	Number of Credit Hours
<b>Fall Semester</b>		
	Seminar	1 (S/U)
	Research (DR)	1-12 (S/U)
<b>Spring Semester</b>		
	Seminar	1 (S/U)
	Research (DR)	1-12 (S/U)
	Dissertation Research (DR)	1
<b>Summer Semester</b>		
	Research (DR)	6 (S/U)

Total Required Hours: At least 32 credit hours of didactic course

Core Curriculum: 20 credit hours

Biochemistry and Cancer Biology Required Courses: 12 credit hours

Elective Courses: As recommended by student's COI

Expected Graduation: 5 - 6 years

Elective courses offered at Meharry:

Advanced Topics in Biochemistry  
Topics in Metabolic Regulation  
Cancer Immunotherapy  
Carcinogenesis & Cancer Therapeutics  
Fundamentals in Immunology  
Fundamentals in Virology  
Directed Studies [Faculty]

Elective courses offered at Vanderbilt:

Advanced Biochemistry, Cell Biology and Genetics (Meharry course # BICH 77001)  
Integrated Biology of Cancer  
Radiation Biology  
Molecular Bioimaging  
Endocrinology  
Immunology  
Extracellular Matrix

**COURSE DESCRIPTIONS FOR THE PROGRAM IN BIOCHEMISTRY AND CANCER BIOLOGY**

**BICH 70401. TOPICS IN METABOLIC REGULATION.** An advanced course on the regulatory mechanisms controlling major metabolic processes in eukaryotes. Prerequisite: Core Curriculum or background in metabolism or cellular physiology. **3 credit hours, SPRING.**

**BICH 70601. MEMBRANE BIOCHEMISTRY.** This course discusses basic and contemporary literature on the structure and functions of biological membranes and includes topics on membrane dynamics, biogenesis and transport by or through membrane components. The cytoskeleton and the extracellular matrix are also discussed. Prerequisite: Background in cell physiology and/or molecular biology. **3 credit hours, SPRING.**

**BICH 71001. SEMINAR IN BIOCHEMISTRY AND CANCER BIOLOGY.** Discussion of contemporary topics in cancer biology, carcinogenesis, biochemistry, cell and molecular biology. **1 credit hour, FALL & SPRING.**

**BICH 71301. ADVANCED TOPICS IN BIOCHEMISTRY.** A lecture course covering specialized and contemporary areas of inquiry in biochemistry. This course is offered about once in every three years. Prerequisite: Consent of the instructor. **3 credit hours, FALL.**

**BICH 80001. DISSERTATION RESEARCH.** This is a practical course in assembling, analyzing, and presenting large quantities of experimental data. Students are required to register for this course in their last semester of residence. Course is completed with the approval of the written dissertation by the COI and submission of three copies of the finalized dissertation on cotton paper to the SOGSR. **1 credit hour, FALL, SPRING, or SUMMER.**

**BICH 73001. CANCER BIOLOGY I.** A multidisciplinary course designed to expose students to the latest and promising areas of basic and translational research. Molecular mechanisms underlying carcinogenesis and tumor progression and their relationship to clinical aspects of the disease and cancer health disparities are discussed. Prerequisite: Consent of the instructor. **3 credit hours,**

FALL.

**BICH 77101. CANCER IMMUNOTHERAPY.** This course is designed to familiarize students with basic and translational tumor immunology and immunotherapy. The objectives of the course are to: 1) assist students in understanding the evolution of the concept of tumor immunosurveillance and immunotherapy; 2) make students aware of challenges associated with effectively using immunotherapy for cancer care; and 3) review the various approaches by which the immune system can be modulated for the treatment of cancer. Prerequisite: Core Curriculum. **2 credit hours, SPRING.**

**BICH 79901. THESIS RESEARCH.** Students are required to conduct original research, culminating in the preparation and defense of a dissertation that is acceptable, at least in part, for publication in a professional journal. **1-12 credit hours, Fall, Spring & Summer.**

**BICH 71201. CYTOKINES.** This course introduces students to the biology of cytokines. It covers the biologic nature, functions, mechanisms of action, and clinical significance and applications of cytokines. The course discusses the basis for regulation of cytokine production and secretion during immune and rheumatoid response as well as during regulation of hematopoiesis and apoptosis. In addition, the course provides students with the basic biochemical, cellular and molecular basis underlying the mechanisms of actions of these important molecules. **2 credit hours, FALL.**

**PHARM 73801. CARCINOGENESIS & CANCER THERAPEUTICS.** This course will cover the mechanisms underlying the carcinogenic process induced by chemical, viral or physical agents. Major emphasis will be focused on the mechanisms exploited in developing therapeutic targets for cancer treatment. Lectures on clinical correlates will be presented by clinical oncologists. **3 credit hours, Fall.**

**SELECTED TOPICS IN MOLECULAR VIROLOGY GENE THERAPY AND TRANSGENICS.** Cross-listed in Microbiology and Immunology

**MECHANISMS OF CANCER THERAPEUTICS.** Cross-listed in Pharmacology

#### **SPECIAL PROGRAMMATIC FEATURES OF THE GRADAUTE PROGRAM IN CANCER BIOLOGY**

**Cancer Biology Retreat.** Preceptors and trainees in the Cancer Biology program participate in the annual Cancer Biology Retreat hosted jointly by Meharry Medical College and the Vanderbilt Ingram Cancer Center. This is an outstanding opportunity to learn of advances in cancer research from bench to bedside to behavioral research and community-based research. Participants also have the opportunity to obtain constructive feedback from a broad audience on each individual's research program.

## **Graduate Program in Microbiology and Immunology**

### **Course Requirements for the Program in Microbiology and Immunology**

DR: Departmental Required Course

DE: Departmental Elective Course

### First Year: Core Curriculum

Semester	Name of Course	Number of Credit Hours
<b>Fall Semester</b>		
	Biomedical Sciences IA (Core)	8
	Biomedical Sciences IIA (Core)	4
	Scientific Communications Part I (Core)	0
	Biomedical Sciences IIIB (Core)	0
<b>Spring Semester</b>		
	Biomedical Sciences IIIB (Core)	6 (S/U)
	Scientific Communications Part II (Core)	3
	Cell Signaling (Core)	3
	Bioinformatics	2

### Second Year:

Semester	Name of Course	Number of Credit Hours
<b>Fall Semester</b>		
	Fundamentals in Virology (DR)	3
	Elective Course(s) (DE)	
	Seminar/Journal Club (DR)	1 (S/U)
	Research (DR)	1-12 (S/U)
<b>Spring Semester</b>		
	Fundamentals of Microbiology (DR)	3
	Fundamentals in Immunology (DR)	3
	Foundations in Research (DR)	3 (S/U)
	Seminar/Journal Club (DR)	1 (S/U)
	Research (DR)	1-12 (S/U)
<b>Summer Semester</b>		
	Research (DR)	6 (S/U)
	Ph.D. Candidacy Exam	

### Subsequent Years:

Semester	Name of Course	Number of Credit Hours
<b>Fall Semester</b>		
	Seminar/Journal Club (DR)	1 (S/U)
	Research (DR)	1-12 (S/U)
<b>Spring Semester</b>		
	Seminar / Journal Club (DR)	1 (S/U)

Research (DR)	1-12 (S/U)
Dissertation Research (DR)	1
<b>Summer Semester</b>	
Research (DR)	6 (S/U)

Total Required Hours: At least 32 credit hours of didactic course  
Core Curriculum: 20 credit hours

Microbiology and Immunology Required Courses: 12 credit hours

Elective Courses: As recommended by student's COI

Expected Graduation: 5 - 6 years

**Elective courses offered at Meharry:**

Advanced Topics in Molecular Parasitology  
Topics in Metabolic Regulation  
Molecular Biology of Animal Viruses  
Cytokines

