

PH.D IN BIOMEDICAL SCIENCE - MOLECULAR MEDICINE

The Molecular Medicine (MOME) track (formerly Cardiovascular and Metabolic Diseases) track in the Biomedical Sciences Graduate program at The University of Toledo College of Medicine & Life Sciences on the Health Science Campus nurtures students and provides them with the necessary tools to pursue an independent career in biomedical sciences. The program encompasses a unique interdisciplinary approach to train students to conduct research in the underlying molecular mechanisms of diseases that have profound impact on human health.

The program draws on faculty research strengths in signal transduction, genetics, molecular and cellular biology, gene microarrays, genomics, proteomics, gene knockout and transgenics, tissue culture, and protein and carbohydrate biochemistry. The MOME faculty members are not only drawn from its associated department, the Department of Physiology and Pharmacology, and from the Center for Diabetes and Endocrine Research (CeDER), but also from other departments including the Departments of Medicine and Orthopedic Surgery. Modern, well-equipped research facilities are available through the participating departments. The MOME program offers degrees of Doctor of Philosophy (PhD) and Masters in Biomedical Sciences (MSBS). The program also offers these graduate degrees in combination with the Medical Degree (MD) that is offered by the medical school. Students from the four programs, PhD, MSBS, MD/PhD and MD/MSBS, follow a well-defined program that includes core courses, journal clubs, seminars, laboratory rotations, independent research, and electives in the area of interest. Students select faculty advisors and begin their independent dissertation research following the laboratory rotations in the biomedical science core curriculum. The curriculum is designed to enable students, guided by their advisors, to develop the expertise that prepares them for a successful career in research and education.

To be admitted to the Ph.D. or Master of Science in Biomedical Sciences (MSBS) Program, applicants must hold an earned baccalaureate (or equivalent) from an accredited college or university and have a minimum overall GPA of 3.0 on a 4.0 scale. Typically, applicants will have an undergraduate major in Biology or a related discipline. For international applicants, an appropriate test of English language proficiency is required. Scores from The Test of English as a Foreign Language (TOEFL) are accepted and a minimum iBT score of 84, or pBT score of 550 is required. Scores from The International English Language Testing Service (IELTS) are also accepted and a minimum score of 6.5 is required. A prior Masters degree is not required to enter the PhD program. At this time, all students accepted without provisions into the PhD in Biomedical Science Program, and maintaining good academic standing, will receive a full tuition scholarship and a research stipend funded in whole or in part by the College of Graduate Studies and funding from a student's advisor through a grant(s). There are also a limited number of tuition scholarships and stipends available for students in the Masters in Biomedical Sciences programs.

Code	Title	Hours
BMSP 6330	Current Problems and Research Approaches in Proteins	2
BMSP 6340	Curr Prob Res App Genes/Genom	2

BMSP 6360	Current Problems and Research Approaches in Cell Membranes	2
BMSP 6380	Methods in Biomedical Sciences	2
BMSP 6390	Mentored Research	1
BMSP 6470	System Pathophysiology	4
BMSP 6350	Cell Biology & Signaling	3
BMSP 5320	Statistical Methods I	3
INDI 6020	On Being a Scientist	1
MOME 6300	Seminars in Molecular Medicine	1
MOME 6500	Advanced Topics in Molecular Medicine	3
MOME 6600	Journal Paper Review in Molecular Medicine	1
MOME 8730	Research in Molecular Medicine	6
MOME 8500	Advanced Topics in Molecular Medicine	3
MOME 8300	Seminar in Molecular Medicine	1
MOME 8890	Independent Study in Molecular Medicine	4
MOME 9990	Dissertation Research in Molecular Medicine	30
BMSP 8250	Grant Writing Workshop	3
ELectives		18
Total Hours		90

The minimum number of credits required for PhD is 90, with a minimum of 20 credits of didactic coursework (letter grade), and a minimum of 30 credits of dissertation research. The rest of the credits are approved electives and research in the Molecular Medicine track.

