

BIOCHEMISTRY AND MOLECULAR GENETICS (PHD)

Doctor of Philosophy in Biochemistry and Molecular Genetics

Unit: School of Medicine (<https://medicine.louisville.edu/>) (GM)

Department: Biochemistry and Molecular Genetics (<https://medicine.louisville.edu/academics-programs/academic-departments/biochemistry-molecular-genetics>)

Academic Plan Code(s): BIOCPHD, BIOCPHDBI

Program Information

As educators and scientists, the faculty of the Department of Biochemistry and Molecular Genetics subscribe to the following missions:

- Provide up-to-date and high-quality classroom and laboratory instruction in the disciplines of biochemistry, molecular biology, and genetics to students at the university.
- Conduct and publish research or other scholarship in areas that advance knowledge of a discipline, and contribute to improving the human condition.
- Train pre- and post-doctoral individuals in biomedical research.

Admission Requirements

All applications must be submitted using the online graduate application (<https://graduate.louisville.edu/admission/apply>).

Doctoral students are admitted for Fall term only. Be sure to select Fall term for start date and Biochemistry and Molecular Genetics for the program. Rolling admission is used for the PhD program. Review of applications begins in December of each year. Applications are reviewed continuously through March.

Criteria and Mechanism for Selection

Criteria

The Biochemistry and Molecular Genetics department uses a holistic approach for reviewing applications and selecting candidates for interview. The applicant's academic record, research experience, and letters of recommendation are closely evaluated. Competitive candidates have a strong background in biochemistry, chemistry, or biology with evidence of rigorous coursework. In addition, a one-to-two-page personal statement describing past educational, laboratory and relevant life experiences, as well as a brief description of professional goals after the degree program, is required.

Competitive applicants have:

- A minimum undergraduate (and graduate) overall grade point average of 3.0 (4.0 system) with an average of 3.0 in science courses.
- Previous research experience
- Strong letters of recommendation

Selection

The Biochemistry and Molecular Genetics Department's Graduate Executive Committee (GEC) reviews and considers applications from December through March. Top candidates will be interviewed online or in person. Select candidates will be invited to a recruitment weekend in February to visit the department and meet faculty and students.

Select candidates are nominated for Integrated Programs in Biomedical Sciences (IPIBS). Fellowship awards for qualified applicants (<https://medicine.louisville.edu/academics-programs/doctoral-programs/phd-program-academics-programs/ipibs>). The department will notify applicants by email of their decision. All applicants who are accepted into the program must respond with their decision no later than April 15. In the absence of a response, after April 15 the position in the program and financial support is no longer guaranteed and may be offered to another applicant. The Biochemistry and Molecular Genetics Department accepts four to six students per year into the PhD program.

Requirements for the PhD Degree in Biochemistry and Molecular Genetics

During PhD training students receive considerable guidance from their mentor, committee, and faculty members of the department. However, students need to recognize that individuals who pursue a biomedical graduate degree are expected to take full responsibility for their own scientific and professional development and to seek out and utilize all available resources for that goal.

Annual progress reports to document that a student is in good standing within the Biochemistry and Molecular Genetics department graduate program are required. The criteria for good standing in the graduate program are based on successful completion of milestones that indicate progression towards a degree. These milestones are the successful completion of:

1. All coursework with a minimum GPA of 3.0.
2. A minimum of two laboratory rotations.
3. Two seminar presentations.
4. Annual progress reports that indicate satisfactory progress.
5. PhD qualifying exam (QE).
6. Approved dissertation research proposal and committee meeting.
7. Annual research conferences with committee meetings in years three and beyond.

To fulfill all requirements for the PhD degree a student must

1. Complete a body of novel research (dissertation).
2. Publish, at minimum, one first author manuscript.
3. Write and defend a doctoral dissertation that is acceptable by the dissertation committee and Graduate School.

Student Support

An IPIBS Fellowship will provide stipend support for the first 23 months. Support after the first 23 months is the responsibility of the individual student's dissertation advisor. Students are also encouraged to seek extramural support.

Guidance for the Student

The Director of the Biochemistry and Molecular Genetics Graduate Program will serve as the first year advisor to all incoming graduate students until a dissertation advisor (mentor) is selected. During the first year, all students will meet with all available faculty to discuss potential research projects and complete a minimum of two laboratory rotations to help select a lab and mentor. After completion of lab rotations and before beginning a second year, the student will select a mentor, subject to the approval of the Graduate Executive Committee and the department chair.

PhD Qualifying Exam

The PhD academic program must be completed by the end of year two.