**Elective courses offered at Vanderbilt:**

Cellular and Molecular Basis of Vascular Disease  
Microbial Genetics  
Molecular Virology  
Cellular Microbiology of the Pathogen-Host Interaction  
Human Genetics  
Cell Biology

**COURSE DESCRIPTIONS FOR THE PROGRAM IN MICROBIOLOGY AND IMMUNOLOGY**

**MICR 70701. FUNDAMENTALS OF MICROBIOLOGY.** This course explores the importance of microorganisms as both living systems and disease-causing agents. Topics will be presented as lecture and discussion of selected, bacterial, parasitic, and fungal infections, and mechanism of disease pathogenesis. **3 credit hours, SPRING every year.**

**MICR 71001. FUNDAMENTALS IN IMMUNOLOGY.** This course reviews the basic concepts in immunology. It consists of the immunology lecture and seminar/discussions focused on selected topics in immunology. This course may serve as a pre-requisite for advanced immunology courses offered by the Department of Microbiology. **3 credit hours, SPRING, every year.**

**MICR 71301. MOLECULAR BIOLOGY of ANIMAL VIRUSES.** Lecture course with emphasis on mechanisms of viral replication, oncogenic transformation, and virus-host cell interactions. Prerequisite: MICR 715. Fundamentals in Virology. **3 credit hours, SPRING, alternate years.**

**MICR 71501. FUNDAMENTALS IN VIROLOGY.** This course provides a fundamental understanding of the molecular basis of viral replication and virus-cell interactions. The objectives of the course will be accomplished through lecture and journal article discussion. Prerequisite for: MICR 713. Molecular Biology of Animal Viruses. **3 credit hours, FALL every year.**

**MICR 80001. DISSERTATION RESEARCH.** This is a practical course in assembling, analyzing, and presenting large quantities of experimental data. Students are required to register for this course in their last semester of residence. Course is completed with the approval of the written dissertation by the COI and submission of three copies of the finalized dissertation on cotton paper to the SOGSR. 1 credit hour, **FALL, SPRING, or SUMMER.**

**MICR 73001. ADVANCED TOPICS IN MOLECULAR PARASITOLOGY.** This is an advanced graduate-level seminar course in modern parasitology. The class is focused on the reading and critical evaluation of papers from the current literature selected by the students in cellular and molecular mechanisms of parasitism. 3 credit hours, **Spring, alternate years.**

**BSCI 73601. READINGS IN BIOMEDICAL SCIENCES (Directed Studies).** Intensive reading under the guidance of a faculty member in an area selected by the student. The student and faculty member meet weekly to discuss the readings; the student may be required to write a paper on the semester's reading. 1-3 credits. **FALL & SPRING, every year.**

**MICR 85001. MICROBIOLOGY RESEARCH.** Ph.D. Dissertation Research. Required of students who are candidates for the doctoral degree. 1-12 credit hours, **FALL & SPRING, every year.**

**MICR 90001. MICROBIOLOGY SEMINAR.** Weekly discussion of current topics in microbiological research and of research within the department. 0-1 credit hour, **FALL and SPRING, every year.**

### **Courses at Vanderbilt that may be taken as electives in this emphasis program**

**CELLULAR AND MOLECULAR PATHOLOGY 337. CELLULAR AND MOLECULAR BASIS OF VASCULAR DISEASE.** Lectures on contemporary research in cell biology, protein and lipid biochemistry, and molecular biology of the vascular system. 3 credit hours, **SPRING.**

**MICROBIOLOGY AND IMMUNOLOGY 328 1. MICROBIAL GENETICS.** The genetics of bacteria and yeast and their use in molecular biology as an experimental tool. 2 credit hours, **FALL.**

**MICROBIOLOGY AND IMMUNOLOGY 328 2. MOLECULAR VIROLOGY.** The interaction of animal viruses with their host cells, discussed at the molecular and cellular level as model systems. Special emphasis on current literature and methodology. 3 credit hours, **FALL.**

**MICROBIOLOGY AND IMMUNOLOGY 350. CELLULAR MICROBIOLOGY OF THE PATHOGEN-HOST INTERACTION.** An interdisciplinary course designed to train students in the field of molecular microbiology and/or cell biology. Model organisms or their products will be analyzed in the context of molecular cell microbiology. Students will be challenged to utilize new information from microbial genome sequencing to understand host cell Subcellular compartments and signaling pathways. 3 credit hours, **SPRING.**

**MOLECULAR PHYSIOLOGY AND BIOPHYSICS 340. HUMAN GENETICS.** Designed to cover background and latest advances in human genetics. Topics will include an overview of mutational mechanisms, cytogenetics (detection and description of chromosomal abnormalities), biochemical genetics (gene defects in biochemical pathways), molecular genetics (gene structure, function, and expression), population genetics (heritability, quantitative traits, variance analysis), gene mapping (positional cloning, statistical and molecular techniques), and genetic epidemiology (genetic linkage analysis, design of gene mapping studies, gene-environment interaction). Topics will be discussed

with reference to specific human genetic diseases. **3 credit hours, SPRING.**

## **SPECIAL PROGRAMMATIC FEATURES OF THE GRADAUTE PROGRAM IN MICROBIOLOGY AND IMMUNOLOGY**

**Microbiology Retreat.** The Microbiology Retreat is a weekday program of informal research talks and discussions. Faculty, students and fellows attend this function. This Retreat provides an outstanding opportunity to keep up to date with the diverse research underway in the program and to participate in vigorous scientific discussions. Students are expected to attend the Retreat, and are encouraged to present their research either as a formal talk or a poster.

## **Graduate Program in Neuroscience**

### **Course Requirements for the Program in Neuroscience**

DR: Departmental Required Course

DE: Departmental Elective Course

V: Vanderbilt Course

### **First Year: Core Curriculum**

<b>Semester</b>	<b>Name of Course</b>	<b>Number of Credit Hours</b>
<b>Fall Semester</b>		
	Biomedical Sciences IA (Core)	8
	Biomedical Sciences IIA (Core)	4
	Scientific Communications Part I (Core)	0
	Biomedical Sciences IIIB (Core)	0
<b>Spring Semester</b>		
	Biomedical Sciences IIIB (Core)	6 (S/U)
	Scientific Communications Part II (Core)	3
	Cell Signaling (Core)	3
	Bioinformatics (Core)	2

### **Second Year:**

<b>Semester</b>	<b>Name of Course</b>	<b>Number of Credit Hours</b>
<b>Fall Semester</b>		
	Graduate Neuroscience (DR)	5
	Neuropharmacology (DR)	3
	Elective Course(s) (DEV)	
	Seminar (DR)	1 (S/U)
	Research (DR)	1-12 (S/U)
<b>Spring Semester</b>		
	Foundations in Research (DR)	3 (S/U)

	Elective Course(s) (DEV)	
	Seminar (DR)	1 (S/U)
	Research (DR)	1-12 (S/U)
<b>Summer Semester</b>		
	Research (DR)	6 (S/U)
	Ph.D. Candidacy Exam	

**Subsequent Years:**

Semester	Name of Course	Number of Credit Hours
<b>Fall Semester</b>		
	Seminar (DR)	1 (S/U)
	Research (DR)	1-12 (S/U)
<b>Spring Semester</b>		
	Seminar (DR)	1 (S/U)
	Research (DR)	1-12 (S/U)
	Dissertation Research (DR)	1-3
<b>Summer Semester</b>		
	Research (DR)	6 (S/U)

