



**PennState**

# **Master of Biotechnology**

*A Professional Science  
Master's Degree Program*



**Student Handbook  
2022-23**

## Introduction

The Master of Biotechnology (MBIOT) at Penn State University is a Professional Science Master's (PSM) degree program offered by the Department of Biochemistry and Molecular Biology in collaboration with the Huck Institutes of the Life Sciences. It is a multidisciplinary program involving faculty members from different academic departments and colleges at Penn State University as well as ad hoc mentors from the academic faculty and from industry.

At the most basic level, the translation of science to benefit society is what Biotechnology is all about. The MBIOT curriculum is designed to give students broad knowledge and training in the scientific and practical aspects of biotechnology, launching them into careers that will benefit society. It involves innovative, hands-on, and multidisciplinary learning approaches to train students in the science and state-of-the-art technology driving modern biotechnology, its business and legal aspects, intellectual property and regulatory aspects, and the ethical and social issues that it brings about. In addition, the courses and the activities required of all students in this program integrate professional development emphasizing teamwork and communication skills, networking and other professional proficiencies transferrable in any workplace.

Graduates of this program are prepared for diverse careers as scientists, educators, leaders and managers, across industry, government, and academic biotechnology realms. Many facets of the biotechnology field including the social, ethical, legal and intellectual property issues are examined. This broad knowledge base enables graduates to fill niches where the ability to interface across organizational groups in the workplace are required; this can accelerate biotechnology careers for our graduates.

## Degree Requirements

The MBIOT degree requires a minimum of 30 graduate credits<sup>1</sup>, 18 credits of which must be from courses in the 500 level and higher. Students are required to take 17 credits from core courses, including 3 credits of the Capstone Research Course. Additional credits are from elective courses chosen from course offerings of various academic departments. Courses related to agricultural applications, medical applications, business, etc. may be selected depending on the student's area of interest. Please see Appendices A and B for a list of required core courses and an exemplar program of study, respectively. MBIOT students must complete a minimum 27 credits between their first two semesters.<sup>2</sup>

### Core Courses

The MBIOT core courses are intended to provide the groundwork for careers in biotechnology; comprehension of molecular biology mechanisms and laboratory techniques, the principals of bioprocessing, and research professionalism are emphasized.

BMB 400	Molecular Biology of the Gene
	The molecular biology of procaryotic and eukaryotic genes and genetics. (2 credits).
MCIBS 593	Molecular Biology Laboratory

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<sup>1</sup> Only courses numbered 400 and above count as graduate credits.

<sup>2</sup> Students must have a minimum of 12 credits for full-time status during the first two semesters.

An intensive lecture/laboratory course on the principles and techniques in molecular biology research. (3 credits)

BIOTC 479 Methods in Biofermentation<sup>3</sup>

Bioprocessing principles and development; uses and operation of biofermentors, determination of biomass; problems of scale-up. (3 credits)

MCIBS 571 Current Issues in Biotechnology

Group projects and lecture series by academic and industry speakers dealing with the state-of-the-art scientific developments in biotechnology, and the business, regulatory, intellectual property, legal, social, ethical and professional aspects of biotechnology. (2 credits)

MCIBS 591 Ethics, Rigor, Reproducibility and Conduct of Research in the Life Sciences  
An examination of integrity and misconduct in life sciences research. (2 credits)

MCIBS 590 Colloquium Seminar Series

A monthly colloquium that will present current life science topics of general interest. (2 credits)

MCIBS 594 Research Project in Biotechnology

Supervised individual projects either in industry, academic or government laboratory, culminating in a Capstone research report (3-5 credits)

### Elective Courses

An extensive number of elective courses are available to MBIOT students, chosen from offerings in various academic departments based on student's interests and career objectives. A sample, non-restrictive list of elective courses previously taken by MBIOT students is found in Appendix C.

