

PhD in Microbiology (MED)

Program Overview

The Molecular Pathogenesis and Therapeutic Graduate Program (MPT) was collaboratively designed by the Department of Molecular Microbiology & Immunology (MMI) and the Department of Veterinary Pathobiology (VPB). The MPT Program offers comprehensive graduate-level training leading to the Doctor of Philosophy (Ph.D.) degree. This program provides individualized training that is strongly oriented toward basic research in molecular and cellular biology, microbial pathogenesis, virology, immunology and host-parasite interactions. Graduates completing this training are prepared to pursue challenging and rewarding professional careers that involve research and teaching at supervisory levels in the academic, government and private sectors.

Graduate students entering into the program should be highly motivated toward a career in research in microbiology. They must have, as a minimum, a baccalaureate degree with an undergraduate record showing superior performance in introductory and advanced coursework in prerequisite subjects (biology, chemistry, physics, and mathematics). They must have taken the Graduate Record Examination and should have superior scores. Additionally, international applicants will require demonstration of English fluency via TOEFL scores. Letters of recommendation from individuals who are qualified to judge should clearly indicate aptitude for, and dedication to, a career in science.

The MMI and VPB Departments are central components of an eminent, interdisciplinary campus program in molecular biology and life sciences, which also involves molecular biologists in Biochemistry and Biological Sciences as well as many other University departments. Campus core facilities provide cell culture and immunology services, DNA sequence analysis, transcriptional analysis, protein structural analysis, transgenic animals, protein expression, proteomics, electron microscopy and molecular cytology.

Degree Requirements

The Doctor of Philosophy (Ph.D.) Degree

The program involves (i) a course of study which includes required and elective course work, (ii) participation in programmatic seminars and journal clubs, (iii) training in teaching through participation in laboratory courses for undergraduates, (iv) a comprehensive examination designed to evaluate a student's ability to propose and experimentally evaluate a significant scientific question, and (v) the successful completion of a creative and original scholarly research project.

On average, the graduate degree program will require four to six years of full-time effort, although this may vary depending on the ability and previous experience of the individual student. A Master of Science Degree is not a prerequisite for the Ph.D. degree.

All students in the program are supported by a stipend (currently \$30,000 per year) plus tuition costs and basic medical insurance.

Laboratory Rotations and Schedule

All new graduate students admitted into the MPT Graduate program are required to complete three laboratory rotations starting in the Fall semester and concluding in mid-January before the Spring semester begins. Students will meet with the Director of Graduate Studies prior to each rotation to determine the appropriate laboratory and rotation advisor. Laboratory rotations expose graduate students to

research activities within the Program and to the experimental laboratory environment in which they will evolve. Prior to finishing the third laboratory rotation the graduate student selects a mentor based on mutual agreement between the student and the mentor. Once the mentor has been selected, the student will perform his or her doctoral research under the guidance of the mentor in his/her laboratory.

The MPT Graduate Student Laboratory Rotation Program represents a vehicle to introduce the research laboratory to incoming students and to stimulate a direct interaction between students, faculty and other program personnel. The program is designed to expose students as quickly as possible to research activities within the Program and to the experimental laboratory environment in which they will evolve.

Laboratory rotations dates can be found in the MPT Graduate Student Handbook at:

<https://medicine.missouri.edu/departments/molecular-microbiology-immunology/graduate-program/graduate-requirements> (<https://medicine.missouri.edu/departments/molecular-microbiology-immunology/graduate-program/graduate-requirements/>)

Students who wish to enter the program early at the beginning of the summer semester preceding their first academic semester may do so, if financial resources are available.** However, this will be considered a "summer research experience" with one of the faculty members but not an official rotation. The student will still be required to perform three rotations with different faculty advisors, starting in the fall. The student would then be able to select one of those advisors including the "summer research experience" advisor as his or her doctoral advisor. Students engaging in the "summer research experience" will register for 4 credit hrs. of TR BIOSC 9085 Problems (Rotations) for the summer semester and will need to be on campus by the beginning of the MU summer semester (usually first Monday in June).