Total Required Hours: At least 32 credit hours of didactic course  
 Core Curriculum: 20 credit hours

Neuroscience Required Courses: 12 credit hours

Elective Courses: As recommended by student's COI

Expected Graduation: 5 - 6 years

**Elective courses offered at Meharry:**

Neurobiology of Disease  
 Toxicology  
 Readings in Neuroscience

**Elective courses offered at Vanderbilt:**

Neuroscience Discussions  
 Cellular and Molecular Neuroscience (Meharry course # NSCI 73701)  
 Fundamentals of Neuroscience I  
 Fundamentals of Neuroscience II  
 Molecular Neurobiology  
 Neuroanatomy

**COURSE DESCRIPTIONS FOR THE PROGRAM IN NEUROSCIENCE**

**NSC1 70001. NEUROBIOLOGY OF DISEASE.** The course has five modules (1 credit hour each). Five modules are: 1) Parkinson's Disease and Movement Disorders; 2) Alzheimer's Disease and Dementias; 3) Chronic Pain; 4) Addictions; 5) Depression and Mood Disorders. The importance of this course, and the rationale for its development, is to foster preparedness for interdependent

collaborative research that spans from bench to bedside, and also allows laboratory investigators to exploit clinical insights to inform basic science inquiries. The goal is to train scholars for participation in interdependent research across the molecular and cellular to integrative and clinical continuum. The course will foster this interdependence by both the content of the courses as well as the participation in these courses by graduate, medical, postgraduate (MD and PhD) fellows. The selection of the disease themes of this course reflect areas of research interest and strength at both Meharry and Vanderbilt, and also- in their didactic content- will allow students to become familiar with the breadth of experimental strategies and areas of scholarship (including genetics and imaging, for example) that converge to facilitate discovery to translation to clinical diagnosis and intervention. Prerequisite: Graduate Neuroscience. **1-5 credit hours, FALL & SPRING.**

**NSCI 70901. ADVANCED NEUROPHYSIOLOGY.** A functional approach to nervous system mechanisms. Topics include sensory and motor mechanisms, sensory motor integration and higher functions. The course will include lectures, selected literature discussions and essay examinations. **3 credit hours, FALL.** Prerequisite: Physiology I. **(Substitute for Systems Neuroscience)**

**NSCI 71201. SEMINAR IN NEUROSCIENCE.** Weekly discussion of current topics in neuroscience research and of research within the Department of Neuroscience and Pharmacology. **1 credit hour, FALL & SPRING.**

**NSCI 71401. RESEARCH IN NEUROSCIENCE.** Participation and credit in this course are arranged by the COI of students working on their PhD thesis research. Required of all students who are candidates for the doctoral degree. **1-12 credit hours, FALL, SPRING & SUMMER.**

**NSCI 72001. READINGS IN NEUROSCIENCE.** Student should complete a comprehensive reading list of topics specifically associated with his/her area of research. There will be no formal meetings or exam. This course may be taken only once for credit. **3 credit hours, FALL or SPRING.**

**NSCI 72101. DISSERTATION RESEARCH.** This is a practical course in assembling, analyzing, and presenting large quantities of experimental data. Students are required to register for this course in their last semester of residence. Course is completed with the approval of the written dissertation by the COI and submission of three copies of the finalized dissertation on cotton paper to the SOGSR. **1 credit hour, FALL, SPRING, or SUMMER.**

**PHARM 72201. NEUROPHARMACOLOGY.** This course presents an overview of neuropharmacology, including fundamentals of receptor theory, Neurotoxicology, neurophysiology and drug abuse. Mechanisms and problems concerned with neurotransmission will be discussed. Emphasis is given to the neurochemical basis of CNS disorders and drug intervention. Lecturers, current literature, discussions are included. **3 credit hours, FALL.**

**PHARM 72301. TOXICOLOGY.** Principles involved in toxicity of drug and chemical agents will be presented. Topics include xenobiotic biotransformation, toxicokinetics, chemical carcinogenesis, neurotoxicology, metal toxicity, toxic response of skin, cardiac, reproductive & developmental, radiation toxicity & occupational toxicology. Toxicological mechanisms of action, rationale for therapeutic measures against effects of toxic chemical agents, and the basis for toxicological pathology, Current issues in toxicology (Toxicogenomics) will also be covered. Course format includes lectures, and student involvement in journal article presentations. **3 credit hours, SPRING.**

**NSCI 72401. NEURONAL PHYSIOLOGY.** Advanced study of cellular processes related to nervous system functions will include aspects of neurophysiology, neurochemistry and neuroanatomy. Format will be primarily lectures and selected literature readings. Prerequisite: core curriculum. (Substitute for NURO 325. Neuroscience Discussions). 1-3 credit hours, FALL.

**NSCI 73501. GRADUATE NEUROSCIENCE.** The goal of this course is to help students achieve an integrated and correlated understanding of nervous system structure, function, dysfunction and therapeutics. The course covers the following major topics: 1) excitable cells and synapses; 2) anatomy of the nervous system, meninges and neuron-vasculature; 3) sensory systems; 4) motor system; and 5) higher functions. Graduate student exams in this course are essay type, and test critical thinking skills. 5 credit hours, FALL.

### **Courses at Vanderbilt that may be taken as electives in this emphasis program**

**NURO 325. PROFESSIONAL DEVELOPMENT IN NEUROSCIENCE.** This two-semester course provides discussions on a broad range of neuroscience topics, ranging from reviews of historical concepts and individuals in neuroscience to science journalism. Other topics include scientific ethics, science policy, good grantsmanship, and communication skills. 1 credit hour, FALL.

**NURO 8340. FUNDAMENTALS OF NEUROSCIENCE II.** Required for Neuroscience majors in the Cognitive & Systems track. Allows students to develop a working knowledge of neural networks and brain systems and the techniques used to study these functions. Includes an introductory overview of neuroanatomy, physiology, and behavior, and then moves on to the sensory and motor systems, motivation, and learning and memory. This course can be taken to satisfy the requirement of Graduate Neuroscience (NSCI 73501). 4 credit hours, FALL.

**NURO 8345. FUNDAMENTALS OF NEUROSCIENCE I.** An overview of major neural networks, including examples from motor and sensory systems, as well as higher cognitive and affective functions. Studies of neural development move from an examination of neurogenesis, cell fate, and phenotype development to an analysis of invertebrate models and how they have advanced our understanding of mechanisms involved in axonal guidance, synapse formation and apoptosis. Additional lectures covering synaptic and systems plasticity, and models of neural networks and learning and memory will also be provided. Emphasis is placed on the integration of anatomical, biochemical and physiological information. 4 credit hours, SPRING.

**NURO 8346. ADVANCED MOLECULAR NEUROBIOLOGY.** Molecular components and interactions that regulate neuronal development, signaling and disease. Classic molecular analysis of neurobiological processes will be coupled with detailed studies of contemporary literature to provide students with a sound foundation for understanding the molecular bases underlying the development and function of the nervous system. Topics to be covered include: development of neuronal identity, axonal transport, growth factors and cell death, axon guidance and synapse formation, electrical and chemical neurotransmission, regulation of neuronal excitability, and genetic analysis of signaling and neural disorders. 4 credit hours, SPRING.

