

Biotechnology

Degree Offered:	M.S., Ph.D.
Program Director:	Tino Unlap, PhD
Phone:	(205) 934-7382
E-mail:	unlap@uab.edu
Website:	http://www.uab.edu/shp/cds/biotech

Program Mission

The Biotechnology program is committed to preparing students for meaningful careers in the biotechnology industry and related scientific fields. Our mission is to provide a transformative educational experience that blends scientific knowledge with practical skills and entrepreneurial insight. We aim to cultivate professionals who are not only technically proficient but also capable of translating scientific discoveries into real-world solutions that improve lives. Through a collaborative and interdisciplinary learning environment, we empower students to think critically, innovate responsibly, and contribute to the advancement of biotechnology.

The PhD in Biotechnology effectively combines biological and scientific knowledge and concepts with the legal, regulatory, marketing, and financial aspects of the life sciences industry.

Students will have the option of working on their own idea for a product/technology or working on projects identified through the UAB Bill L. Harbert Institute for Innovation & Entrepreneurship (HIIE) and/or through our partnership with Southern Research (SR).

Program Benefits

- Graduates will be highly competitive for a variety of jobs in the life sciences industry.
- Develop knowledge on how to seek patent applications, pursue licensing or commercialization strategies as part of dissertation work, and understand components to launch a biotechnology company.
- Blends traditional scholarly research and pedagogy with practicum-based learning, providing unique, and highly marketable skillsets.

Biotechnology Careers

The goal of the master's degree program is to provide a more direct route to a career in biotechnology by focusing on mastering current techniques used in biotechnology coupled with the business fundamentals necessary for successful product/technology development in the industry. The multi-disciplinary aspects of this program will broaden and expand the knowledge base of students, thus making graduates particularly useful to potential industry employers. According to the U.S. Department of Labor Occupational Outlook Handbook, the demand in the biotechnology field continues to drive job growth, with much higher expected increases in career opportunities to be realized as compared to all other industries in future years.

The Master of Science in Biotechnology degree requires 3 semesters of full-time enrollment for completion. The Master of Science requires 37 credit hours and is designed for individuals who hold a Bachelor of Science or Bachelor of Arts degree in a related discipline including biology, chemistry, biochemistry, physics, engineering, mathematics, psychology, sociology, and similar disciplines.

Biotechnology is an industry based on biology that harnesses cellular and molecular processes to create novel technologies and products that will positively impact the quality of our lives and the health of our planet. The Biotechnology program at UAB provides students with the training necessary to be part of the industry's specialized workforce. PhD students will develop a strong knowledge base in science, technology, research, commercialization and biotechnology industry-specific business development and entrepreneurial skills.

Upon completion of the program, graduates will have earned their PhD and be prepared for key roles in research and the life sciences industry. Students acquire skills in business, management, research and development, regulatory affairs and understanding the key aspects to commercializing innovative biotechnology products and technologies. The biotechnology industry will continue to be a key economic engine for the United States with strong job growth. At UAB, we are proud to offer students the specialized training needed for the continued support and growth of the biotechnology industry in the United States.

Essential Requirements

Fundamental tasks, behaviors, and abilities necessary to successfully complete the requirements of the program are available upon request from the Biotechnology program. If you have a disability that may affect your ability to meet these requirements, please contact Disability Support Services (DSS) for support. DSS can be reached at (205) 934-4205 or visit <http://www.uab.edu/students/disability/>.

Additional Information

Entry Term	M.S. - Fall, Spring, and Summer; Ph.D. - Fall
Deadline for All Application Materials to be in the Graduate School Office:	M.S. - August 1 (Fall), December 1 (Spring), April 1 (Summer); Ph.D. Fall admission November 30 (priority application deadline) and March 1 (final application deadline)
Financial Aid:	M.S. financial aid (fellowship, stipend, or assistantship) is not available from the program. However, once enrolled in the program, scholarships may be available through the School of Health Professions or UAB offices.
International Applicants:	https://www.uab.edu/gradadmissions/apply/international-applicants

Contact Information

Department of Clinical and Diagnostic Sciences
Biotechnology Program
UAB School of Health Professions, SHPB 430
1716 9th Avenue South
Birmingham, Alabama 35294-1212
Telephone: 205-934-3209
E-mail: biotech@uab.edu