Required Courses for Graduate Students in Program

Required Courses taken Fall semester, 1st year		
BIOCHM 8240	Introduction to Graduate Biochemistry I	5
MICROB 8050	Graduate Student Survival Skills	1
TR BIOSC 9085	Rotations in Translational Bioscience	1-99
Choose two from the following Basic courses		
MICROB 8404	Foundations in Bacterial Pathogenesis	2
MICROB 8303	Fundamental Virology	2
MICROB 8304	Immunology	3
Choose three from the following (only one of these may be an approved elective)		
MICROB 9404	Advanced Bacterial Pathogenesis (only offered Spring semester of odd years)	4
MICROB 9407	Advanced Immunology (only offered Spring semester of even years)	4
MICROB 9449	Infection and Immunity (only offered Fall semester)	4
MICROB 9001	Topics in Microbiology (Take Advanced Virology, offered every other Spring semester of odd year)	4
Approved 8000/9000 current literature-based electives		
8000/9000-level electives: The DGS and the Curriculum Committee must approve these courses. They should also be approved by the student's doctoral committee. (Examples of courses still needing approval are given below):		
V_PBio 8436	Pathogenic Mechanisms in Veterinary Pathobiology	3
BIO_SC 8320	Developmental Genetics	3

BIO_SC 8440	Integrative Neuroscience I	3
BIO_SC 8442	Integrative Neuroscience II	3
MPP 9426	Transmembrane Signaling	4
MPP 9435	Molecular Exercise Biology	3
V_BIO 8641	Introduction to Research Ethics (every Spring semester)	1
MICROB 9087	Seminar in Microbiology (required to take this four times: 2nd-5th years, offered every Spring semester)	1
MICROB 9403	Advanced Medical Microbiology (credit for teaching)	2

Other duties

- Act as a teaching assistant (TA) in MICROB 2800 or MICROB 3200 for two semesters (to be completed during the first two years, but not during the Fall semester of the first year).
- Attend Program seminars (any invited speakers and student seminars) on Wednesdays at 1:15 pm usually in Monsanto Auditorium in the Bond LSC; attendance will be taken; enroll in MICROB 9087 Seminar in Microbiology for 1 credit hr. in the Spring semesters of years 2-5. **You will need to give a seminar during those years; course grade will be determined by attendance and your presentation.**

English-Language Proficiency Requirements for International Students

Any graduate student who completed primary and secondary education (equivalent of K-12 in the U.S.) in a country where English is not the primary language is required by the state of Missouri law to be assessed for English language proficiency. The Speaking Proficiency English Assessment Kit (SPEAK) test is conducted through the Graduate School. International graduate students must receive a level 2 or higher on their language assessment to meet the requirements to TA. If they receive a score below 2 additional courses may be recommended for the student to increase their language skills before their English language is reassessed.

ONITA training is offered during the week preceding the Fall and Spring semester. The training is required for all new international graduate students before the first semester of teaching or assisting with teaching at MU.

Credit Hour Requirements:

The Graduate School requires 72 hours of advanced study to be completed for the Ph.D. degree. A minimum of 15 hours of 8000-9000 level course work, not including TR_BIOSC 9085 Rotations in Translational Bioscience and MICROB 9090 Research in Microbiology. A maximum of four hours of MICROB 9087 Seminar in Microbiology can count toward this requirement.

Full-time Student Enrollment

Graduate student full-time enrollment statuses pre-comprehensive exam:

- 9 credit hours for fall and spring, 4 credit hours for summer.

Graduate student full-time enrollment statuses post-comprehensive exam:

- 2 credit hours for fall and spring, 1 credit hour for summer.

Dual Degree

A program leading to the combined Ph.D. /M.D. degrees can be designed for students who are admitted to the Medical School and to the MPT Graduate Program. It is anticipated that these students will fulfill their first two years of Medical School academic requirements before entering the MPT Graduate Program for the research-oriented Ph.D. degree. All coursework, TA responsibilities, rotations, comprehensive examination and research requirements are the same as for any other graduate student. Dual degree students will be encouraged to complete research rotations during the summer semesters of their two years of medical curriculum so that a dissertation research project can be initiated immediately upon entering the Ph.D. program. Typically, clinical requirements for the M.D. will be completed after fulfillment of the requirements for the Ph.D.