**PHAR 8320 & 8321. PHARMACOLOGICAL TARGETS AND MECHANISMS.** Introduction to in vivo physiological mechanisms, anatomical structure of organ systems, and regulatory feedback pathways responsible for drug metabolism and physiological homeostasis. Classical studies that shifted the paradigm in a particular area and contemporary research will be discussed to demonstrate clarity of thinking, focused experimental strategies leading to genuine discovery, as well as potential difficulties in interpretation of results of experiments. NOTE: CNS module is

offered in the spring to satisfy the requirement for Neuropharmacology. (Pharm 72201) (FALL& SPRING)

## SPECIAL PROGRAMMATIC FEATURES OF THE GRADUATE PROGRAM IN NEUROSCIENCE

**Neuroscience Retreat.** In order to enhance the cohesiveness and visibility of the neuroscience program, a one-day Meharry-Vanderbilt Neuroscience Retreat is organized to focus on an emerging area of neuroscience. The central theme is developed by three to four faculty research presentations that move from molecules to neural systems to behavior or disease. A nationally recognized neuroscientist is invited to present a plenary lecture that relates to the central theme. The one-day program includes poster presentations by graduate students (second year and beyond) in the program, thus giving students an opportunity to get constructive input about their ongoing projects from the visiting as well as local scientists outside the program. Thus, the Spring Retreat serves as a venue for highlighting students in our program and providing valuable contacts for future career opportunities. In addition to the educational benefits, this experience will serve as a confidence builder for the students and provide time for informal scientific and social interactions. An added benefit of the Retreat is that advice is sought from the invited speaker on improvements in our training program.

**The Neuroscience Student Organization (NSO).** This was established by graduate students in 1998, and membership includes any interested graduate student doing neuroscience-related work in any department or program at Meharry or Vanderbilt. The NSO is run by students and has its own infrastructure, including a President and advisory council. The NSO organizes a biweekly Summer Seminar Series to which only students are invited. Individual students make research presentations providing an opportunity for them to discuss their research in a relaxed environment and get input from students of diverse backgrounds and interests. The NSO also coordinates an annual Spring Neuroscience Seminar with students selecting the topic and speaker, making travel and itinerary arrangements, and setting up and advertising the seminar. One of the goals of the Spring Neuroscience Seminar is to allow trainees to develop a professional network in the at-large community that will serve as a foundation for future professional endeavors. Finally, the NSO is instrumental in helping coordinate aspects of the annual Neuroscience Retreat and Brainstorm Brain Awareness Program, making this organization a dynamic and enriching component of the Neuroscience Graduate Program.

## Graduate Program in Pharmacology

### Course Requirements for the Program in Pharmacology

DR: Departmental Required Course

DE: Departmental Elective Course

### First Year: Core Curriculum

Semester	Name of Course	Number of Credit Hours
<b>Fall Semester</b>		
	Biomedical Sciences IA (Core)	8
	Biomedical Sciences IIA (Core)	4
	Scientific Communications Part I (Core)	0
	Biomedical Sciences IIIB (Core)	0

<b>Spring Semester</b>		
	Biomedical Sciences IIIB (Core)	6 (S/U)
	Scientific Communications Part II (Core)	3
	Cell Signaling (Core)	3
	Bioinformatics (Core)	2

**Second Year:**

<b>Semester</b>	<b>Name of Course</b>	<b>Number of Credit Hours</b>
<b>Fall Semester</b>		
	General Pharmacology (DR)	5
	Neuropharmacology (DR)	3
	Elective Course(s) (DE)	
	Seminar (DR)	1 (S/U)
	Research (DR)	1-12 (S/U)
<b>Spring Semester</b>		
	Foundations in Research (DR)	3 (S/U)
	Elective Course(s) (DE)	
	Seminar (DR)	1 (S/U)
	Research (DR)	1-12 (S/U)
<b>Summer Semester</b>		
	Research (DR)	6 (S/U)
	Ph.D. Candidacy Exam	

**Subsequent Years:**

<b>Semester</b>	<b>Name of Course</b>	<b>Number of Credit Hours</b>
<b>Fall Semester</b>		
	Seminar (DR)	1 (S/U)
	Research (DR)	1-12 (S/U)
<b>Spring Semester</b>		
	Seminar (DR)	1 (S/U)
	Research (DR)	1-12 (S/U)
	Dissertation Research (DR)	1
<b>Summer Semester</b>		
	Research (DR)	6 (S/U)

Total Required Hours: At least 32 credit hours of didactic course

Core Curriculum: 20 credit hours

Pharmacology Required Courses: 12 credit hours

Elective Courses: As recommended by student's COI

Expected Graduation: 5 - 6 years

**Elective courses offered at Meharry:**

Cardiovascular Pharmacology  
Research Problems in Pharmacology  
Carcinogenesis & Cancer Therapeutics  
Toxicology

**Elective courses offered at Vanderbilt:**

Receptor Theory, Cell-Surface Receptors and Signal Transduction Pathways (Meharry course # PHAR 70401)  
Pharmacological Targets and Mechanisms (Meharry course # PHAR 74101)  
Scientific Communication Skills  
Principles of Drug Action  
Cardiovascular Pharmacology  
Pharmacology of Psychotropic Drugs  
Cellular and Molecular Neuroscience  
Molecular Endocrinology (Meharry course # PHAR 73301)  
Molecular Neurobiology

**COURSE DESCRIPTIONS FOR THE PROGRAM IN PHARMACOLOGY**

**PHAR 70201. PHARMACOLOGY SEMINAR.** Weekly discussion of current topics in pharmacology research and of research within the Department of Neuroscience and Pharmacology. **2 credit hour, FALL & SPRING.**

**PHARM 70501. CARDIOVASCULAR PHARMACOLOGY.** The pharmacology of drug agents exerting major effects on the cardiovascular system will be presented in lectures, discussions, and demonstrations. Mechanism of action, basis for therapeutic application and limiting side effects of the drug agents will be discussed. Research methodology utilized in studying these agents will also be covered. **2 credit hours, SPRING.**

**PHARM 70601. GENERAL PHARMACOLOGY.** The pharmacological basis of therapeutics is presented by means of lectures, conferences and demonstrations. Emphasis is placed on the factors governing drug action, dose-response relationships, the relationship between chemical structure and pharmacological action, the problems associated with absorption, distribution metabolism and elimination, and the mechanism of action of the common classes of drugs. Attention is also given to contra-indications, side effects and toxic effects of these compounds. **5 credit hours, FALL.**

**PHARM 70701. PHARMACOKINETICS.** This course is designed to understand the pharmacokinetics principles that govern the absorption, distribution, metabolism, and elimination of drugs. Basic pharmacokinetics parameters are examined using one- and two-compartment modeling. In addition, applications of pharmacokinetics are examined with respect to clinical situations, and students will be introduced to the use of computer programs in pharmacokinetics. **2 credit hours, SPRING.**

**PHARM 71501. DRUG METABOLISM.** This course will cover in depth the concepts involved in metabolism of lipophilic molecules - identifying Phase I & Phase II enzymes; their location,

mechanism, typical substrates, genetic variation, species variation, inhibition and drug interaction and drug design. **2 credit hours, SPRING.**

**PHARM 80001. DISSERTATION RESEARCH.** This is a practical course in assembling, analyzing, and presenting large quantities of experimental data. Students are required to register for this course in their last semester of residence. Course is completed with the approval of the written dissertation by the COI and submission of three copies of the finalized dissertation on cotton paper to the SOGSR. Required of all students who are candidates for the doctoral degree. **1 credit hour, FALL, SPRING, or SUMMER.**

**PHARM 72201. NEUROPHARMACOLOGY.** This course presents an overview of neuropharmacology, including fundamentals of receptor theory, Neurotoxicology, neurophysiology and drug abuse. Mechanisms and problems concerned with neurotransmission will be discussed. Emphasis is given to the neurochemical basis of CNS disorders and drug intervention. Lecturers, current literature, discussions are included. **3 credit hours, FALL.**