M.S. Admission Requirements

In addition to the general Graduate School admission requirements, applicants to both the online and in-person M.S. programs must:

- Have a bachelor's degree in biology, chemistry, or a related discipline from an accredited college or university,
- Have completed the following prerequisite courses with a letter grade of C or higher,
 - Genetics
 - Introductory Biology
 - General Chemistry II
 - General Chemistry I
 - Pre-calculus Algebra (or higher-level mathematics)
- Have a minimum undergraduate GPA of 3.0 on a 4.0 scale (A = 4.0), computed from all undergraduate credits or from the last 60 semester hours of undergraduate course credit,
- Provide a written statement of career goals,
- Applicants may also be asked to complete an interview with the program admissions committee.
- International applicants, please visit [Graduate Admissions-International Applicants](#) for all additional requirements.

If accepted, students must complete the following tasks prior to the add/drop deadline of their admission term: Background check and drug screen through UAB approved vendor; provide proof of required immunizations; and provide proof of insurance or submit the waiver if already covered by insurance.

Master of Science in Biotechnology (In Person)

Requirements	Hours
BT 500 Principles of Biotechnology - Nucleic Acid Technology	3
BT 550 Principles of Biotechnology - Amino Acid Technology	3
BT 600 Principles of Biotechnology - Systems Biology & Pharmacology	3
BT 650 Applications in Biotechnology I	2
BT 651 Applications in Biotechnology II	2
BT 652 Applications in Biotechnology III	2
BT 670 Bench to Commercialization I	3
BT 671 Bench to Commercialization II	3
BT 672 Bench to Commercialization III	3
BT 676 Innovative Technologies in Biotechnology (1 credit; taken 3 times)	3
BT 690 Capstone: Integrating Basic Science and Product Development	4
BT 695 Biotechnology Internship	2
CDS 505 Professional Skills Development	1
CDS 610 Research Design and Statistics	3
Total Hours	37

Master of Science in Biotechnology (Online)

Requirements	Hours
BT 500 Principles of Biotechnology - Nucleic Acid Technology	3
BT 550 Principles of Biotechnology - Amino Acid Technology	3
BT 600 Principles of Biotechnology - Systems Biology & Pharmacology	3
BT 605 Applications of Biochemistry in Biotechnology	3
BT 670 Bench to Commercialization I	3
BT 671 Bench to Commercialization II	3
BT 672 Bench to Commercialization III	3

BT 675	Special Topics in Biotechnology	3
Innovative Technologies in Biotechnology (1 credit; take three times)		3
BT 676	Innovative Technologies in Biotechnology	
BT 690	Capstone: Integrating Basic Science and Product Development	4
BT 695	Biotechnology Internship	2
CDS 505	Professional Skills Development	1
CDS 610	Research Design and Statistics	3
Total Hours		37

Program Information

The PhD program in Biotechnology offers a completely new approach to doctoral learning, blending traditional scholarly research and pedagogy with practicum-based learning that ultimately will provide graduate students with unique and highly marketable skill sets. Specifically, core training in the program will span from scientific discovery to the collection of proof-of-concept data and the development of intellectual property, and the analysis of market opportunities and business plans for a novel product, all with the goal to officially launch a biotechnology company post-graduation. In addition to scientific discovery capability, the biotechnology doctoral students will graduate with the knowledge and skills needed to successfully conduct and evaluate research within the setting of a biotechnology company and will have acquired the knowledge of biotechnology economics, regulatory affairs, how to launch a biotechnology company, and the finance skills specific to moving a biotechnology product and company forward. Upon graduation, the successful student will be equipped to launch a biotechnology company or market a patented product post-graduation.

Ph.D. Admission Requirements

In addition to the general Graduate School admission requirements, applicants to the Ph.D. program must:

- Provide a personal statement: Use this component to tell the admissions committee about yourself, your research experience, the area of research you are interested in, why you want a PhD, which researchers at UAB you are interested in, etc.,
- Provide a resume or curriculum vitae: Include relevant research experience, publications, presentations, awards, etc.,
- Request three (3) letters of recommendation: Letters should be submitted by professionals who are in a position to provide appropriate input with a thorough knowledge on the applicants academic ability and potential to succeed in the Biotechnology PhD program.,
- International applicants, please visit [Graduate Admissions-International Applicants](#) for all additional requirements.
- Official Transcripts - For the initial application review, we can accept unofficial transcripts (if from an institution outside the US, they must be evaluated). If offered admission, we will then require official documents. Submit transcripts from all post-secondary institutions attended, including community colleges and high school dual-enrollment.
- Application fee paid
- All required documents must be "complete" in UAB admissions system to be considered for review.
- Selected students under consideration will also be required to complete an interview with the faculty before final acceptance into the program. Students will be notified by email if selected for interview.

