

# BIOTECHNOLOGY

<b>Graduate Program Head</b>	Santhosh Girirajan
<b>Program Code</b>	BIOT
<b>Campus(es)</b>	University Park (M.BIOT.)
<b>Degrees Conferred</b>	Master of Biotechnology (M.BIOT.) Integrated B.S. in Biotechnology and M.BIOT. in Biotechnology
<b>The Graduate Faculty</b>	View ( <a href="https://secure.gradsch.psu.edu/gpms/?searchType=fac&amp;prog=BIOT">https://secure.gradsch.psu.edu/gpms/?searchType=fac&amp;prog=BIOT</a> )

The Master of Biotechnology degree program is offered through a collaboration of the Department of Biochemistry and Molecular Biology and the Huck Institutes of the Life Sciences. It is a multidisciplinary program involving faculty members from different academic departments in Penn State University as well as ad hoc mentors from the academic faculty and from industry.

The Master of Biotechnology curriculum is designed to give students broad knowledge and training in the scientific and practical aspects of biotechnology. It involves innovative, hands-on, and multidisciplinary learning approaches to educate and train students in the science behind biotechnology, its business and legal 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 develop transferable professional skills such as team-working and communication skills, which are very important in industry in particular.

Graduates of this program are expected to have the knowledge and training for diverse career options: as academic educators, as scientists in both academic and industry settings, as members of decision-making business and management teams in government and biotechnology industries, as bioentrepreneurs, and as members and leaders of governmental, public, and private organizations that deal with social, ethical and legal issues in biotechnology. Because of their broad knowledge in biotechnology, graduates of this program are expected to fill a niche in industry where knowledge and ability to interface and communicate with various functional groups within the organization are required.

## Admission Requirements

Applicants apply for admission to the program via the Graduate School application for admission (<https://gradschool.psu.edu/graduate-admissions/how-to-apply/>). Requirements listed here are in addition to Graduate Council policies listed under GCAC-300 Admissions Policies (<https://gradschool.psu.edu/graduate-education-policies/>).

The program is appropriate for students with a baccalaureate degree in biological sciences, chemistry, or engineering or other baccalaureate degrees that include sufficient credits from relevant courses in the life sciences. Applicants must have a minimum junior/senior grade point average of 3.00 (on a 4.00 scale). Graduate Record Examinations (GRE) scores are not required. Typically, students are admitted as part of a cohort to commence studies in the Fall. The best-qualified applicants will be accepted up to the number of spaces available for new students.

## Degree Requirements

### Master of Biotechnology

Requirements listed here are in addition to Graduate Council policies listed under GCAC-700 Professional Degree Policies (<https://gradschool.psu.edu/graduate-education-policies/>).

A minimum of 30 credits at the 400, 500, or 800 level is required for completion of the degree, 18 credits of which must be from courses in the 500 or 800 level, with a minimum of 6 credits at the 500 level. Students are required to take 16 to 18 credits from core courses listed below. Additional credits are from industry internship or cooperative education (co-op) and elective courses. A list of approved elective courses is maintained by the graduate program office. All Master of Biotechnology candidates are required to write a research paper based on a research project conducted in an academic, government, or industry research laboratory as the culminating experience for the degree. The research paper is completed while the student is enrolled in MCIBS 594.

Code	Title	Credits
<b>Required Courses</b>		
BMB 400	Molecular Biology of the Gene	3
BIOTC 479	Methods in Biofermentations	3
or BE 468	Microbiological Engineering	
MCIBS 571	Current Issues in Biotechnology	2
MCIBS 590	Colloquium	2
MCIBS 591	Ethics, Rigor, Reproducibility and Conduct of Research in the Life Sciences	2
MCIBS 593	Molecular Biology Laboratory	3
<b>Electives <sup>1</sup></b>		
<b>Culminating Experience</b>		
MCIBS 594	Research Topics	3-6

<sup>1</sup> These courses are chosen from offerings in various academic departments based on students' interest or track and career objectives. These also include MCIBS 595 (Internship) and any 596 (Individual Studies) course under a faculty member whose research relates to a student's area of interest. A list of approved elective courses is maintained by the graduate program office.

## Integrated Undergrad-Grad Programs

### Integrated B.S. in Biotechnology and M.BIOT. in Biotechnology

This Integrated Undergraduate/Graduate (IUG) degree program combines the B.S. in Biotechnology with the M.Biot. in Biotechnology offered at the following campuses:

#### Undergraduate Degree

- University Park

#### Graduate Degree

- University Park

Requirements listed here are in addition to requirements listed in GCAC-210 Integrated Undergraduate-Graduate (IUG) Degree Programs (<https://gradschool.psu.edu/graduate-education-policies/gcac/>)

gcac-200/gcac-210-integrated-undergraduate-graduate-degree-programs/).

The integrated B.S. in Biotechnology-Master of Biotechnology degree program is designed to enable qualified undergraduate students in the B.S. Biotechnology program to graduate in five years with the Master of Biotechnology degree.

### Admission Requirements

Students must apply to the program via the Graduate School application for admission (<http://www.gradschool.psu.edu/prospective-students/how-to-apply/>), and must meet all the admission requirements of the Graduate Council, listed under GCAC-300 Admissions Policies (<https://gradschool.psu.edu/graduate-education-policies/>), and the Biotechnology graduate program for the Master of Biotechnology degree, listed on the Admission Requirements tab.