**PHARM 72301. TOXICOLOGY.** Principles involved in toxicity of drug and chemical agents will be presented. Topics include xenobiotic biotransformation, toxicokinetics, chemical carcinogenesis, neurotoxicology, metal toxicity, toxic response of skin, cardiac, reproductive & developmental, radiation toxicity & occupational toxicology. Toxicological mechanisms of action, rationale for therapeutic measures against effects of toxic chemical agents, and the basis for toxicological pathology, Current issues in toxicology (Toxicogenomics) will also be covered. Course format includes lectures, and student involvement in journal article presentations. **3 credit hours, SPRING.**

**PHARM 73501. RESEARCH PROBLEMS IN PHARMACOLOGY.** This is essentially an independent study, qualified students work with individual staff members in areas not covered in other available courses. **1-6 credit hours, FALL & SPRING.**

**PHARM 73601. CURRENT TOPICS IN PHARMACOLOGY.** By means of lectures and/or discussion sessions, this course will offer opportunity to evaluate current advances in the field of pharmacology. Each student enrolled will be required to write and submit a critical evaluation of an assigned, current, published research article. **3 credit hours, SPRING.**

**PHARM 73801. CARCINOGENESIS & CANCER THERAPEUTICS** (cross-listing with Cancer biology). This course will cover the mechanisms underlying the carcinogenic process induced by chemical, viral or physical agents. Major emphasis will be focused on the mechanisms exploited in developing therapeutic targets for cancer treatment. Lectures on clinical correlates will be presented by clinical oncologists (cross-listing with Cancer Biology). **3 credit hours, FALL.**

**PHAR 79901. RESEARCH IN PHARMACOLOGY.** Students are required to conduct original research, culminating in the preparation and defense of a dissertation. **1-12 credit hours, FALL, SPRING & SUMMER.**

#### **Courses at Vanderbilt that may be taken as electives in this emphasis program**

**PHAR 324. RECEPTOR THEORY, CELL-SURFACE RECEPTORS AND SIGNAL TRANSDUCTION PATHWAYS.** Course covering structure and function of cell-surface receptors and the molecular bases by which they activate cellular function. Topics include receptor identification; quantitation of simple and complex binding phenomena; molecular bases for receptor coupling to GTP-binding proteins; the structure and function of ligand-operated ion channels, receptor tyrosine kinases and

receptor-induced signal transduction cascades receptors as oncogenes and proto-oncogenes. (SUMMER)

**PHAR 8320 & 8321. PHARMACOLOGICAL TARGETS AND MECHANISMS.** Introduction to *in vivo* physiological mechanisms, anatomical structure of organ systems, and regulatory feedback pathways responsible for drug metabolism and physiological homeostasis. Classical studies that shifted the paradigm in a particular area and contemporary research will be discussed to demonstrate clarity of thinking, focused experimental strategies leading to genuine discovery, as well as potential difficulties in interpretation of results of experiments. (FALL& SPRING)

**PHAR 321. PRINCIPLES OF DRUG ACTION.** The mechanisms of drug action are taken up in a systematic manner. Course includes didactic lectures and parallel, guided readings on drug discovery and design, based on current advances in basic science and clinical research. (SPRING)

**PHAR 322. SCIENTIFIC COMMUNICATION SKILLS.** Techniques in effective oral communication of scientific research as well as practical experience in research and literature presentation and in the preparation of grant proposals. (FALL)

**PHAR 323. EXCITABLE MEMBRANES IN NERVE AND MUSCLE.** Recent findings concerning the structure, function, and pharmacology of ion channels. Topics will include the relationship between amino acid sequence, protein subunit structure, and function of both voltage- and ligand-gated channels; the relationship between channel structure and pharmacology; the interaction of drugs with channels and receptor/channel proteins, with special emphasis on the interaction of compounds with different functional channel states; indirect coupling between ion channels and neurotransmitter and hormone receptors. Classes will include both presentations by the instructors and discussion of recent publications by students.

**PHAR 325. CARDIOVASCULAR PHARMACOLOGY.** Cardiovascular physiology and pharmacology from the molecular to the organismal level. Classic experimental studies, molecular studies, and clinical observations will be presented to demonstrate the power of interdisciplinary approaches in answering complex questions in biology. Students will have the opportunity to identify specific areas or pathophysiologic states for emphasis. Topics covered: development of the cardiovascular system, regulation of cardiac contractility and electrophysiology, blood pressure regulation, coagulation, and select cardiovascular pathophysiologies. (SPRING)

**PHAR 329. PHARMACOLOGY OF PSYCHOTROPIC DRUGS.** An advanced course that focuses on the mechanism of action of CNS-active drugs, with extensive literature reading and student presentations.

**PHAR 345. CELLULAR AND MOLECULAR NEUROSCIENCE.** An overview of major neural networks, including examples from motor and sensory systems, as well as higher cognitive and affective functions. Studies of neural development move from an examination of neurogenesis, cell fate, and phenotype development to an analysis of invertebrate models and how they have advanced our understanding of mechanisms involved in axonal guidance, synapse formation and apoptosis. Additional lectures covering synaptic and systems plasticity, and models of neural networks and learning and memory will also be provided. Emphasis is placed on the integration of anatomical, biochemical and physiological information.

**PHAR 346. MOLECULAR NEUROBIOLOGY.** Molecular components and interactions that regulate neuronal development, signaling and disease. Classic molecular analysis of neurobiological processes

will be coupled with detailed studies of contemporary literature to provide students with a sound foundation for understanding the molecular bases underlying the development and function of the nervous system. Topics to be covered include: development of neuronal identity, axonal transport, growth factors and cell death, axon guidance and synapse formation, electrical and chemical neurotransmission, regulation of neuronal excitability, and genetic analysis of signaling and neural disorders.

## SPECIAL PROGRAMMATIC FEATURES OF THE GRADUATE PROGRAM IN PHARMACOLOGY

### Pharmacology Retreat

Each fall, the Department of Pharmacology at Vanderbilt University holds a retreat in conjunction with the Pharmacology graduate program at Meharry Medical College at a nearby state park. **Attendance at and full participation in the Retreat is required for all graduate students who are in the Pharmacology program at Meharry Medical College.** The speakers at the retreat are students and postdoctoral fellows. Each of the talks by the students is ten minutes in length, and focuses on future research plans rather than past accomplishments. Although a few minutes of the presentation are used to explain the research problem under study, its importance, and what has been learned to date, the students are expected to spend the majority of the ten minute presentation explaining what they want to accomplish or learn in the coming year and what strategies they will employ to do so. This emphasis on the future tense encourages a great deal of input, discussion, and critical consideration of the project at a level of intensity that would not necessarily occur following presentations of already-completed work. Furthermore, by learning the methodologies being established in different laboratories, participants in the training program can more readily learn from one another, rather than "reinventing the wheel." Important collaboration and "crash courses" in different technologies have emerged because of this retreat, and this mode of scientific exchange has fostered an acceleration of the productivity of graduate students and participating mentors alike.

