Graduate Studies in

Biomolecular Science

Kent Gallaher,
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Graduate Studies in Biomolecular Science

• Master of Science

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Kent Gallaher, Academic Chair, Department of Biology; Director, Graduate Studies in Biomolecular Science

The mission of the graduate program in Biomolecular Science is to prepare competent scientists whose practice is informed by faith and who are well positioned for successful careers in biomedical science, basic research, genetic testing, cancer biology, developmental biology and DNA forensics. Additionally persons may elect to pursue this graduate program to better position themselves for entry into graduate programs in medicine, dentistry and other allied health professions.

Admission Policies and Procedures

Applicants to graduate programs must submit the following:

1. **Application Form.** Each applicant must complete an application form. The application form is available at lipscomb.edu/admissions/graduate then click on Apply by Program to complete the online application.

2. **Application Fee.** Each application should be accompanied by a $50 nonrefundable application fee ($75 for international students).

3. **Standardized exam score.** Each applicant must submit scores from an appropriate exam. The program accepts scores from the Graduate Record Examination (GRE), Medical College Admissions Test (MCAT), and Dental College Admissions Test (DAT). For more information on the GRE, visit www.ets.org/ and click on GRE. For more information on the MCAT, visit www.aamc.org. For more information on the DAT, visit www.ada.org. Students who have already earned a master’s level degree may apply to the program without submitting a standardized test score.

4. **References.** Two letters of reference are required: one academic reference and one character reference.

5. **Official Transcript(s).** Each applicant must submit an official transcript, showing degree conferral when appropriate, from all schools attended.

6. **Health Form.** Each applicant must submit a completed health form signed by a health care provider. (To print a copy of the health form, visit www.lipscomb.edu/healthcenter/forms.)

7. **FERPA.** The Family Educational Rights and Privacy Act affords students certain rights of access to educational records; even if you are independent of your parents, you must submit this form prior to enrollment.

8. **Resume.** A resume detailing the applicant’s work and academic experience is required.

9. **TOEFL.** The Test of English as a Foreign Language (TOEFL) is required for international students. (See section titled International Students for more information.)

All application items should be submitted to the Graduate Studies in Biomolecular Science office no later than 15 days before the beginning of the semester or term in which the student plans to enroll. Items should be mailed to: Graduate Studies in Biomolecular Science, Lipscomb University, One University Park Drive, Nashville TN 37204-3951.

*These forms must be submitted after acceptance into the program.*
Transfer and Waiver of Courses
Although all graduate credit hours may be transferred from another accredited institution, a maximum of 9 hours will be counted toward the M.S. in Biomolecular Science. The director or appropriate faculty member of the graduate program will evaluate the course(s) being proposed for transfer and make a determination of suitability. No course with a grade below a “B” will be considered for transfer.

Special consideration for course waiver may be given to the student who has special study and/or experience in a given subject area. The waiver will be by means of an examination that is passed with a grade of “B” or better. A $170 fee is charged for each examination taken (includes $70 for evaluating and recording and $100 per course for constructing and administering). A maximum of 6 hours may be waived by examination. Arrangements for a waiver are to be made through the Graduate Studies office. No graduate credit is awarded. Documentation

Student Classifications
Students are admitted to graduate courses in one of five categories:

1. **Graduate Student**: one who has satisfied all admissions requirements. (Average of 3.0 on undergraduate work, acceptable standardized exam scores.) A student with an incomplete admission file will be accepted to the program at the discretion of the program director but will be placed on an Academic Hold which will prevent registration for the following semester. Once the proper admissions documents have been received, the hold will be removed and the student will be allowed to register for the following semester.

2. **Conditionally Admitted Student**: one who has been admitted conditionally, at the discretion of the program director, without satisfying all admission requirements. Students admitted with the following criteria may be required to complete a minimum of nine hours of graduate work with a grade of “B” or above.
   a. From an unaccredited school or with a substandard GPA or Standardized Test score.
   b. A transfer student with a graduate GPA between 2.50 and 2.99. The transfer student must be in good standing at the previous institution attended.

Documentation
Students are required to provide satisfactory documentation of personal identification for off-site learning experiences required in many programs of graduate study at Lipscomb University. Failure to provide proper credentials will result in failure to complete the desired course of study. For complete policy, see section entitled Required Documentation for Off-Site Learning Experiences in the opening section of this catalog.
c. As a student who has not completed a bachelor’s degree program. The transfer student must be in good standing at the previous institution attended.

3. **Non-Degree Student:** one who has been admitted to graduate studies and has met all admission requirements except GPA or standardized exam score. The student may take up to 9 semester hours for graduate credit. Those hours may be applied toward a master’s degree if the student makes a grade of “B” or better in the courses taken for credit and if all admission requirements (GPA and entrance test score) are met and the student is formally admitted to a graduate program as a degree-seeking student.