Code	Title	Hours
FIRST TERM		
	Introduction to Biomedical Research ¹	0
Current Problems and Research Approaches (CPRA) in:		
BMSP 6330	Current Problems and Research Approaches in Proteins	2
BMSP 6340	Curr Prob Res App Genes/Genom	2
BMSP 6360	Current Problems and Research Approaches in Cell Membranes	2
BMSP 6380	Methods in Biomedical Sciences	2
BMSP 6390	Mentored Research (two five week rotations)	1

Code	Title	Hours
SECOND TERM		
BMSP 6350	Cell Biology & Signaling	3
BMSP 6470	System Pathophysiology	4
BMSP 6390	Mentored Research (one 5 week lab rotation)	1
MOME 6600	Journal Paper Review in Molecular Medicine	1

Code	Title	Hours
THIRD TERM		
		6 credits
BMSP 5320	Statistical Methods I (Required BMS core course)	3
INDI 6020	On Being a Scientist	1
MOME 8730	Research in Molecular Medicine	2

¹ Required

MOME PhD Program Students: Year 2 and beyond required courses:

Code	Title	Hours
MOME 6300	Seminars in Molecular Medicine ¹	1
MOME 6500	Advanced Topics in Molecular Medicine ²	3
MOME 6600	Journal Paper Review in Molecular Medicine ³	1
BMSP 8250	Grant Writing Workshop ⁴	3

¹ Required in fall and spring semesters of the 2nd, 3rd and 4th years.

² Required in fall of 2nd year

³ Required in fall and spring of 2nd and 3rd years

⁴ Required in spring of 2nd year

Curriculum to include advanced electives in Molecular Medicine or other areas to make up the required number of didactic credit hours. Students will also be expected to present a poster or oral presentation in the annual COMLS Graduate Research Forum in the spring of each year and the Pharmacology Research Colloquium. The Pharmacology Research Colloquium is held on a rotating basis at UTHSC, Michigan State University, the University of Michigan and Wayne State University. It is an annual event in which the students of "pharmacology" departments at the respective Medical Schools have participated in since 1973. These events provide students with excellent opportunities for developing skills in organizing, presenting and discussing their work.

PhD Program Students: Year 2

Code	Title	Hours
FOURTH TERM		9
MOME 8500	Advanced Topics in Molecular Medicine	3
MOME 6300	Seminars in Molecular Medicine	1
MOME 6600	Journal Paper Review in Molecular Medicine	1
MOME 8730	Research in Molecular Medicine (or Electives)	4
	or MOME 8890 Independent Study in Molecular Medicine	

The PhD Qualifying Exam is taken at the end of the Fall semester of the second year. Prior to passing the PhD Qualifying Exam, the student carries out their research under the course Research in Molecular Medicine (MOME 6730, 1-9 credit hours) or in some cases Independent Study in Molecular Medicine (MOME 6890). After passing the PhD Qualifying Exam, the student carries out their research under the course Dissertation Research (MOME 9990).

Code	Title	Hours
FIFTH TERM		9
MOME 6300	Seminars in Molecular Medicine	1
MOME 6600	Journal Paper Review in Molecular Medicine	1
BMSP 8250	Grant Writing Workshop	3
MOME 9990	Dissertation Research in Molecular Medicine (and/ or Electives)	4

Code	Title	Hours
SIXTH TERM		6
MOME 9990	Dissertation Research in Molecular Medicine (or Electives)	6

PHD PROGRAM STUDENTS: YEAR 3

Code	Title	Hours
SEVENTH TERM		9
MOME 6300	Seminars in Molecular Medicine	1
MOME 6600	Journal Paper Review in Molecular Medicine	1
MOME 9990	Dissertation Research in Molecular Medicine	7

Code	Title	Hours
EIGHTH TERM		9
MOME 6300	Seminars in Molecular Medicine	1
MOME 6600	Journal Paper Review in Molecular Medicine	1
MOME 9990	Dissertation Research in Molecular Medicine	7

Code	Title	Hours
NINTH TERM		6
MOME 9990	Dissertation Research in Molecular Medicine	6

PHD PROGRAM STUDENTS: YEAR 4 AND BEYOND

Code	Title	Hours
Fall, Spring and Summer		
MOME 6300	Seminars in Molecular Medicine	1
MOME 9990	Dissertation Research in Molecular Medicine ¹	5
		or
		8

8 (fall and spring); 5 (summer) ¹

Total: 9 (fall and spring); 6 (summer)

PHD Program students: Year 5 and beyond

Code	Title	Hours
MOME 9990	Dissertation Research in Molecular Medicine ¹	1
	1 credit until graduation ¹	