Upon successful completion of all coursework, a student becomes eligible to take the PhD Qualifying Exam (QE). The purpose of the QE is to evaluate the student's ability to interpret literature, develop a research plan, integrate material from the graduate curriculum, display core knowledge of biochemical principles, and orally defend his/her ideas.

The format of the QE requires the student to write and orally defend a NIH-style fellowship proposal, followed by an oral exam covering general biochemical/genetic principles covered in the curriculum. Upon successful completion of the QE, a student becomes a doctoral candidate and may also be eligible to earn an MS degree. An initial committee meeting should be held during the second year to provide guidance on the student's research. A full research proposal must be completed and approved by the committee before the end of the Spring term of the student's year three.

Curriculum

Year 1	Hours
Fall	
Required Courses	
BIOC 613 Biochemistry Laboratory	4
BIOC 645 Nutritional Biochemistry	4
BIOC 646 Nucleic acids and information metabolism	1
BIOC 648 Journal Club in Biochemistry and Molecular Genetics	1
BIOC 649 Protein Function: from interactions to enzyme control	1
Hours	11
Spring	
Required Courses ¹	
BIOC 630 Responsible Conduct of Research: Survival Skills and Research Ethics	1
BIOC 648 Journal Club in Biochemistry and Molecular Genetics	1
BIOC 667 Cell Biology	3
BIOC 668 Molecular Biology	4
Electives	0-3
BIOC 613 Biochemistry Laboratory	2-4
BIOC 619 Research	1-9
ENGL 677 Graduate Writing in the Disciplines	3
Hours	15-28
Summer	
Required Courses	
BIOC 619 Research	6
Hours	6
Year 2	
Fall	
Required Courses ¹	
BIOC 606 Biochemistry Seminar	1
BIOC 619 Research	1
BIOC 648 Journal Club in Biochemistry and Molecular Genetics	1
BIOC 670 Biomedical Genetics and Genomics	3
ASNB 622 Analytics in Biomedical Science	3
Electives	
BIOC 676 Molecular Evolution and Phylogenetics	3
BIOC 663 High-Throughput Sequencing Data Analysis	
BIOC 670 Biomedical Genetics and Genomics (for 2 additional credits)	
Hours	12
Spring	
Required Courses ¹	
BIOC 619 Research	2-3
BIOC 620 Scientific Method and Grant Writing	2
BIOC 648 Journal Club in Biochemistry and Molecular Genetics	1

Electives		
BIOC 661	Molecular Mechanisms of Toxicology	3
BIOC 675	Cancer Biology	4
BIOC 671	Scientific Programming in Perl, Python, and R	3
ENGL 677	Graduate Writing in the Disciplines	3
Hours		18-19
Summer		
Required Courses		
MAST 600	Master's Degree Candidacy	0 or 6
or BIOC 619	or Research	
Hours		0-6
Years 3-5		
Required Courses ¹		
DOCT 600	Doctoral Candidacy	
Hours		0
Minimum Total Hours		62-82

¹ Students seeking only the PhD must complete 42 minimum total hours to earn the degree. Students in the MD-PhD program typically complete 24 minimum total hours to earn the degree.

Bioinformatics Specialization

Year 1	Hours
Fall	
Required Courses	
BIOC 613 Biochemistry Laboratory	4
BIOC 645 Nutritional Biochemistry	4
BIOC 648 Journal Club in Biochemistry and Molecular Genetics	1
BIOC 663 High-Throughput Sequencing Data Analysis	3
Hours	12
Spring	
Required Courses ¹	
BIOC 613 Biochemistry Laboratory	2-4
BIOC 630 Responsible Conduct of Research: Survival Skills and Research Ethics	1
BIOC 648 Journal Club in Biochemistry and Molecular Genetics	1
BIOC 667 Cell Biology	3
BIOC 668 Molecular Biology	4
BIOC 671 Scientific Programming in Perl, Python, and R	3
Electives	0-3
Hours	14-19
Summer	
Required Courses	
BIOC 619 Research	6
BIOC 674 Algorithms in Bioinformatics	3
Hours	9
Year 2	
Fall	
Required Courses ¹	
BIOC 606 Biochemistry Seminar	1
BIOC 619 Research	1
BIOC 648 Journal Club in Biochemistry and Molecular Genetics	1
BIOC 670 Biomedical Genetics and Genomics	3
ASNB 622 Analytics in Biomedical Science	3
Electives	
BIOC 676 Molecular Evolution and Phylogenetics	3
BIOC 663 High-Throughput Sequencing Data Analysis	3
BIOC 670 Biomedical Genetics and Genomics (for 2 additional credits)	
Hours	15
Spring	
Required Courses ¹	