4. **Visiting Student:** one who is currently enrolled as a student in good standing at the post-bachelor’s level at another graduate school, wishes to take courses at Lipscomb and desires to have transcript evidence of course work done at Lipscomb provided for the school of primary enrollment.

5. **Probationary Student:** one who has been readmitted to a graduate program following academic suspension from the program.

Admission to a program does not imply admission to candidacy for the master’s degree. Only those students who meet the requirements for “Graduate Student” described above are eligible for candidacy.

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### Academic Policies

#### Course Load

A student enrolled for 9 hours per semester is considered a full-time student. A student enrolled for less than 9 is considered a part-time student. No student will be permitted to enroll for more than 15 hours per semester without special approval from the director of the graduate program.

#### Academic Standing

1. **Good Academic Standing:** To remain in good academic standing, the M.S. in Biomolecular Science student must maintain a cumulative 3.00 GPA and a 3.00 GPA on the most recent 12 semester hours of work.

2. **Probation:** Should the student’s cumulative graduate GPA fall below 3.00, he/she will be placed on academic probation. A student on academic probation will not be allowed to enroll for more than 6 hours during any term the probation applies.

The probationary student is required to achieve a 3.00 cumulative GPA by the time the student has completed the next 9 hours of course work. A course(s) may be repeated to achieve the requisite GPA. If the requisite GPA is attained, the academic probation status will be removed.

3. **Suspension:** If the requisite GPA is not attained, the student will be suspended from graduate studies at Lipscomb for the following semester, after which the student may apply for readmission. The student may be required to appear before the Graduate Committee.

Failing grades will provide no credit toward the degree but will be included in figuring scholarship level, unless replaced with a higher grade by repeating the course(s). A 3.00 GPA must be maintained to be eligible for financial assistance.

4. **Appeals:** Appeals to suspension decisions should be made in writing to the Vice Provost for Academic Development and Graduate Studies. Appeals must be received no later than 4:30 p.m. on the Monday of the week before classes begin for the term during which the student wishes to be readmitted.

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### Degree Completion Requirements

#### Residency

No period of formal residency is required for a degree in a master’s program.

#### Statute of Limitations

All requirements for the M.S. in Biomolecular Science degree must be completed within a 5-year period from the time of initial matriculation.

#### Candidacy

Admission to a program does not imply admission to candidacy for the master’s degree. During the course of pursuing the M.S. degree, the student must be admitted to “candidacy.” For admission to candidacy the student must satisfy the following:

1. Complete all required undergraduate deficiencies if admitted on condition.
2. Complete at least twelve hours of graduate work.
3. Maintain a 3.00 GPA on all courses taken toward the requirements for the degree with no incomplete grades.

4. File a degree plan/application for candidacy in the graduate program office which meets all requirements and is approved by the administrator of the graduate program and the dean of the college. The degree plan must be filed during the second semester of graduate work in the program.

After admission to candidacy and approval of the degree plan, any changes in the degree plan must be approved by the administrator of the graduate program and the dean of the college. The application for candidacy must be filed before the beginning of the student’s last semester in the program. No student will be allowed to graduate in the same semester in which the application for candidacy is filed.

**Minimum Credits**
The M.S. in Biomolecular Science requires 30 semester hours, exclusive of hours accumulated to satisfy academic deficiencies.

**Minimum GPA**
The minimum cumulative grade point average (GPA) for all graduate education programs is 3.00 for all graduate courses taken for graduate credit while pursuing the degree. No grade below a “C” is acceptable. Such grades will not apply toward degree completion.

**Graduation**
Students must register for GN 999X the semester in which all coursework will be completed for graduation. Students who do not file their Intent to Graduate form in the Registrar's Office by the end of the first week of their last semester may be delayed in graduating.

Graduate students receiving degrees are hooded during the May and December commencement exercises.

**Appeals**
Any exceptions to the above stated requirements would require approval via the appeal process established by the Graduate Academic Leadership Team.

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**Financial Information**

**Tuition and Fees for 2015-2016**

*Basic charges* per semester:

- Tuition per semester hour of graduate credit...... $934
- Tuition to audit without credit...... 50% of regular tuition

*Special Fees*

- Application fee .... $50 ($75 for international students)
- Application for Graduation................................. $195
- Returned check fee ................................................$30
- TouchNet monthly payment plan enrollment fee ....$60 per semester
- Withdrawal fee.................................................... $195

*Effective May 1, 2015*

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**Master of Science in Biomolecular Science**

**(30 to 33 hours)**

The M.S. in Biomolecular Science (30 hrs) is offered in a block format. Each block is 8 weeks, with one calendar year consisting of 5 blocks. In order to complete the degree in one calendar year, students must enroll in two courses per block. Students may enter the program three times each year (June, August, and January). To accommodate working professionals, courses and laboratories are offered in the evening. Lecture courses meet two nights each week (6:00 – 8:20 p.m.) with laboratories meeting one night each week (6:00 – 9:50 p.m.).