For detailed course descriptions and additional elective options, please see:

<https://bulletins.psu.edu>

For Fall 2022 schedule of courses offered, please see: <https://public.lionpath.psu.edu>

A strongly recommended elective is 'Individual Studies' (MCIBS 596, or equivalent 596 course under another department). This course listing allows students to gain additional research experience and technical skills in laboratories on campus while earning elective credits (1-3 credits). Students must first seek permission from the faculty member whose research is of interest to them and agree on a work schedule in the host faculty's laboratory; this process is often initiated prior to the student's arrival to campus. Students interested in learning the technologies in the core research facilities on campus may also register MCIBS 596 after consultation with the academic adviser and the core facility concerned.

### Responsible Conduct of Research Training

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<sup>3</sup> Alternatively, students may take BE 468 - Microbiological Engineering (3 credits).

All students in the MBIOT graduate program are required to complete the online Collaborative Institutional Training Initiative (CITI) Biomedical Science Responsible Conduct of Research (RCR). This online course will supplement in-class, discussion-based RCR training provided in MCIBS 591, Ethics, Rigor, Reproducibility and Conduct of Research in the Life Sciences, a required 2-credit course.

New students must complete the online CITI RCR course at the start of their first semester, via the following process:

- Register on the Penn State CITI website <http://citi.psu.edu/>.
- Select your campus (University Park), then select Pennsylvania State University Courses and register for the Biomedical Responsible Conduct of Research Course.
- Independently complete the course modules and pass the on-line quizzes.
- Submit a copy of the 'Completion Report' to the program administrative office (email to [faqh5144@psu.edu](mailto:faqh5144@psu.edu)).



### Capstone Research Project

All MBIOT degree candidates are required to complete a capstone research project culminating in a research paper. The primary objective of the research project is to provide to students a meaningful, practical work experience in biotechnology. This project can incorporate any topic related to the student's specific area of interest in biotechnology, including but not limited to: scientific/technical research, business practices, intellectual property and legal practices, or social and ethical facets.

The research project is completed during a 6-month, full-time research position, during which students enroll in MCIBS 594 (3-5 credits, depending on research outcomes); registration to this course must be done in consultation with the student's academic adviser. During this time, student immersion in the dynamics and expectations of the real-world workplace is meant to enhance their preparation and qualification for entry-level employment. Students are expected to learn not only about their host institution or laboratory but also:

- the work expectations within the host organization,
- the techniques involved in the specific research project,
- the existing knowledge that underlies the research problem,
- the skills involved in gathering, analyzing, organizing, and presenting data, and
- how to communicate the research properly and effectively, in writing.

The capstone research is typically conducted off-campus, hosted by industry, academic, non-government, or government organizations as a cooperative education (co-op) or internship activity. Students are required to independently apply, interview, and negotiate their individual co-op positions, though on-campus resources are available for support. In practice, students start preparing their resume in their first semester and begin applying for co-op positions in late Fall and early Spring semesters.

Students may also elect to do their research project on campus if that best suits their career objectives. It is each student's responsibility to identify a host laboratory or unit working in his/her area of interest, before or soon after arrival to campus. Students must also discuss the expectations for the project and terms of support with hosting faculty.

The capstone research project culminates in a scholarly research paper, submitted at the end of the co-op<sup>4</sup>. Evaluation of the report will be the responsibility of the graduate faculty member in charge of MCIBS 594, in consultation with the research supervisor, and/or a member of the biotechnology graduate faculty who has interest and expertise in the research project of the student. Regardless of whether the research is done on- or off-campus, the student must make it clear to the host laboratory/unit/employer that a written report will be required and will need to be completed at a specific date determined by the student's curriculum.

## MBIOT Program Contacts

For questions about the Master of Biotechnology degree program, please contact:

### Natasha Tirko, Ph.D.

Program Director, Academic Advisor  
211 Life Sciences Building  
[nmt108@psu.edu](mailto:nmt108@psu.edu)  
814-863-5751

### MBIOT Program Administration

The Huck Institutes  
101 Life Sciences Building  
[fqh5144@psu.edu](mailto:fqh5144@psu.edu)

## University Resources

### MBIOT Program Websites

The Huck Institutes of the Life Sciences:

<https://www.huck.psu.edu/graduate-programs/master-of-biotechnology>

The Department of Biochemistry and Molecular Biology:

<https://science.psu.edu/bmb/graduate/masters-programs>

The Graduate School Bulletin:

<https://bulletins.psu.edu/graduate/programs/majors/biotechnology/>

Integrated Undergraduate-Graduate Program in Biotechnology:

<https://science.psu.edu/bmb/undergraduate/degree-programs/BIOTC-IUG>

### The Graduate School

<http://www.gradschool.psu.edu/>

The Penn State Graduate School website includes comprehensive resources for all graduate students, including: education resources, student life information, general degree requirements, alumni and diversity information. Please take careful note of the graduate student policies and academic integrity expectations - <http://www.gradschool.psu.edu/current-students/student/>.