- Scientific research or life science/biotechnology industry research experience highly recommended, but not required with excellent undergraduate/master's level academic performance.

If accepted, students must complete the UAB medical history questionnaire and physical, provide proof of required immunizations, and receive satisfactory screening by the UAB Medical Center Student Health Service before enrollment. Accepted students must complete a background check and drug screen at admission-as required by the program.

Degree Requirements

The PhD in Biotechnology includes didactic coursework, laboratory training, and both mentored and independent research. Students can explore additional opportunities to complete either the existing Biotechnology Regulatory Graduate Certificate or the Technology Commercialization and Entrepreneurship Graduate Certificate, concurrently with the doctoral degree. Upon completion of didactic course work, students will be expected to pass a competency examination relevant to content in laboratory and lecture courses before they can transition to internships and dissertation work. This examination will be comprised of written, oral, and practical components and generally will be completed by the end of Semester 7.

Doctor of Philosophy in Biotechnology

Requirements	Hours
Core Requirements	
BT 701 Cellular and Molecular Biotechnology I	3
BT 702 Cellular and Molecular Biotechnology II	3
BT 725 Creating a Biotechnology Venture	3
BT 730 Managing and Leadership in Biotechnology	3
BT 732 Financing a Biotechnology Venture	3
BT 750 Laboratory Rotation I	1
BT 751 Laboratory Rotation II	1
BT 752 Laboratory Rotation III	1
BT 795 Special Topics in Biotechnology ¹	9
Required Courses	
GBS 701 Core Concepts in Research: Critical Thinking & Error Analysis	1
GBS 716 Grantsmanship and Scientific Writing	3
GRD 717 Principles of Scientific Integrity	3
BT 675 Special Topics in Biotechnology	2
BT 740 Biotechnology Seminar/Journal Club (1 credit hour course, taken 3 terms)	3
BT 745 Research Design and Statistics for Biotechnology	3
BT 753 Advanced Applications in Biotechnology	3
BTR 705 Biotechnology Regulatory & Quality Systems	3
Suggested Electives ²	6
BT 607 Recombinant DNA	
BT 770 Drug Discovery	
BT 772 Medicinal Chemistry	
GBS 728 JC- Bio-Nano Technology	
GBS 753 Intro to Pharmacology & Toxicology	
GBS 762 Virology	
BTR 720 Regulation of Food and Drugs	
BTR 790 Clinical Trial Implementation	
BT 797 Independent Study	
Non-Dissertation/Dissertation Research Requirements ³	

BT 798	Nondissertation Research (minimum 12 hours)	12
BT 799	Dissertation Research (minimum 12 hours)	12

Dissertation		
Total Hours		78

- ¹ BT 795: Commercialization Strategy, 3 credit hour course taken 3 times
- ² 9 of these hours are elective/certificate earning hours
- ³ BT 750, BT 751, and BT 752 may be allowed to count as part of the required hours of research based courses or non-dissertation research depending upon progression of curriculum plan.

Degree Offered:	Graduate Certificate in Biotechnology Regulatory Affairs
Program Coordinator:	Kimberly McCall, Ph.D.
Phone:	(205) 934-3209
E-Mail:	ASKCDS@uab.edu
Website:	https://www.uab.edu/shp/cds/biotechnology-regulatory-affairs

Program Mission

As the biotechnology industry grows and life science companies mature, there is an increasing demand for a workforce trained in regulatory affairs to ensure that therapeutics, biologics, diagnostics and medical device products progress successfully through the development, manufacturing and marketing processes. Currently, there are thousands of ongoing clinical trials of new drugs, with many of them soon to be approved and ready for full-scale production, resulting in an all-time high demand for individuals with regulatory training.