Requirements for Qualifying and Comprehensive Exam

Each student will be required to master two phases of the curriculum, qualifying and advanced, designed to achieve the educational objectives described above. The MPT Graduate Program Curriculum Committee makes decisions regarding additions or changes to the basic curriculum. Due to the changing environment in this field of research, the MPT Graduate Program curriculum may be subject to change.

Qualifying Phase

A required basic series of courses are designed to establish a foundation in bacteriology and pathogenesis (MICROB 8404), virology (MICROB 8303), and immunology (MICROB 8304).

Advanced Phase

It is expected that combinations of advanced courses in molecular biology of eukaryotes (MICROB 9432), immunology (MICROB 9407), virology (MICROB 9001), infection and immunity (MICROB 9449), and bacterial pathogenesis (MICROB 9404) will comprise the core curriculum, although alternative courses may be prescribed by the MPT Curriculum Committee and by Doctoral committees based upon individual student needs. Satisfactory performance is defined as a grade of B or above in these 8000/9000 level courses. Unsatisfactory performance(s) must be corrected according to the recommendations of the Graduate Student Advisory Committee. Such recommendations may include retaking the course(s), additional examinations, or dismissal from the Graduate Program.

Goals and Purpose of Qualifying and Comprehensive Exams

Qualifying Exam

The goal of this exam is to determine whether the student is qualified to enroll in advanced graduate courses as well as intellectually prepared to perform research in this program. Passage of all three fundamental courses will constitute passage of the qualifying exam. The guidelines for this process are covered in greater detail in Section VI of our MPT Graduate Student Handbook (<https://medicine.missouri.edu/departments/molecular-microbiology-immunology/graduate-program/graduate-requirements/>).

Comprehension Exam

The purpose of the comprehensive exam is to certify that the student has sufficient scientific knowledge (from the course work) and research

insight to advance to candidacy for the Ph.D. This knowledge and insight are examined in this program through the student writing and orally defending an NIH-style research grant proposal. This examination will be administered at the end of the fall semester of the third year. The guidelines for this process are covered in greater detail in Section VII of the MPT Graduate Student Handbook (<https://medicine.missouri.edu/departments/molecular-microbiology-immunology/graduate-program/graduate-requirements/>).

PhD Dissertation Guidelines

The final educational requirement for the Ph.D. degree is the written and oral presentation of a novel and creative piece of scholarly research that represents new information and significantly advances knowledge in that field of research. The dissertation project must be approved by the student's doctoral committee and should demonstrate the student's scientific maturity and ability to write in a scholarly fashion. At the completion of the dissertation research, the student will present his/her research findings in a public seminar for program faculty and personnel and will defend the project before his/her doctoral committee. The project will be detailed in a formal written thesis that conforms to Graduate School guidelines with respect to format. Approval of the scientific content of the thesis is the responsibility of each doctoral committee and requires the signature of each committee member, with no more than one dissenting or abstaining vote. The evaluation will consider the following guidelines with respect to thesis content.

a. **Introduction** – The manuscript should describe pertinent background material that establishes the foundation for the overall thesis proposed as well as the specific research questions being addressed and the significance of this project with respect to the field.

b. **Materials and Methods** – The thesis should describe in detail the experimental protocols used in the study; where applicable, references to published protocols should be made, but modifications to such procedures should be defined. The methods may be presented as a component of each Results chapter, or may be combined into a single, separate chapter.

c. **Results** – Presentation of the data accumulated during the study that is relevant to the thesis being examined and the conclusions reached. The data should be presented in chapter format, with each chapter devoted to particular questions relative to the overall thesis. Since students are encouraged to publish their work during their graduate studies, these chapters may represent those publications (however, the student must be responsible for the writing and presentation of this work in the thesis).

d. **Discussion** – While each chapter presenting research data may contain a discussion of those specific data, the thesis should be concluded with a summary discussion that presents the student's overall conclusions about the study and the relevance of this work to the field as a whole. This summary provides the student an opportunity for knowledgeable speculation as to the significance of the work and its impact on the field.

Program of Study

The program involves satisfactory completion of a minimum of 72 hours of graduate study as well as completion of original research and a thesis, which demonstrates research competence. Of the 72 hours graduate credit, 15 hours must be in courses numbered 8000/9000 (excluding

research and problems courses, but including up to 4 credit hours of seminar courses).