BIOC 620	Scientific Method and Grant Writing	2
BIOC 648	Journal Club in Biochemistry and Molecular Genetics	1
BIOC 619	Research	2-3
Electives		
BIOC 661	Molecular Mechanisms of Toxicology	3
BE 540	Machine Learning in Medicine	3
BIOC 675	Cancer Biology	4
ENGL 677	Graduate Writing in the Disciplines	3
Hours		18-19
Summer		
Required Courses		
MAST 600 or BIOC 619	Master's Degree Candidacy or Research	0 or 6
Hours		0-6
Years 3-5		
Required Courses¹		
DOCT 600	Doctoral Candidacy	
Hours		0
Minimum Total Hours		68-80

Doctor of Medicine (MD) (<https://catalog.louisville.edu/professional/medical-bulletin/courses-programs/>) and Doctor of Philosophy (PhD) in Biochemistry and Molecular Genetics (<https://catalog.louisville.edu/graduate/programs-study/doctor-philosophy-biochemistry-molecular-biology/>)

Unit(s): School of Medicine (<http://louisville.edu/medicine>)

Program Webpage (<https://medicine.louisville.edu/academics-programs/dual-degree-programs>)

Academic Plan Code(s): MED_MD and BIOCPHD

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Program Overview

The MD#PhD in Biochemistry and Molecular Genetics prepares physician#scientists to investigate the molecular mechanisms that shape human health and disease. The program integrates

pre#clinical medical study, advanced research training in biochemistry and molecular genetics, dissertation work, and clinical rotations. Students gain experience in laboratory investigation and patient care, supported by close faculty mentoring and access to extensive research and clinical resources. This dual#degree option benefits students interested in careers that combine medical practice with molecular and genetic research, academic medicine, or innovation in biotechnology, pharmaceuticals, and other research settings. Students receive full tuition remission, a competitive stipend, and health insurance during the graduate research phase. For more information on program benefits and examples of student research and publications, visit the MD#PhD Program website (<https://medicine.louisville.edu/md-phd-program>).

Admission

Applicants must meet the School of Medicine admission requirements (<https://catalog.louisville.edu/professional/medical-bulletin/admissions/>) and apply through the American Medical College Application Service (AMCAS) (<https://students-residents.aamc.org/applying-medical-school-amcas/apply-medical-school-amcas-program>), including submission of MCAT scores. Applicants indicate interest in the MD-PhD program within the AMCAS application. Selected applicants interview with both the School of Medicine Admissions Committee and the MD-PhD Program Committee. Research experience and interest in a physician#scientist career are important considerations.

Current UofL medical students may apply after completing the second year of medical school by contacting the MD-PhD Program Director (<https://catalog.louisville.edu/graduate/programs-study/doctor-philosophy-biochemistry-molecular-biology/#contact>).

Dual Degree Requirements

The MD#PhD in Biochemistry and Molecular Genetics dual degree is delivered through an integrated curriculum that allows students to complete requirements for both degrees in fewer total credit hours than would be required if the degrees were completed separately. This structure is made possible by allowing selected courses and training components from the MD curriculum to satisfy requirements for the PhD in Biochemistry and Molecular Genetics when they meet the same learning outcomes. In this format, the dual degree may be completed in approximately seven (7) to eight (8) years with a minimum of 193.5 total credit hours. Students must also complete all remaining degree requirements for both the MD (<https://catalog.louisville.edu/professional/medical-bulletin/md-requirements/>) and the PhD in Biochemistry and Molecular Genetics (<https://catalog.louisville.edu/graduate/programs-study/doctor-philosophy-biochemistry-molecular-biology/#degreerequirementstext>), except where those requirements are modified by the approved dual degree structure. Students should consult with the MD#PhD Program Co#Directors (<https://catalog.louisville.edu/graduate/programs-study/doctor-philosophy-biochemistry-molecular-biology/#contact>) to develop an individual plan of study.

Minimum Credit Hours and Milestone Requirements

The table below summarizes the minimum credit hours and milestones typically required for the dual degree.