The Biotechnology Regulatory Affairs certificate program is designed to provide students with targeted training and education in:

- The philosophies and roles of the domestic and international regulatory agencies that oversee drug, biologic, device, and diagnostics development,
- The laws that govern the development, manufacturing and commercial distribution of drugs, biologics and medical devices,
- The analysis of how emerging developments and trends are reshaping drug development and medical device regulation,
- The biological processes and laboratory techniques utilized for the discovery, development and evaluation of therapeutic drugs,
- Major concepts under which clinical trials are designed and run,
- The roles of the U.S. Food and Drug Administration (FDA), Institutional Review Boards, the Code of Federal Regulations and ethical principles,
- The complexities of clinical trial initiation and the issues of site and data management.

Essential Requirements

Fundamental tasks, behaviors, and abilities necessary to successfully complete the requirements of the Program are available upon request from the Biotechnology program office. If you have a disability but have not contacted Disability Support Services (DSS), please call 934-4205 or visit <http://www.uab.edu/students/disability/>.

Additional Information

Entry Term	Deadline
Entry Term:	Fall Semester
Deadline for All Application Materials to be in the Graduate School Office:	February 28 (Early Acceptance); August 1 (Final Acceptance)
Entrance Tests:	For international applicants from non-English speaking countries, scores for the Test of English as a Foreign Language (TOEFL) and the Test of Written English (TWE)
Comments:	Financial aid (fellowship, stipend, or assistantship) is not available from the program; transcript evaluation by WES is required for applicants with foreign university degrees

Graduate Certificate in Biotechnology Regulatory Affairs

Requirements	Hours
BTR 605 Biotechnology Regulatory & Quality Systems	3
BTR 615 Applications of Biological Processes in Drug Development	3
BTR 620 Regulation of Food and Drugs	3
BTR 640 Clinical Development of Drugs, Biologics, Diagnostics, and Medical Devices	3
BTR 690 Clinical Trial Implementation	3
Total Hours	15

Contact Information

Department of Clinical and Diagnostic Sciences
 Biotechnology Program
 UAB School of Health Professions, SHPB 430
 1716 9th Avenue South
 Birmingham, Alabama 35294-1212
 Telephone: 205-934-3209
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BT-Biotechnology Courses

BT 500. Principles of Biotechnology - Nucleic Acid Technology. 3 Hours.

Theories and knowledge required for the development and commercialization of nucleic acid-based technology for the biotechnology industry including genes, cloning, detection, therapies, diagnostics, and analysis.

BT 550. Principles of Biotechnology - Amino Acid Technology. 3 Hours.

Theories and knowledge required for the development and commercialization of amino acid-based technology for the biotechnology industry including protein-based therapeutics, diagnostics, vaccines, and research reagents.

BT 600. Principles of Biotechnology - Systems Biology & Pharmacology. 3 Hours.

Theories and knowledge required for the understanding of the science and technology of systems biology and pharmacology.

BT 605. Applications of Biochemistry in Biotechnology. 3 Hours.

Current concepts of human biochemistry and molecular biology; protein structure and function, enzymes, intermediary metabolism, biosynthesis of lipids, and utilization of lipids; special emphasis on the molecular basis of inherited genetic diseases, acquired diseases, and clinically-related biochemistry in Biotechnology.

BT 607. Recombinant DNA. 3 Hours.

Introductory course for the basic concepts of Recombinant DNA with emphasis on the types of enzymes and vectors used and the various methods of cloning and expression of genes in prokaryotic and eukaryotic systems.

BT 650. Applications in Biotechnology I. 2 Hours.

Lab provides the opportunity to set-up, perform, and interpret the results of various molecular assays. These include, but are not limited to, the following: nucleic acid isolation, enzymatic manipulation of nucleic acids, gel electrophoresis, amplifications reactions and hybridization reactions. Most of the laboratory work will involve a eukaryotic system.

BT 651. Applications in Biotechnology II. 2 Hours.

A laboratory that prepares students for the biotechnology industry by teaching how recombinant DNA can be used to generate specific proteins in any protein expression system.

BT 652. Applications in Biotechnology III. 2 Hours.

Laboratory applications required for the research and development of nucleic acid and amino acid-based technology for the biotechnology industry.