Current Lipscomb undergraduate students may elect to apply to the 150 hr B.S. to M.S. Bridge program. In this scenario, students who are accepted into the program may transition to graduate classes once they have completed 120 hrs of undergraduate coursework, receiving both a B.S. in Molecular Biology and an M.S. in Biomolecular Sciences after completion of 150 hrs of total course work, including all of the respective degree requirements.

**Program Core Requirements (15 hours)**

- BMS 5103 Introduction to Research (3)
- BMS 5113 Biomolecular Laboratory I (3)
- BMS 5213 Biostatistics (3)
- BMS 5223 Ethics in Science and Biotechnology (3)
- BMS 5503 Capstone Research (3)
Laboratory Research Track (15 hours):
BMS 5123 Biomolecular Laboratory II (3) 
Plus 12 hours of elective courses in biomolecular science

Human Disease Track (18 hours):
BMS 5133 Scientific Communication (3) 
BMS 5463 Clinical Research (3) 
Plus 12 hours of elective courses in biomolecular science

Course Descriptions

BMS 5013 Molecular Biology (3)
This course is designed to be an upper level, laboratory based course focusing on DNA, RNA, and protein laboratory techniques. Students will learn to apply previously mastered concepts in cell biology and genetics to practical laboratory-based problems. Additionally, students will learn and apply the practice of grant writing and peer review, and will critically discuss numerous scientific journal articles. Cross listed with BY 4013.

BMS 5023 Cancer Biology (3)
This course is designed to give students an in-depth understanding of the molecular basis of cancer, as well as an increased knowledge in clinical aspects of cancer diagnosis and treatment. Characteristics of cancer cells, oncogenes and tumor suppressors, the tumor microenvironment, tumor immunology, and novel cancer therapies are major areas covered. Cross listed with BY 4023

BMS 5103 Introduction to Research (3)
This course is designed to prepare biomolecular science students for labs required for this program. Students will learn to search and review literature, solve scientific problems using common molecular biology laboratory techniques, and learn to trouble shoot common problems that arise in a biomolecular laboratory. This is a 3 hr online course with emphasis on learning and understanding common research methods.

BMS 5113 Biomolecular Laboratory I (3)
A course designed to give graduate students hands-on experience with techniques common to molecular research laboratories. Students will learn how to perform common research methods and troubleshoot those methods when problems arise. Techniques will include: reverse-transcriptase PCR, basic cell culture, immunostaining and microscopy, and protein interactions and analysis including SDS-Page and western blotting. This laboratory is a foundation for the Biomolecular Lab II and Capstone Project.

BMS 5123 Biomolecular Laboratory II (3)
This laboratory course is designed so that students learn to apply methods learned in BMS 5103 and BMS 5113. The goal of this laboratory course is for students to learn to become independent researchers.

BMS 5133 Scientific Communication (3)
This course provides instruction in the types of professional communications common to science. Topics will include abstracts and summaries, literature reviews, research proposals, poster and oral presentations, and journal publications.

BMS 5213 Biostatistics (3)
This is a mathematically sophisticated introduction to the concepts and methods of biostatistical data analysis. The topics include descriptive statistics, sampling distributions, point and confidence interval estimation, hypothesis testing, a variety of one and two-sample parametric and non-parametric methods for analyzing continuous and discrete and simple and linear regression. The course provides hands-on training with SAS applications to prepare students for real life data collection and analysis.
BMS 5223  Ethics in Science and Biotechnology (3)
An ethics course aimed to prepare students to face and surmount current and emerging ethical issues as professionals in a scientific field. Topics emphasized will include authorship, medical ethics, honesty, and responsibilities to colleagues, society, and the common good. A mixture of student and professor led discussion and case studies will be used to gain understanding of the key ethical challenges faced in the biotechnology community.

BMS 5303  Cellular and Molecular Physiology (3)
This course is an in-depth examination of the physiology of the cell. We will focus on the cell membrane, cell signaling, cytoskeletal dynamics and cell cycle regulation. Special attention will be given to how mammalian cell function relates to mammalian cell structure and to how cells interact to make a complex functioning multicellular organism.

BMS 5313  Advanced Cancer Biology (3)
This course will build on previously mastered concepts in cancer biology, using the primary literature to focus on current research topics in cancer biology, including oncogenes, tumor suppressors, genomic instability, genomic profiling, tumor microenvironment, invasion, metastasis, angiogenesis, and miRNA regulation of cancer genes. Call discussions will center on the critical evaluation of the primary literature.