### The Graduate School's New Student Orientation

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<sup>4</sup> Any proprietary information involved in the work can be uncoupled from the written report or the oral presentation; notify the instructor in-charge in advance so that an alternative written assignment can be arranged, if necessary.

<https://gradschool.psu.edu/external-links/new-graduate-student-orientation-canvas-course/>

The Graduate School's New Student Orientation will be delivered as a Canvas course for Fall 2022; it will go live in late July 2022 and will remain in a student's Canvas dashboard for the remainder of their time at the University. The Orientation Canvas course has a wealth of information about the University, tips on how to be successful as a graduate student, and information about the many resources available to graduate students from health insurance to student support offices.

### **Student Life Resources**

<https://www.psu.edu/current-students>

General resources and up-to-date information on University policies, registration and financial resources, academic resources, student living, diversity and inclusion, health and wellness and services and support.

### **Penn State Global**

<https://global.psu.edu/category/international-students>

Information and resources for prospective and current international students as well as international alumni.

### **Career Services**

<http://www.studentaffairs.psu.edu/career/>

Information regarding career counseling, resume review, mock interviews, career fairs, on-campus recruiting events, etc.

### **nittanylionCAREERS**

<https://nittanylioncareers.psu.edu>

Penn State's single-system recruiting platform for all students, alumni and employers.

### **Commencement**

<https://www.commencement.psu.edu/>

Information and resources needed as you prepare for graduation.

## Appendix A: MBIOT Program of Study

	Course Code	Course Title	400-level Credits	500-level Credits	Suggested Semester
<b>Core/Required Courses</b>	MCIBS 590	Life Sciences Colloquium		2	Fall
	MCIBS 593	Molecular Biology Laboratory		3	Fall**
	MCIBS 591	Ethics in the Life Sciences		2	Fall**
	BIOTC 479* or BE 468	Biofermentaion/ Bioprocessing	3		Spring
	MCIBS 571	Current Issues in Biotechnology		2	Spring**
	BMB 400	Molecular Biology of the Gene	2		Spring**
	MCIBS 594	Research Project in Biotechnology		3	Year 2**
<b>Elective Courses</b>					
<b>Total Credits (by course level)</b>				(Must be at least 18)	
<b>Total Credits</b>			(Must be at least 30)		

\* BIOTC 479 or BE 468 will meet the program requirement.

\*\* This is the required time to enroll in this course.

## Appendix B: Example MBIOT Course Plan

	Course Code	Course Title	400-level Credits	500-level Credits
<b>Year 1 - Fall Semester</b>	MCIBS 590	Life Sciences Colloquium		2
	MCIBS 593	Molecular Biology Laboratory		3
	MCIBS 591	Ethics in the Life Sciences		2
	Elective	Course Title	3	
	Elective	Course Title		2
	MCIBS 596	Independent Research		2
	<b>Semester Total Credits</b>			14
<b>Year 1 - Spring Semester</b>	BMB 400	Molecular Biology of the Gene	2	
	BIOTC 479	Biofermentaion	3	
	MCIBS 571	Current Issues in Biotechnology		2
	BMB 400	Molecular Biology of the Gene	2	
	Elective	Course Title		2
	MCIBS 596	Independent Research		2
	<b>Semester Total Credits</b>			13
<b>Summer Semester</b>	MCIBS 594	Co-op Capstone Research		1
<b>Year 2 - Fall Semester</b>	MCIBS 594	Co-op Capstone Research		2
	<b>Co-op Total Credits</b>			3
<b>Total Credits (by course level)</b>			11	19
<b>Total Credits</b>			30	