BT 670. Bench to Commercialization I. 3 Hours.

Focus on growth of a biotechnology company from inception through the early stages of development. Topics will include market assessment, business plan development, raising capital, and regulatory and quality systems requirements for drugs, biologics, medical devices or combination products.

BT 671. Bench to Commercialization II. 3 Hours.

Focus is on the issues and challenges affecting the life cycle of a biotechnology company and product as it progresses through the different stages of development including regulatory strategies, financing strategies, business development, and marketing strategies.

BT 672. Bench to Commercialization III. 3 Hours.

Focus is on the role of managers and leaders within biotechnology companies as they undergo constant change. The course will review effective communication strategies, problem solving tactics, leadership skills and development of methods to implement change. Students will focus on developing writing, verbal, and presentation skills through a series of projects.

BT 675. Special Topics in Biotechnology. 1-4 Hour.

Exploration of current issues in Biotechnology.

BT 676. Innovative Technologies in Biotechnology. 1 Hour.

An overview of new and innovative technologies used in the discovery, development, and production of biotechnology products. This will include a series of guest speakers who have successfully discovered novel technologies and products and transitioned them into early-stage companies.

BT 690. Capstone: Integrating Basic Science and Product Development. 1-4 Hour.

Synthesis of biotechnology knowledge used to develop innovative products for the life science industry. Application of product phases including the discovery, preclinical, clinical, FDA review and post-marketing surveillance. Working in teams, to select products/medical devices and critically evaluate how these products were developed and identify strengths and weaknesses in each phase of development.

BT 695. Biotechnology Internship. 2 Hours.

Supervised basic research in areas including molecular biology, protein chemistry, drug discovery, cardiovascular diseases, neurodegenerative diseases and cancer. Students are trained in research planning and execution, problem-solving, teamwork, and data analysis and presentation.

BT 701. Cellular and Molecular Biotechnology I. 3 Hours.

Study of prokaryotic systems focusing on structures, functions and replicative processes with particular emphasis on the systems that are used in the Biotechnology Industry, especially bacteria. The students will learn the central dogma in prokaryotes from DNA replication to transcription and translation and the sorting of proteins to various destinations using different transport systems. Bacterial enzymes, including restrictions endonucleases, will be examined and the use of these enzymes to develop innovative products for the life science industry.

BT 702. Cellular and Molecular Biotechnology II. 3 Hours.

Study of the principles of cellular and molecular biology using innovative life science technologies to demonstrate the biological mechanisms that were used to develop these products. General topics will include DNA replication, DNA repair, DNA Transcription, Posttranscriptional Modifications, Translation, and Posttranslational Modifications. Existing technologies will be discussed under the appropriate topic in order to enable the students to see how a particular biological process leads to the development of a number of innovative technologies.

BT 725. Creating a Biotechnology Venture. 3 Hours.

An in-depth look at starting a new biotechnology company. Specifically, the course will provide a roadmap for starting a company with an overview of the challenges and opportunities that biotechnology start-ups face.

BT 730. Managing and Leadership in Biotechnology. 3 Hours.

Leadership skills, communication, conflict resolution and organizational structures specific to biotechnology companies.

BT 732. Financing a Biotechnology Venture. 3 Hours.

Provide students with limited knowledge in finance the ability to understand the financial basics unique to running a biotechnology company from inception through commercialization.

BT 740. Biotechnology Seminar/Journal Club. 1 Hour.

Assigned readings, student presentations, and discussion of current literature and development activity in the life sciences and biotechnology industries.

BT 745. Research Design and Statistics for Biotechnology. 3 Hours.

Issues of contemporary research design and methods in biotechnology; focus on translational research and areas of controversy; application of statistical software with emphasis on interpretation of findings for decision support.

BT 750. Laboratory Rotation I. 1 Hour.

First in series of three laboratory rotations completed during the first two years of graduate study. Each laboratory rotation is 8-12 weeks in duration, and will be designed to allow the student to explore a potential avenue of research for their dissertation and project deliverable.

BT 751. Laboratory Rotation II. 1 Hour.

Second in series of three laboratory rotations completed during the first two years of graduate study. Each laboratory rotation is 8-12 weeks in duration, and will be designed to allow the student to explore a potential avenue of research for their dissertation and project deliverable.