Before applying to the Graduate School, students must have completed entrance to their undergraduate major and have completed no less than 60 credits. Students must be admitted no later than the end of the second week of the semester preceding the semester of expected conferral of the undergraduate degree. Transfer students must have completed at least 15 credits at Penn State to enroll in an IUG. Students must have a GPA of 3.5 at the time of application to the integrated degree program when they have completed at least 75 credits of their B.S. curriculum at the time of their admission to the integrated degree program.

In consultation with an adviser, students must prepare a plan of study appropriate to this integrated program, and must present their plan of study to the head of the graduate program or the appropriate committee overseeing the integrated program prior to being admitted to the program. The plan should cover the entire time period of the integrated program, and it should be reviewed periodically with an adviser as the student advances through the program.

### Degree Requirements

Student must fulfill all degree requirements for each degree in order to be awarded that degree, subject to the double-counting of credits as outlined below. Degree requirements for the Bachelor of Science in Biotechnology are listed in the Undergraduate Bulletin (<http://bulletins.psu.edu/undergraduate/>). Degree requirements for the Master of Biotechnology in Biotechnology degree are listed on the Degree Requirements tab of this bulletin.

Students must sequence their courses so all undergraduate degree requirements are fulfilled before taking courses to count solely towards the graduate degree. Students are expected to complete the undergraduate degree requirements within the typical time to degree for the undergraduate major. In the semester in which the undergraduate degree requirements will be completed, IUG students must apply to graduate, and the undergraduate degree should be conferred at the next appropriate Commencement. If students accepted into the IUG program are unable to complete the M.BIOT. degree, they are still eligible to receive their undergraduate degree if all the undergraduate degree requirements have been satisfied.

Up to 12 credits may be double-counted towards the degree requirements for both the graduate and undergraduate degrees; a minimum of 50% of the double-counted courses must be at the 500 or 800 level. Independent study courses and credits associated with the culminating experience for the graduate degree cannot be double-counted.

Code	Title	Credits
<b>Courses Eligible to Double Count for Both Degrees</b>		
BMB 400	Molecular Biology of the Gene	2-3
BIOTC 479	Methods in Biofermentations	3
or BE 468	Microbiological Engineering	
MCIBS 571	Current Issues in Biotechnology	2
MCIBS 590	Colloquium	1-3
MCIBS 591	Ethics, Rigor, Reproducibility and Conduct of Research in the Life Sciences	2
MCIBS 593	Molecular Biology Laboratory	3

## Minor

A graduate minor is available in any approved graduate major or dual-title program. The default requirements for a graduate minor are stated in Graduate Council policies listed under GCAC-600 Research Degree Policies (<https://gradschool.psu.edu/graduate-education-policies/>) and GCAC-700 Professional Degree Policies (<https://gradschool.psu.edu/graduate-education-policies/>), depending on the type of degree the student is pursuing:

- GCAC-611 Minor - Research Doctorate (<https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-600/gcac-611-minor-research-doctorate/>)
- GCAC-641 Minor - Research Master's (<https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-600/gcac-641-minor-research-masters/>)
- GCAC-709 Minor - Professional Doctorate (<https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-700/gcac-709-professional-doctoral-minor/>)
- GCAC-741 Minor - Professional Master's (<https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-700/gcac-741-masters-minor-professional/>)

## Student Aid

Graduate assistantships available to students in this program and other forms of student aid are described in the Tuition & Funding (<https://gradschool.psu.edu/graduate-funding/>) section of The Graduate School's website. Students on graduate assistantships must adhere to the course load limits (<https://gradschool.psu.edu/graduate-education-policies/gsad/gsad-900/gsad-901-graduate-assistants/>) set by The Graduate School.

## Courses

Graduate courses carry numbers from 500 to 699 and 800 to 899. Advanced undergraduate courses numbered between 400 and 499 may be used to meet some graduate degree requirements when taken by graduate students. Courses below the 400 level may not. A graduate student may register for or audit these courses in order to make up deficiencies or to fill in gaps in previous education but not to meet requirements for an advanced degree.

Elective courses may be taken from chosen from offerings in various academic departments based on students' interest or track and career objectives

Graduate Courses List (<https://bulletins.psu.edu/university-course-descriptions/graduate/>)

## Learning Outcomes

1. **KNOW.** Students will be able to demonstrate conceptual and practical knowledge of the broad aspects of biotechnology: the core areas in science and the technologies that drive progress in biotechnology, the business, intellectual property, regulatory, legal, social and ethical aspects of the biotechnology industry; students will also be able to show practical understanding of the professional skills vital to employment and career success in biotechnology.
2. **APPLY/CREATE/THINK.** Students will be able to demonstrate critical review of scientific literature, proficiency in the conduct of scientific research independently or in a team setting, as well as in non-bench research-related responsibilities in broad areas of biotechnology as necessary. Students will also demonstrate adequate professional preparation for competitive curricular employment (internships and cooperative education or co-op) and entry-level employment post-degree.
3. **COMMUNICATE.** Students will demonstrate skills in communicating scientifically through group work, research papers and oral presentations, and professionally through networking, interviews, resumes or curriculum vitae (CVs), and other required career-related activities.
4. **PROFESSIONAL PRACTICE.** Students will demonstrate knowledge of interpersonal workplace dynamics, the ability to perform in a team environment and adapt to a very dynamic biotechnology workplace, participation in professional networking, and engagement in professional activities and organizations serving the discipline and the industry.

## Contact

<b>Campus</b>	University Park
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<b>Director of Graduate Studies (DGS) or Professor-in-Charge (PIC)</b>	Natasha N Tirko
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<b>Program Website</b>	View ( <a href="https://www.huck.psu.edu/graduate-programs/master-of-biotechnology/">https://www.huck.psu.edu/graduate-programs/master-of-biotechnology/</a> )