Code	Title	Hours
Dual Degree Requirements		
<i>MD Requirements</i>		169.5
United States Medical Licensing Examination (USMLE) Step 1		Passed
<i>PhD Requirements</i> ¹		
BIOC 648	Journal Club in Biochemistry and Molecular Genetics	2
BIOC 619	Research ²	14-15
BIOC 630	Responsible Conduct of Research: Survival Skills and Research Ethics	1
BIOC 606	Biochemistry Seminar	1
BIOC 620	Scientific Method and Grant Writing	2
Upper-Level BIOC Elective ²		3-4
PhD Dissertation Research Proposal		Successfully Defended
DOCT 600	Doctoral Candidacy	0
PhD Dissertation		Successfully Defended
Minimum Total Hours		193.5

¹ A passing score on the USMLE Step 1 examination substitutes for the PhD qualifying exam requirement, as the exam demonstrates competency in foundational biomedical sciences comparable to the program's qualifying assessment. In addition, the learning outcomes of Clinical Anatomy, Development, Examination and Neurosciences (IDEP 811) and Molecular Basis of Life, Defense, and Disease (IDEP 812) align with the learning competencies embedded in many required and elective courses in the PhD curriculum. Completion of these courses therefore fulfills a substantial portion of the core course requirements for the PhD in Biochemistry and Molecular Genetics.

² Students must complete at least three (3) credit hours in upper-level BIOC electives (<https://catalog.louisville.edu/graduate/courses/bioc/>). To remain enrolled in the required nine (9) credit hours for full-time status during the fall and spring semesters, students may complete one (1) additional credit hour of BIOC 619 Research if the upper-level BIOC electives (<https://catalog.louisville.edu/graduate/courses/bioc/>) selected carry only three (3) credit hours instead of four (4).

Program of Study

The table below outlines the **typical** sequence of coursework, research, and clinical training required for the MD-PhD dual degree, including important program milestones. Students should consult with the MD/PhD Program Co-Directors (<https://catalog.louisville.edu/graduate/programs-study/doctor-philosophy-biochemistry-molecular-biology/#contact>) to develop an individual plan of study.

Code	Title	Hours
Prior to Year 1		
<i>Summer</i>		
Summer Biomedical Research ¹		

Year 1		
<i>Fall - Spring</i>		
Medical School Year One Curriculum ²		44
<i>Summer</i>		
Summer Biomedical Research ¹		
Year 2		
<i>Fall - Spring</i>		
Medical School Year Two Curriculum ²		40
<i>Summer</i>		
United States Medical Licensing Examination (USMLE) Step 1		Passed
Year 3		
<i>Fall</i>		
BIOC 648	Journal Club in Biochemistry and Molecular Genetics	1
BIOC 619	Research	4
Upper-Level BIOC Elective ³		4
<i>Spring</i>		
BIOC 630	Responsible Conduct of Research: Survival Skills and Research Ethics	1
BIOC 648	Journal Club in Biochemistry and Molecular Genetics	1
BIOC 606	Biochemistry Seminar	1
BIOC 620	Scientific Method and Grant Writing	2
BIOC 619	Research	4
<i>Summer</i>		
BIOC 619	Research	6
PhD Dissertation Research Proposal		Successfully Defended
Years 4 - 5/6		
DOCT 600	Doctoral Candidacy ⁴	0
PhD Dissertation		Successfully Defended
Year 6/7		
Medical School Year Three Curriculum - Core Clerkships ²		55
Year 7/8		
Medical School Year Four Curriculum - Clinical Rotations ²		30.5
Residency Interviews		Completed
Minimum Total Hours		193.5

¹ Dual degree students are encouraged to participate in the Summer Undergraduate Research Program before the first year of medical school and in the Summer Research Scholar Program between the first and second years. These experiences are not required but are strongly recommended to help prepare students for biomedical research. More information is available on the School of Medicine Research Programs website (<https://medicine.louisville.edu/research/research-programs>).

² Find detailed information about the medical school curriculum in the School of Medicine Bulletin (<https://catalog.louisville.edu/professional/medical-bulletin/md-requirements/>).

³ Students must complete at least three (3) credit hours in upper-level BIOC electives (<https://catalog.louisville.edu/graduate/courses/bioc/>). To remain enrolled in the required nine (9) credit hours for full-time status during the fall and spring semesters, students may complete one (1) additional credit hour of BIOC 619 Research if the upper-level BIOC electives (<https://catalog.louisville.edu/graduate/>)

courses/bioc/) selected carry only three (3) credit hours instead of four (4).

- ⁴ Students must remain enrolled in Doctoral Candidacy (DOCT 600) until they successfully defend their dissertation. This stage typically takes two (2) to three (3) years, depending on the scope of the student's research study.

Contact

MD-PhD Program Co#Directors:

- Dr. Maxwell Boakye, MD, MBA, FACS, FAANS – (502) 407#3276
- Dr. Kenneth Palmer, PhD – (502) 852-1339
- Email: mdphd@louisville.edu

Department of Biochemistry and Molecular Genetics Director of Graduate Studies:

- Dr. Brian Clem, PhD – (502-852-8427)
- Email: brian.clem@louisville.edu