More information at the MPT Graduate Student Handbook (<https://medicine.missouri.edu/departments/molecular-microbiology-immunology/graduate-program/graduate-requirements/>).

Research and Teaching Assistantships

Students in the doctoral program are awarded Graduate Research Assistantships, (currently at \$30,000). Graduate Research Assistants work with faculty members to obtain practical experience in carrying out a research project through the collection of research data and writing research reports. All students in the graduate program are required to participate as teaching assistants for two semesters during their graduate studies.

Degree Completion Requirements

To be accepted for candidacy into the MPT PhD program, all applicants must perform satisfactorily in a core curriculum that includes advanced-level courses in the sub disciplines of immunology, molecular biology and microbial pathogenesis. Under the guidance of a doctoral program committee, a course of study is individually designed to fit each student's academic background, experience and objectives. Interdisciplinary courses in biochemistry, molecular and cellular biology and genetics provide breadth and balance in the program and enhance the student's research abilities. In addition, the PhD program consists of the following:

- Practical experience in teaching
- Successful completion of a comprehensive examination that tests the student's ability to develop an original scientific hypothesis and devise a feasible research plan that will test the hypothesis.
- A demonstration of research and writing ability by completing a scholarly dissertation on an approved research problem that results in the contribution of significant new knowledge. The final examination primarily covers this dissertation research.

Admissions

The Molecular Pathogenesis and Therapeutics Graduate Program (MPT) is offered through the Departments of Microbiology and Immunology in the School of Medicine and Veterinary Pathobiology in the College of Veterinary Medicine. This graduate training program is designed to prepare students for an advanced professional career in microbiology and immunology. Emphasis is placed on developing outstanding students for productive supervisory roles in universities and colleges, industry, government and research institutes. Enrollment is limited to those students who show evidence of potential for research.

Application Deadline

Fall deadline: December 5

Admission Criteria

- Minimum English scores

Item	Score
Academic International English Language Testing System (IELTS)	6.5 (6.5 Graduate School requirement)
Internet-Based test (IBT)	92 (80 Graduate School requirement)
PTE	62 (59 Graduate School requirement)

Cambridge - C1 Advanced	185 (180 Graduate School requirement)
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- Minimum GRE scores

When did you take the GRE?	Verbal + Quantitative	Analytical
No more than 5 years old.	300	3.0

- Minimum GPA: 3.0
- Bachelor's degree from an accredited college or university
- Courses in the following: biology; advanced courses in biochemistry and/or molecular biology are highly desirable; chemistry (quantitative or organic); physics; mathematics

The PhD degree is offered only to students who demonstrate a high level of specialized knowledge and clear evidence of research potential.

Required Application Materials

To the Graduate School:

- All required Graduate School (<https://gradschool.missouri.edu/admissions/>) documents
- TOEFL score (if international applicant)
- 3 letters of recommendation from individuals competent to comment on the applicant's potential for graduate research and course
- GRE scores are required by our program
- Personal statement and research experience
- CV

University of Missouri Graduate School Application:

Applications should be submitted through the University of Missouri, Graduate School (<https://gradschool.missouri.edu/admissions/>). Applicants will not be registered with the University of Missouri, Graduate School until they have completed the graduate school application and paid the graduate school application fee.

Applicants who are in the United States and reviewed favorably by the Graduate Admissions Committee will be invited to visit the University of Missouri for an interview for which the program defrays expenses. This visit provides an excellent opportunity for the prospective student to meet the faculty members, talk and interact with our current students, view the University of Missouri-Columbia and the Molecular Pathogenesis and Therapeutics Graduate Program, and experience Columbia, Missouri.

All application materials are filed alphabetically under the family name as indicated by the applicant on the International Student Application form. It is important that all supporting documents use the same name and spelling as the International Student Application so they can be quickly matched up to complete the application file.

Upon acceptance by the Molecular Pathogenesis and Therapeutics Graduate Program, the applicant should then convey his/ her decision to Accept or Decline by April 15th - deadline set by the Council of Graduate Schools, which MU is a member. Once the applicant has declared his decision to the MPT Program, and start date they are posted in the MU application system for the MU Graduate School final review of transcripts and English requirements. The Graduate School will notify the applicant and program of any deficiencies in the application and will let the applicant know that final transcripts will be needed.

Contact Information:

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