## Graduate Program in Physiology

### Course Requirements for the Program in Physiology

DR: Departmental Required Course

DE: Departmental Elective Course

### First Year: Core Curriculum

Semester	Name of Course	Number of Credit Hours
<b>Fall Semester</b>		
	Biomedical Sciences IA (Core)	8
	Biomedical Sciences IIA (Core)	4
	Scientific Communications Part I (Core)	0
	Biomedical Sciences IIIB (Core)	0
<b>Spring Semester</b>		
	Biomedical Sciences IIIB (Core)	6 (S/U)
	Scientific Communications Part II (Core)	3
	Cell Signaling (Core)	3
	Bioinformatics (Core)	2

**Second Year:**

Semester	Name of Course	Number of Credit Hours
<b>Fall Semester</b>		
	Physiology I (DR)	3
	Elective Course(s) (DE)	
	Seminar (DR)	1 (S/U)
	Research (DR)	1-11 (S/U)
<b>Spring Semester</b>		
	Physiology II (DR)	3
	Foundations in Research (DR)	3 (S/U)
	Elective Course(s) (DE)	
	Seminar (DR)	1 (S/U)
	Research (DR)	1-11 (S/U)
<b>Summer Semester</b>		
	Research (DR)	6 (S/U)
	Ph.D. Candidacy Exam	

**Subsequent Years:**

Semester	Name of Course	Number of Credit Hours
<b>Fall Semester</b>		
	Seminar (DR)	1 (S/U)
	Research (DR)	1-11 (S/U)
<b>Spring Semester</b>		
	Seminar (DR)	1 (S/U)
	Research (DR)	1-11 (S/U)
	Dissertation Research (DR)	1
<b>Summer Semester</b>		
	Research (DR)	6 (S/U)

Total Required Hours: At least 32 credit hours of didactic course

Core Curriculum: 20 credit hours

Physiology Required Courses: 12 credit hours

Elective Courses: As recommended by student's COI

Expected Graduation: 5 - 6 years

**Elective courses offered at Meharry:**

Endocrinology/Gastrointestinal Physiology

Readings in Physiology and Biology

Advanced Cardiovascular Physiology

Cardiovascular Pharmacology

## **COURSE DESCRIPTIONS FOR THE PROGRAM IN PHYSIOLOGY**

**PHYS 72501. PHYSIOLOGY I.** This course covers the cell physiology including excitable cells, the autonomic nervous system, muscle, cardiovascular, pulmonary and renal organ systems. The format of the course will include lectures, discussion sessions, as well as, student presentations. Grades will be assigned based on student participation, presentations and performances on examinations. **3 credit hours, FALL.**

**PHYS 72601. PHYSIOLOGY II.** This course covers the gastrointestinal, endocrinology and reproductive system. The format of the course will include lectures, discussion sessions, as well as, student presentations. Grades will be assigned based on student participation, presentations and performances on examinations. **3 credit hours, SPRING.**

**PHYS 70701. ENDOCRINOLOGY/GASTROINTESTINAL PHYSIOLOGY.** This course extends the knowledge base of Endocrine and Gastrointestinal Physiology gained in Human Physiology (PHYS 702). Thus, it will explore the historical and current literature to provide a solid base of knowledge, and enable the students to interpret scientific data and critique experimental design as it relates to endocrine and gastrointestinal physiology. In addition, there will be a number of laboratories in which the structure and microanatomy of the endocrine and gastrointestinal tissues are examined in relationship to function. Advanced concepts and the impact of current research will be emphasized. Grades will be determined by student participation, examinations, and a review paper. **4 credit hours, FALL.**

**PHYS 71001. ADVANCED CARDIOVASCULAR PHYSIOLOGY.** This course will start out with basic biophysics of ion channels in cardiac muscle, and describe the heart as a pump in the general dynamics of cardiac function. Hemodynamics of flow will be dealt with, and the interplay of various regulatory mechanisms in vascular reactivity. The course will also include vascular smooth muscle cell function and regulation, and endothelial cell control of vascular tone, oxidative stress and vascular functions. Molecular studies in hypo, hyper and normotensive mice (the implications in human), ischemic heart disease and congestive heart failure, implications in diabetes, endocrine disorders (risk factors in African-American population) and the role of nutrition and behavior in such diseases will constitute an important part of this segment. Student presentations of recent and important literatures on these subjects, a mid-term examination and a final paper will determine the grade. **3 credit hours, SPRING.**

**PHYS 71201. SEMINARS IN PHYSIOLOGY.** Topics relevant to physiology will be presented by faculty, visiting scholars and graduate students. Participating graduate students who have achieved candidacy status will present one seminar per year. This course is required for all graduate students studying for the Ph.D. degree in physiology. Attendance is mandatory to receive a satisfactory grade. **1 credit hour, FALL & SPRING.**

**PHYS 71401. RESEARCH IN PHYSIOLOGY.** Research opportunities are available from the molecular to systems level physiology on contemporary problems in cardiovascular disease, endocrine and neuroscience. Students will participate in experimental design, research, data analysis and data reporting. Prior approval of supervising faculty member and department chairperson is required. Students will receive satisfactory or unsatisfactory grades until degree requirements have been fulfilled. **1-11 credit hours, Fall, SPRING & SUMMER.**

**PHYS 72001. READINGS IN PHYSIOLOGY.** In this course, the student should complete comprehensive reading list of subjects specifically associated with his/her area of research. There

will be no formal meetings or exam but a review article may be required. This course may be taken only once for credit. **3 credit hours, Fall, SPRING & SUMMER.**

**PHYS 72101. DISSERTATION RESEARCH.** This is a practical course in assembling, analyzing and presenting large quantities of experimental data. Students are expected to register for this course in their last semester of residence. Course is completed with the approval of the written dissertation by the COI and submission of three copies of the finalized dissertation on cotton paper to the SOGSR. **1 credit hour, Fall, SPRING or SUMMER.**

### **SPECIAL PROGRAMMATIC FEATURES OF THE GRADUATE PROGRAM IN PHYSIOLOGY**

Each fall, the Department of Physiology participates in the Tennessee Physiological Society meeting which is held at one of the Medical Schools in Tennessee. The purpose of the organization is to "enhance and advance the field of physiology with all its molecular, cellular, organ and organismal basic and applied disciplines of research and education and unite the Physiologists for this purpose within the State of Tennessee." Students in the Physiology Program present at this meeting and network with other students and faculty in the state to stay abreast of current research in the area of physiology and build collaborations.

# APPENDICES

Ph.D. Program Milestone Timetable for Completion of Degree in 5 Years  
Self-Tracking Summary Progress Checklist for the Overall Program  
Self-Tracking Committee On Instruction (COI)/Qualifying Exam Checklist  
Written Preliminary Exam (Proposal) Grading Form  
Oral Preliminary Exam Grading Form  
COI Meeting Report Form  
Individual Development Plan (IDP) Forms (2<sup>nd</sup> Year & Advanced)  
Self-Tracking FINAL DISSERTATION Defense Checklist  
PhD Dissertation Defense Application Form  
Dissertation Defense Evaluation Form

## Ph.D. Program Milestone Timetable for Completion of Degree in 5 Years

<b>First year:</b>	Successfully complete core courses Identify lab and preceptor With preceptor/mentor input, form a Committee on Instruction (COI)
<b>Second Year:</b>	Develop and Individual Development Plan (IDP) for Year Two Successfully complete discipline-based courses Present at Student Research Day Have a COI meeting in the Fall and Spring Prepare for candidacy (preliminary) exam Present journal clubs and departmental seminars Successfully complete candidacy (preliminary) exam by the end of the Summer
<b>Third Year:</b>	Develop an IDP for Year Three Present at Student Research Day Submit abstract to local or national meeting Have a COI meeting in the Fall and Spring Prepare and submit a F31 pre-doctoral fellowship or other fellowship Present journal clubs and departmental seminars Present works-in-progress annually Have a preliminary draft of a manuscript
<b>Fourth Year</b>	Develop an IDP for Year Four Continue with dissertation research Present at Student Research Day Submit abstract to national meeting Complete experiments and submit a manuscript for publication Have a COI meeting in the Fall and Spring Present journal clubs and departmental seminars Present works-in-progress annually
<b>Fifth Year</b>	Develop an IDP for Year Five Have the manuscript(s) accepted in peer-reviewed journal(s) Present at Student Research Day Submit abstract to national meeting Submit applications for post-doctoral position Present journal clubs and departmental seminars Present works-in-progress annually Have a COI meeting in the Fall and Spring Write and defend dissertation

