Biotechnology

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

Program Information

Program Mission

The faculty members of the Biotechnology Programs are devoted to providing excellent service to the community and its graduates. The faculty, in its concern for the health and safety of the general public, is committed to ensuring that each student develops knowledge, skills, and values essential to their appropriate role providing the basis for continuing intellectual and professional growth.

Out of a great concern for applied technology and the role that it plays in the diagnosis, management and treatment of human disease, and in developing products to solve problems for present and future generations, the Biotechnology Programs are designed to provide instruction through didactic and practical training in order to ensure that graduates possess the critical knowledge and skill sets that are required for intellectual and professional growth in the future. Online options are available to give individuals with BS degrees already working in the Life Science industry the opportunity to earn a relevant MS degree or certificate.

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 mufti-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 Biotechnology Master of Science degree program requires 3 semesters for completion as full-time students. 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 and sociology.

M.S. Admission Requirements

In addition to the general Graduate School admission requirements, applicants to the M.S. program must:

- Have a biology, chemistry, or a related major from an accredited college or university,
- Have a minimum undergraduate GPA of 3.0 (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,
- Complete an interview with the program admissions committee, and
- If foreign-educated, have a score of at least 550 for paper version (or 80 for Internet version; or 213 for computer version) on the TOEFL, submit a transcript evaluation from World Education Services (WES) at www.wes.org.

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 and prior to placement in clinical internships by school policy.

Ph.D. Admission Requirements

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

- Provide a personal statement,
- Provide a resume or curriculum vitae,
- Request three (3) letters of recommendation,
- If foreign-educated, have a score of at least 550 for paper version (or 80 for Internet version; or 213 for computer version) on the TOEFL, submit a transcript evaluation from World Education Services (WES) at www.wes.org.

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 and prior to placement in clinical internships by school policy.

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	M.S. - Fall, Spring, and Summer Semesters; Ph.D. - Fall Semester
Deadline for All Application Materials to be in the Graduate School Office:	M.S. - August 1 (Fall), December 1(Spring), May 1(Summer); Ph.D. Fall admission November 30 (priority application deadline) and December 31 (final application deadline)
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:	M.S. Financial aid (fellowship, stipend or assistantship) is not available from the program; scholarship availability is limited; transcript evaluation by WES is required for applicants with foreign university degrees

Contact Information

For detailed information, contact the 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 AskCDS@uab.edu

Master of Science in Biotechnology

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 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
Innovative Technologies in Biotechnology (take three times)		**3**
BT 676	Innovative Technologies in Biotechnology	
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 695	Biotechnology Internship	2
BT 698	Non-Thesis Research	4
CDS 505	Professional Skills Development	1
CDS 610	Research Design and Statistics	3
Total Hours		**37**

Biotechnology, PhD

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 skillsets. 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.

Degree Requirements

The 78-credit-hour curriculum comprises didactic instruction, laboratory training, and mentored and independent research. Students will have the opportunity 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 in Semester 7.

Requirements		Hours
Core Requirements		
BT 701	Cellular and Molecular Biotechnology I	3
BT 702	Cellular and Molecular Biotechnology II	3
BT 670	Bench to Commercialization I	3
BT 671	Bench to Commercialization 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
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 745	Research Design and Statistics for Biotechnology	3
BT 740	Biotechnology Seminar/Journal Club * 1 credit hour course taken three terms	3
BT 753	Advanced Applications in Biotechnology	3
BT 675	Special Topics in Biotechnology	2
BTR 605	Biotechnology Regulatory & Quality Systems	3
Certificate Requirements or Electives		9
Non-Dissertation/Dissertation Research Requirements		
BT 798	Nondissertation Research	6

BT 799	Dissertation Research	12
Recommended Electives		
GBS 753	Intro to Pharmacology & Toxicology	
GBS 762	Virology	
GBS 728	JC- Bio-Nano Technology	
BTR 615	Applications of Biological Processes in Drug Development	
BTR 620	Regulation of Food and Drugs	
BTR 640	Clinical Development of Drugs, Biologics, Diagnostics, and Medical Devices	
BTR 690	Clinical Trial Implementation	
BT 797	Independent Study	
Total Hours		**72**

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**

Program Information

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.

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Contact Information

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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 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 on 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, team work, and data analysis and presentation.

BT 698. Non-Thesis Research. 1-4 Hour.
Non Thesis Research.

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.