BMS 5323  Advanced Immunology (3)
This course focuses on the molecular basis of immunity and the major components of the immune system. The interaction of the components as they relate to the protection from disease and the development of the specific autoimmune conditions will be the major topics covered within this course. Students will also develop practical skills in data interpretation, communication as well as interpersonal and team-working skills.

BMS 5413  Microbial Pathogenesis (3)
This course will focus on specific bacterial and viral human pathogens and the molecular mechanisms used to induce disease. This course will provide current information on selected topics in microbial pathogenesis, including molecular mechanisms and emergent technologies.

BMS 5423  Neurobiology (3)
This course discusses the principles that govern neural activity. Focus is on the development of the nervous system, the interactions between neurons through neurotransmitters, electrical properties of neurons, neural receptors, synaptic transmission and sensory transduction. Additionally students will discover how the anatomy of the central nervous system dictates function and how the molecular biology of the neuron results in specified behavior, memory and sensory function.

BMS 5433  Stem Cell Biology (3)
The course will provide students with knowledge of wide-ranging topics related to stem cell and regenerative biology, including: a brief history of the field, research on animal models of regeneration, tissue engineering and the promise of disease cures. As a part of the learning objectives of this course, students will be able to list the properties that define a stem cell; explain how stem cells are derived for scientific research; compare and contrast tissue-specific stem cell types and the mechanisms that regulate them; list the common and extrapolate the potential clinical use(s) of stem cells; discuss emerging regenerative research finding and how they relate to stem cell biology.

BMS 5453  Developmental Genetics (3)
How does an organism transform from a ball of undifferentiated cells to a complex patterned multicellular organism with specific tissues for specific functions? This course will examine the genetic signals and
responses involved in patterning and formation of an organism. We will focus on the general principles and specific mechanisms of development. We will further discuss the advantages and limitation of the genetic model organisms commonly used to study development. Lastly, students will gain experience in critical reading and interpretation of primary research articles.

BMS 5463  Clinical Research (3)
This is a course on the general principles underlying clinical research design. Topics covered in this course include: formulation of research objectives, and hypothesis, methods of analysis, “blinding”, and clinical epidemiology including disease etiology, causation, diagnostic testing, and evaluation of treatment efficacies. The content is designed to allow students to classify studies in the medical literature as experimental or observational, prospective or retrospective, case-control, cross sectional, or cohort. Additionally students will understand the relative limitations and advantages of each type and will be introduced to the ethical issues related specifically to clinical research.

BMS 5xn3  Topics in Biomolecular Science (3)
This course may be either lecture or laboratory based depending upon the topic selected; and is designed to represent and in-depth approach to a specific area of biomolecular science of interest to the student. Examples may include: apoptosis, angiogenesis, viral pathogenesis, etc.

BMS 5503  Capstone Research (3)
This course will serve as the culmination of the M.S. in Biomolecular Science program, as students will apply the laboratory techniques and analytical skills that they have acquired to a specific research question. This course will be an independent study supervised by a selected graduate faculty mentor. The student will choose an area of ongoing research, formulate a novel hypothesis, propose a series of experiments to test the hypothesis, and perform experiments towards that goal.

BMS 5500  Capstone Continuation (3)
This course is a continuation of capstone research. It is utilized by students who do not complete their laboratory research project in a single semester. A lab fee will be assessed to students in this course to cover the ongoing expense of their laboratory research.

Biomolecular Science Core Faculty
The graduate faculty in the Biomolecular Science represents the areas of immunology, genetics, cancer biology, and the biomedical sciences.

Beth Conway, B.S. (Abilene Christian University), Ph.D. (University of Connecticut Health Science Center), Associate Professor of Biology

Kevin Heath, B.S. (Lipscomb University), M.D. (Tulane University School of Medicine), Assistant Professor of Biology

Jon Lowrance, B.S. (Lipscomb University), M.S. (Middle Tennessee State University), Ph.D. (University of Tennessee Health Science Center), Post-Doctoral Fellowship (University of Missouri School of Medicine), Professor of Biology

Florah Mhlanga, B.S. (University of Zimbabwe), M.S. and Ph.D. (Michigan State University), Professor of Biology

Bonny Millimaki, B.S. (Middle Tennessee State University), Ph.D. (Texas A&M University), Assistant Professor of Biology

Mary Sledge, B.S., Ph.D. (University of Georgia), Professor of Biology

Amanda Williams, B.S. (Lipscomb University), M.S. (Vanderbilt University School of Medicine), A.B.D. (Meharry Medical College), Instructor of Biology and Research Coordinator