ALL REQUIREMENTS FOR THE PH.D. MUST BE COMPLETED WITHIN SEVEN YEARS AFTER ADMISSION TO THE SOGSR. IF A STUDENT HAS BEEN *ADMITTED TO CANDIDACY* BUT HAS NOT COMPLETED HIS/HER STUDIES WITHIN THE SIX-YEAR PERIOD: (1) THE STUDENT MAY BE GIVEN UP TO TWO SEMESTERS TO FINISH THE PH.D., OR (2) THE STUDENT MAY BE ISSUED A TERMINAL MASTER'S DEGREE. IF SUCH ACTION IS TAKEN AND THE STUDENT DOES NOT MEET THE NEW DEADLINE, THE STUDENT MAY BE DROPPED FROM THE SOGSR. WHEN A STUDENT EXCEEDS THE SEVEN-YEAR LIMIT THE DGS SHALL RECOMMEND TO THE DEAN WHICH ACTION SHOULD BE TAKEN. THE DEAN'S DECISION IS CONSIDERED FINAL. A STUDENT'S PROGRAM OF STUDY CANNOT EXTEND BEYOND EIGHT YEARS.

# Self-Tracking Summary Progress Checklist

Summary Progress in the PhD Program in Biomedical Sciences  
At Meharry Medical College

Year Entered Program: \_\_\_\_\_

Preceptor/Dissertation  
Advisor: \_\_\_\_\_

Graduate Program: \_\_\_\_\_  
Emphasis \_\_\_\_\_

Lab Rotations (faculty member name):

Lab #1: \_\_\_\_\_

Lab #2: \_\_\_\_\_

Lab #3: \_\_\_\_\_

Required Courses Completed (record semester and year completed and grade earned):

Biomedical Sciences IA \_\_\_\_\_

Biomedical Sciences IIA \_\_\_\_\_

Scientific Communications (Part I&II) \_\_\_\_\_

Research Laboratory Rotations (I, II, III) \_\_\_\_\_

Cell Signaling \_\_\_\_\_

Bioinformatics \_\_\_\_\_

Foundations in Research \_\_\_\_\_

Elective Courses Completed (course name & number, date completed, credit hours, & grade)

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

## Self-Tracking COI/Qualifying Exam Checklist

**Dissertation/COI Committee** -at least five members; please give names of committee members and their affiliations; at least one member of the committee should come from outside MMC

**1. Committee**

Chairperson \_\_\_\_\_

**2. Dissertation**

Advisor/Mentor \_\_\_\_\_

**3. Outside**

MMC Member \_\_\_\_\_

4. \_\_\_\_\_

5. \_\_\_\_\_

6. \_\_\_\_\_

Date Passed Qualifying Exam \_\_\_\_\_

Dissertation Title: \_\_\_\_\_

Defense Date: \_\_\_\_\_

**Abstracts, Publications, and Honors** (use continuation pages if necessary):

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**Written Preliminary Exam (Proposal) Grading Form:**

Student: \_\_\_\_\_

Exam Committee Member: \_\_\_\_\_

Date: \_\_\_\_\_

**A. Hypothesis/Specific Aims (15 Points)**

- i. Do the aims test the hypothesis? (0-5 points) \_\_\_\_\_
- ii. Do the aims test a causal relationship (not descriptive)? (0-5 points) \_\_\_\_\_
- iii. Why test this hypothesis? (0-5 points) \_\_\_\_\_
- Total Hypothesis/Specific Aims Points*** \_\_\_\_\_

**B. Background and Significance (15 Points)**

- i. How will the work advance the field? (0-5 points) \_\_\_\_\_
- ii. Are the preliminary data/information relevant? (0-5 points) \_\_\_\_\_
- iii. Are the references from primary literature or mostly from review articles?  
(0-5 points) \_\_\_\_\_
- Total Background and Significance Points:*** \_\_\_\_\_

**C. Experimental Design (20 Points)**

- i. Is the rationale for each aim provided and is based on valid reasoning? (0-5 points) \_\_\_\_\_
- ii. Are expected results provided and are they based on valid reasoning? (0-4 points) \_\_\_\_\_
- iii. Are potential limitations and alternate experiments adequately discussed  
for each aim? (0-4 points) \_\_\_\_\_
- iv. Are techniques explained? (0-4 points) \_\_\_\_\_
- v. Are statistical analyses described and are they appropriate? (0-3 points) \_\_\_\_\_
- Total Experimental Design Points:*** \_\_\_\_\_

**Total Points for the Written Proposal:** \_\_\_\_\_

## Oral Preliminary Exam Grading Form:

Student: \_\_\_\_\_

Exam Committee Member: \_\_\_\_\_

Date: \_\_\_\_\_

Please use the following scale to evaluate the presentation.

1-Completely unacceptable	2- Noticeably less than average	3-Average, strengths and weaknesses are equal	4-Very Good	5-Excellent
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1. In the introduction, did the student present sufficient background material?  
1                      2                      3                      4                      5
2. How clearly did the student convey the originality or novelty and significance of the proposed research?  
1                      2                      3                      4                      5
3. How well were the preliminary data/information presented?  
1                      2                      3                      4                      5
4. How clearly did the student explain the scientific approach (including use of statistics) and scientific rigor of the proposed study?  
1                      2                      3                      4                      5
5. How clearly did the student explain expected results, potential problems and alternative approaches?  
1                      2                      3                      4                      5
6. How well did the student field questions and answer them clearly and informatively?  
1                      2                      3                      4                      5
7. How was the student's overall knowledge base regarding the subject matter?  
1                      2                      3                      4                      5
8. How was the student's overall knowledge base regarding understanding theory of experimental techniques?  
1                      2                      3                      4                      5
9. How well did the student integrate his/her basic science knowledge into his/her project?  
1                      2                      3                      4                      5
10. What was the overall quality of the presentation [include in your assessment 1) the quality of the slide design and organization, 2) how well the student "make and keep eye contact" with the audience and 3) did the student speak clearly and in a confident, professional manner]?  
1                      2                      3                      4                      5

Additional Comments:

Total Score \_\_\_\_\_

# Committee On Instruction (COI) Meeting Report Form

Student's Name: \_\_\_\_\_

Funding Source: \_\_\_\_\_

Date and Time of Meeting: \_\_\_\_\_

Location: \_\_\_\_\_

COI Members Present:

COI Members Absent:

Completed Candidacy Exam \_\_\_\_\_ Yes \_\_\_\_\_ No  
\_\_\_\_\_ Date

The purpose of this meeting is (please check one):

- Pre-candidacy       Post-Candidacy       Dissertation Defense Readiness

Dissertation Title: \_\_\_\_\_  
\_\_\_\_\_

Annual IDP Submitted \_\_\_\_\_ Yes \_\_\_\_\_ No  
\_\_\_\_\_ Date

IDP Goals Achieved \_\_\_\_\_ Yes \_\_\_\_\_ No \_\_\_\_\_ Partially (%)

Comments \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Progress on Specific Aims:

Sp Aim 1: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Sp Aim 2: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Sp Aim 3: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Committee Recommendations:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Publications within last 6 months:            \_\_\_Yes     \_\_\_No

Authors, title, journal volume and year

Presentations at National Meetings within the last 6 months:     \_\_\_Yes     \_\_\_No

Authors, title, meeting (name, location and date)

**Committee Members Signatures:**

(At least ONE member must be from an academic institution other than MMC)

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Chair of Committee

Student

NOTE: This form must be submitted by the Chair of the Committee (Faculty Preceptor) to the DGS of the student's Graduate Program, and copied to the SOGSR no later than 2 weeks after the COI meeting.