## Appendix C: Sample of Elective Course Offerings

Course Abbreviation	Course Number	Course Title	Course Credits
AGBIO	520	Agricultural Biosecurity: Protecting a Key Infrastructure	3
AGRO	460	Transgenic Plants	3
ANSC	413	Transgenic Biology	3
BBH	451	Pharmacological Influences on Health	3
BBH	452	Women's Health Issues	3
BIOE	512	Cell and Molecular Bioengineering	3
BIOE	514	Quantitative Microscopy	3
BIOE	597K	Regenerative Medicine	3
BIOET	501	Perspectives and Methods in Bioethics	3
BIOL	428	Population Genetics	3
BIOL	439	Practical Bioinformatics	3
BIOL	467	Neurodiseases	3
BIOL	469	Neurobiology	3
BIOL	472	Mammalian Physiology	3
BIOL	497	Evolution of Infectious Diseases	3
BIOL	597F	Bioinformatics I	3
BMB	408	Instructional Practice	1
BIOTC	416	Microbial Biotechnology	2
BIOTC/HORT	459	Plant Tissue Culture and Biotechnology	3
BIOTC	460	Advances and Applications of Plant Biotechnology	3
BIOTC	489	Animal Cell Culture Methods	3
BMB	401	General Biochemistry	2
BMB	411	Survey of Biochemistry and Molecular Biology Literature	1
BMB	432	Advanced Immunology: Signaling the Immune System	3
BMB	433	Molecular Toxicology	3
BMB/VBSC	435	Viral Pathogenesis	2
BMB	460	Cell Growth and Differentiation	3
BMB	464	Molecular Medicine	3

BMB	474	Analytical Biochemistry	3
BMB/MICRB	480	Cancer Development and Progression	3
BMB	484	Functional Genomics	3
BMMB	502	Critical Analysis of Biochemical, Microbial, and Molecular Biology Scientific Literature	1
BMMB	503	Molecular and Cellular Genetics	4
BMMB	510	Current Literature in Molecular Biology	1
BMMB	542	Eukaryotic Cell Biology	3
BMMB/MCIBS	551	Genomics	3
BMMB/MCIBS	554	Bioinformatics I	3
BMMB	852	Applied Bioinformatics	2
BRS	597	Biomanufacturing Lab	1-9
CHE	449	Bioseparations	3
ENGR	405	Project Management for Professionals	3
ENGR	425	New Venture Creation	3
ENGR	426	Invention Commercialization	3
ENTR	504	Essentials of Business Planning	2
ENT	535	Statistical Techniques in Entomology	3
FDSC	407	Food Toxins	2
FDSC	408	Applied Food Microbiology	2
HORT/BIOTC	459	Plant Culture and Biotechnology	3
HPA	410	Public Health Principles	3
MCIBS	596	Individual Studies	1-3
MCIBS	592	Current Research Seminar	2
MICRB	408	Laboratory Instructional Practice	2
MICRB	410	Principles of Immunology	3
MICRB	412	Medical Microbiology	3
MICRB	415	General Virology	3
MICRB	422	Medical Microbiology Laboratory	2
MICRB	435	Medical Virology	2
MICRB	447	Molecular Immunology Laboratory	1
MGM/IST/ENGR	425	New Venture Creation: Introduction to Entrepreneurship	3
MGMT	426	Invention Commercialization	3
MGMT	427	Managing an Entrepreneurial Start-up Company	3
NEURO	520	Cellular and Molecular Neuroscience	3

NUTRN	520	Readings in Nutrition	0.5
PHSIO	571	Animal Physiology	3
PPEM	405	Microbes and Plants	3
SOILS	420	Remediation of Contaminated Soils	3
STAT	500	Applied Statistics	3
STAT	501	Regression Methods	3
STAT	506	Sampling Theory and Methods	3
STAT	555	Statistical Analysis of Genomics Data	3
STS	589	Ethics and Values in Science and Technology	3
VBSC	405	Laboratory Animal Science	3
VBSC	420	General Animal Pathology	3
VBSC	430	Principles of Toxicology	3
VBSC	520	Pathobiology	3
VBSC	534	Current Topics in Cancer Research	3
VBSC	596	Individual Studies	1-3