BT 752. Laboratory Rotation III. 1 Hour.

Third in series of three laboratory rotations completed during the first two years of graduate study. Each laboratory rotation is 8-12 weeks in duration, and will be designed to allow the student to explore a potential avenue of research for their dissertation and project deliverable.

BT 753. Advanced Applications in Biotechnology. 3 Hours.

Basic molecular techniques used in research from bacterial culture to gene regulation. Techniques will be taught under the umbrella of a research project which will involve the cloning of a mammalian gene into an expression vector, its purification, sequencing, transfection into a mammalian cell host and the detection of the protein product. The techniques used will include PCR, cloning, transformation, plasmid isolation, DNA sequencing, transfection and protein detection using immunofluorescence and Western blot techniques.

BT 770. Drug Discovery. 3 Hours.

Overview of pharmaceutical development from target identification through pre-clinical development; focus on small molecule and biological products.

BT 772. Medicinal Chemistry. 3 Hours.

Comprehensive overview of concepts related to actions and clinical uses of major classes of drugs from their chemical structures; focus on structure-activity relationships, pharmacokinetics, and pharmacodynamics.

BT 795. Special Topics in Biotechnology. 1-4 Hour.

Special topics in Biotechnology.

BT 797. Independent Study. 1-3 Hour.

Student exploration of topic specific to their research agenda.

BT 798. Nondissertation Research. 1-9 Hour.

Independent student research to prepare dissertation proposal. Mentored by appointed Graduate Study Committee. Continuous registration is required until student is admitted to candidacy.

BT 799. Dissertation Research. 1-12 Hour.

Independent student research to complete dissertation project and written report. Mentored by appointed Graduate Study Committee.

BTR- Biotech Regulatory Courses**BTR 605. Biotechnology Regulatory & Quality Systems. 3 Hours.**

U.S. and European Union regulatory affairs frameworks and practices governing the development, approval, manufacturing and surveillance of pharmaceuticals and medical devices, including in vitro diagnostic products. Regulations covered include investigational new drug applications (IND), new drug applications (NDA), good laboratory practices (GLP), good clinical practices (GCP) and current good manufacturing practices (cGMP).

BTR 615. Applications of Biological Processes in Drug Development. 3 Hours.

Overview of biological processes and laboratory techniques for discovery, development and evaluation of therapeutic drugs. Focus on drug development processes such as gene cloning, culture scale-up, downstream processing, and product purification. Emphasis on theory and application of laboratory methods used in drug development.

BTR 620. Regulation of Food and Drugs. 3 Hours.

Administrative procedures followed by the FDA; enforcement activities of the FDA, including searches, seizure actions, injunctions, criminal prosecutions, and civil penalties authorized by statutes.

BTR 640. Clinical Development of Drugs, Biologics, Diagnostics, and Medical Devices. 3 Hours.

Major concepts under which clinical trials are designed and run. Focus on phases of clinical trial development, role of the U.S. Food and Drug Administration, Institutional Review Boards, and the Code of Federal Regulations and ethical principles.

BTR 675. Special Topics in Biotechnology Regulatory Affairs. 1-4 Hour.

Exploration of current issues in Biotechnology Regulatory Affairs.

BTR 690. Clinical Trial Implementation. 3 Hours.

Activities involved in running a clinical trial from study initiation to study close-out. Complex details and issues associated with study initiation, site and data management, preparation of the final report and study close-out.

BTR 705. Biotechnology Regulatory & Quality Systems. 3 Hours.

U.S. and European Union regulatory affairs frameworks and practices governing the development, approval, manufacturing and surveillance of pharmaceuticals and medical devices, including in vitro diagnostic products. Regulations covered include investigational new drug applications (IND), new drug applications (NDA), good laboratory practices (GLP), good clinical practices (GCP) and current good manufacturing practices (cGMP).

BTR 720. Regulation of Food and Drugs. 3 Hours.

Administrative procedures followed by the FDA; enforcement activities of the FDA, including searches, seizure actions, injunctions, criminal prosecutions, and civil penalties authorized by statutes.

BTR 790. Clinical Trial Implementation. 3 Hours.

Activities involved in running a clinical trial from study initiation to study close-out. Complex details and issues associated with study initiation, site and data management, preparation of the final report and study close-out.