- PLO 1. FY1. Identify and summarize the structure and function of cells, tissues, and organs.
- PLO 2. FY2. Describe the molecular, biochemical, and cellular mechanisms that maintain the normal function, development, and plasticity of cells, tissues, and organs.
- PLO 3. FY3. Summarize basic disease causes and processes that affect the structure and function of cells, tissues, and organs.
- PLO 4. FY4. Assess and critically analyze relevant basic science and clinical literature.
- PLO 5. FY5. Design and conduct applicable biomedical sciences experiments.
- PLO 6. FY6. Organize, interpret and summarize results of applicable biomedical sciences experiments.
- PLO 7. FY7. Demonstrate ethical and responsible conduct in research and all other scholarly activities consistent with the University of Toledo, Health Science Campus, Standards of Conduct
- PLO 8. K1 Describe the normal structure and function of the body and its major organ systems, with emphasis on the systems studied in MOME laboratories (e.g., cardiovascular, renal, digestive, endocrine and neuroendocrine systems)

- PLO 9. K2 Describe biochemical, molecular and cellular mechanisms that are important in maintaining cardiac and vascular function as well as metabolism and energy balance.
- PLO 10. K3 Explain the pathophysiology of prevalent cardiovascular and metabolic diseases, such as diabetes, obesity, fatty liver disease, hypertension, heart failure, and ischemic heart disease.
- PLO 11. K4 Describe the genetic and environmental basis of prevalent cardiovascular and metabolic diseases, such as hypertension, diabetes and obesity.
- PLO 12. K5 Describe the epidemiology of prevalent cardiovascular and metabolic diseases, such as hypertension, diabetes and obesity.
- PLO 13. K6 Describe the basic principles of pharmacology (drug action) and pharmacology of specific drugs used in the treatment of prevalent cardiovascular and metabolic diseases.
- PLO 14. K7 Apply statistical methods in the design and interpretation of research projects.
- PLO 15. K8 Apply the principles that govern ethical decision making in the design and conduct of research projects, including the publication and reporting of results.
- PLO 16. K9 Describe the various approaches used to develop research proposals and to raise funds to finance biomedical research projects.
- PLO 17. S1 The ability to perform most basic laboratory procedures that are commonly used in the track laboratories.
- PLO 18. S2 The ability to perform advanced/specialized procedures that are necessary for the completion of the student's thesis research project(s)
- PLO 19. S3 The ability to design and complete independent research projects, including the introduction and optimization of unfamiliar techniques and the development of new research techniques
- PLO 20. S4 The ability to perform productively as a member of a research team and train junior students in routine and basic laboratory techniques
- PLO 21. S5 The ability to recognize hazardous procedures in the laboratory and follow appropriate precautions to protect the laboratory and institutional personnel
- PLO 22. S6 The ability to communicate effectively, both verbally and in writing, with other students, post-doctoral fellows and faculty members, as well as with national and international collaborators
- PLO 23. S7 The ability to present their results at local, national and international meetings as well as to be able to organize and chair local meetings
- PLO 24. S8 The ability to retrieve biomedical information from electronic databases and other sources; to manage, and utilize the information, including by use of bioinformatics, in order to develop hypotheses to address scientific issues and the means to test them and to discuss the results in the context of reports in the literature.
- PLO 25. S9 The ability to write and submit manuscripts and to communicate effectively with scientific journal editors and reviewers
- PLO 26. S10 The ability to write a comprehensible research proposal and raise funds to support it from federal, state and other funding agencies
- PLO 27. P1 Students will demonstrate ethical, responsible, reliable, and dependable behavior in all aspects of their professional lives, and a commitment to the profession and society.
- PLO 28. P2 Students will demonstrate honesty and integrity in all interactions with faculty advisors, colleagues, faculty members, laboratory and institutional staff, research subjects, and others with whom students may interact in their professional lives.
- PLO 29. P3 Students will demonstrate honesty and integrity in research conduct and reporting of results.
- PLO 30. P4 Students will demonstrate responsible behavior while using shared equipment and facilities.
- PLO 31. P5 Students will demonstrate responsible behavior and willingness to train and teach junior students to the best of their knowledge.
- PLO 32. P6 Students will demonstrate professionalism in dress and grooming in compliance with health and safety rules applicable to the research laboratories and other research sites.
- PLO 33. P7 Students will demonstrate compassionate treatment of patients as subjects of research, and respect for their privacy and dignity.
- PLO 34. P8 Students will demonstrate compassionate treatment of experimental animals, and respect for all laws and regulations applicable to the use of animals in medical research.
- PLO 35. P9 Students will demonstrate professionalism in following rules and regulations set by different committees of the institution, e.g. IACUC, IRB, Biohazard committee, Radiation Safety etc.