## Individual Development Plan For 2<sup>nd</sup> Year Students

Name: \_\_\_\_\_ Program: \_\_\_\_\_

Advisor: \_\_\_\_\_ Period of IDP: \_\_\_\_\_ Year in Program: \_\_\_\_\_

**Career Objective:**

**Specific Goals:**

ACTION STEPS	Start Date	Completion
<b>A. COURSES TO BE TAKEN (List Course Names and Numbers)</b>		
<b>B. FORMATION OF COMMITTEE ON INSTRUCTION (COI (List Names and title of COI Members and their institutional Affiliation); Tentative date for 1<sup>st</sup> COI Meeting</b>		
<b>C. SPECIFIC AIMS (list each aim and steps to be taken to accomplish each aim)</b>		

ACTION STEPS	Start Date	Completion
<b>E. DISSERTATION PROPOSAL/FELLOWSHIP WRITING PROJECTS</b> (list plans to prepare and submit candidacy exam, NIH, NSF, or other fellowship applications)		
<b>F. SEMINAR SERIES or JOURNAL CLUBS TO ATTEND</b>		
<b>G. ORAL PRESENTATIONS</b> (date for your scheduled Journal Club/WIP presentation)		
<b>H. PROFESSIONAL DEVELOPMENT ACTIVITY</b>		

**I have discussed this IDP with my advisor/mentor:** \_\_\_Yes \_\_\_No **Date Discussed:**\_\_\_\_\_

**Mentor:** How can the student improve performance and achieve his/her goals for the upcoming year?

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\_\_\_\_\_  
Student Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Mentor Signature

\_\_\_\_\_  
Date

## Individual Development Plan for Advanced Students

Name: \_\_\_\_\_ Program: \_\_\_\_\_

Advisor: \_\_\_\_\_ Period of IDP: \_\_\_\_\_ Year in Program: \_\_\_\_\_

**Career Objective:**

**Specific Goals:**

ACTION STEPS	Start Date	Completion
<b>A. SPECIFIC AIMS</b> (list each aim and steps to be taken to accomplish aim)		

<p><b>B. PUBLICATIONS</b> {include potential title of manuscript as well as name of potential journal(s) for submission}</p> <p><i>Manuscripts In Progress (plans for developing Intro, M&amp;Ms, Drafts of Figures, Summary/Conclusion)</i></p> <p><i>Manuscript(s) to be Submitted</i></p>		
<p><b>C. FELLOWSHIP WRITING PROJECTS</b> (list plans to prepare and submit NIH or other fellowship applications)</p>		
<p><b>D. PROFESSIONAL DEVELOPMENT ACTIVITIES</b></p>		

**I have discussed this IDP with my advisor/mentor:** \_\_\_Yes \_\_\_No **Date Discussed:** \_\_\_\_\_

**Mentor:** How can the student improve performance and achieve his/her goals for the upcoming year?

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\_\_\_\_\_  
Student Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Mentor Signature

\_\_\_\_\_  
Date

# Self-Tracking FINAL DISSERTATION Defense Checklist

## STEP I: Pre-Defense COI Committee Meetings:

Between the time you successfully complete your Dissertation Defense Proposal and defend your Dissertation, you must meet with your COI each semester, in order for the Committee to monitor your progress and make suggestions, as well as for you to have the opportunity to solicit input and advice

### a. Dates of Dissertation Committee Meetings:


### b. Date Dissertation Committee granted permission to write:

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## STEP II: Before You Begin Writing Your Final Draft

Please obtain and examine a copy of Meharry Medical College's official **Guidelines for Writing Dissertations from the Graduate School Office** prior to writing your dissertation.

## STEP III: While Writing Your Dissertation

- a. After you have the main components of your dissertation written (e.g., cover page, table of contents, a figure, a table, a page of standard text), **MAKE AN APPOINTMENT WITH THE INTERIM ASSOCIATE DEAN IN THE GRADUATE SCHOOL** to review the samples for formatting requirements. They can be reached at 327- 6533.

## Self-Tracking FINAL DISSERTATION Defense Checklist (continued)

- b. The Graduate School ultimately determines if you have completed all the necessary requirements for the Ph.D. degree in Biomedical Sciences and confers your degree. The guidelines for *Public Seminar and Defense of Dissertation/Thesis* can be found in the **Student Academic Policies and Procedures Manual**.

## Self-Tracking FINAL DISSERTATION Defense Checklist (continued)

- STEP V: Dissertation Submission and Defense  
a. Scheduling your oral defense:

Once your dissertation is written, set a COI meeting to be granted approval for an oral defense date. **A PhD Dissertation Defense Application Form** (page 56) must be filled out for this process. As it is often difficult to schedule a time for your defense that is convenient for all of the members of your COI, it is suggested that you begin your scheduling well in advance of your anticipated defense meeting. **ALL DISSERTATION COMMITTEE MEMBERS MUST ATTEND.** You must notify the DGS of the date, time and place of your defense, as well as your dissertation title **AT LEAST 3 WEEKS BEFORE THE DATE OF YOUR DEFENSE MEETING** so this information can be approved and received by the Graduate School 2 weeks prior to your defense.

Scheduled Date of Dissertation  
Defense: \_\_\_\_\_

Date Notification Submitted to DGS: \_\_\_\_\_

The reservation of a room for the Dissertation Defense should be done by calling the Graduate School Office 327-6533. Your reservation will not be complete until the DGS or the Department Chair receives a letter from your COI chair indicating that you are approved to defend. The Chair of the Department or the DGS of your program will then write a letter to the Dean of the Graduate School indicating that you are recommended to defend your dissertation.

- b. Submitting your dissertation

Your Committee should receive a copy of your dissertation **at least two weeks prior to your oral defense.** Your dissertation should have been carefully critiqued by, and be acceptable to, you and your dissertation advisor prior to its submission to the Dissertation Committee.

Date Dissertation Submitted to Committee Members:  
\_\_\_\_\_

c. Defending your dissertation:

Prepare a 35-45 minute oral summary

You must bring at least three title pages on bonded paper from your dissertation to your Defense and get **ORIGINAL** Committee signatures on each. Original signatures are required for all final copies of your dissertation submitted to the Graduate School.

Once you have completed your dissertation defense, a **Dissertation Defense Evaluation Form** (page 57) will be signed by your Committee indicating either a Pass or Fail and submitted to the Dean of the Graduate School by the DGS.

Remember, even if your oral defense is successful and your dissertation is accepted by your Dissertation Committee, there are still almost always minor corrections and revisions required by each Committee member.

d. Dissertation binding:

Once you have successfully completed your Dissertation Defense, and made any corrections required by your Committee, you must provide one electronic PDF, and three final copies of your dissertation on bonded paper to the Graduate School for binding. The Dissertation binding fee is paid by your graduation fee. (You must pay for extra copies for family or friends.)

## Self-Tracking FINAL DISSERTATION Defense Checklist (continued)

Final submission of the Dissertation to the Graduate School is required on these dates:

May graduation	Last Friday in April
June graduation	Last Friday in May
October graduation	Last Friday in July
December graduation	Last Friday in October



**PhD Program  
School of Graduate Studies & Research  
Meharry Medical College  
Dissertation Defense Evaluation Form**

Name of Student: \_\_\_\_\_

Date: \_\_\_\_\_

Quality of Oral Thesis Defense

\_\_\_\_\_ Pass      \_\_\_\_\_ Fail

Committee Members:

\_\_\_\_\_ (Chair)  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
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\_\_\_\_\_

Comments:

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