

BIOTECHNOLOGY

ASSOCIATE DEGREE PROGRAM

Biotechnology is considered by the U.S. Department of Labor to be a high growth, high demand industry with its foundation in many disciplines, including biology, microbiology, biochemistry, molecular biology, immunology, genetics, chemistry, and biomanufacturing technology. The combined biotechnology and pharmaceutical industry is expected to be one of the 10 fastest growing industries between now and 2012, with a projected growth rate of 70 percent (U.S. Bureau of Labor Statistics, Career Guide to Industries, 2004-2005 edition). According to the U.S. Bureau of Labor Statistics, biological technicians, a key biotechnology occupation, are expected to grow by 19.4 percent between now and 2012.

Research and development in biotechnology seeks answers and solutions that will improve human health, agriculture and food production, and environmental solutions. Applications of biotechnology are diverse, including producing new pharmaceuticals, transgenic organisms, and biological fuels; applying genetic techniques to correct inborn errors of metabolism; improving crops; and clearing up pollution.

The curriculum covers the basic principles of chemistry, biology, and microbiology; recombinant DNA; analytical chemistry; laboratory instrumentation; and growth, isolation, and characterization of microorganisms and cells and their components. Students receive training in basic plant and animal cell culture, recombinant DNA methods, immunological techniques, and purification and identification of important biological molecules. The general studies component of the curriculum develops written and oral communication skills and computational skills and provides breadth to the curriculum in the areas of humanities, behavioral sciences, and mathematics. The associate degree provides graduates with opportunities for career mobility and facilitates continuing education at the baccalaureate level.

CAREER OPPORTUNITIES

Biotechnology laboratory technicians gain employment in private, governmental, or educational laboratories that perform research in basic or applied science or in the development of therapeutic proteins, pharmaceuticals, and medical devices. Biotechnology laboratory technicians receive training in advanced analytical instrumental techniques, including HPLC, GC-mass spectrom-

etry, AA, IR and UV-vis spectrometry using integrated data stations. Students receive hands-on laboratory techniques in preparation of reagents, buffers and media, aseptic techniques and gravimetric and titrimetric analysis, maintaining laboratory notebooks, and data collection and management. Students receive advanced training in industrial cell culture, recombinant DNA methodologies, PCR, ELISAs, bioseparations, and electrophoretic analysis of proteins and DNA.

PROGRAM EXPENSES

The recent reauthorization of the Higher Education Act requires all colleges and universities to notify students and prospective students of all program costs for which they will be responsible. Students will be responsible for the following expenses:

- Quarterly tuition (\$45 per credit hour)
- Quarterly student activity fees (\$16)
- Quarterly registration fee (\$26)
- Quarterly accident insurance fee (\$4)
- Quarterly instructional and technology supply fee (\$35)
- Program supply fee (Varies – see course descriptions for exact costs)
- Textbooks (Approximately \$3,500 for associate degree program, \$1,200 for Analytical Chemistry Laboratory Technician program, \$1,700 for Biological Sciences Laboratory Technician program, \$2,000 for Molecular Biology Technician program, and \$1,300 for Regulatory Compliance Technician program)

The expenses are based on costs in effect at the time this catalog was published. Prices are subject to change.

ADMISSION REQUIREMENTS

Applicants must submit the following information to the Admissions Office:

- a. Completed and signed application for admission and a \$20 nonrefundable application fee;
- b. Official high school or GED transcripts and/or official college transcripts from all colleges attended in the past that document completion of two units of algebra or more advanced mathematics (see *General Admission Requirements*); and
- c. Valid COMPASS, ASSET, SAT, or ACT test scores (see *ASSET and COMPASS Placement Tests*).

BIOTECHNOLOGY CURRICULUM OUTLINE

Associate of Applied Science Degree Program (Major Code: BI03)

Credit Required for Graduation: 104 quarter credit hours

	Credits
General Education	45
* BIO 1111 Biology I	5
* BIO 1112 Biology II	5
* CHM 1111 Chemistry I	5
* CHM 1112 Chemistry II	5
ENG 1101 Composition and Rhetoric	5
ENG 1102 Literature and Composition	5
* MAT 1111 College Algebra	5
PSY 1101 Introduction to Psychology	5
SPC 1101 Public Speaking	5
Science Core	32
BIO 200 Biotechnology Seminar	1
CHM 200 Introduction to Laboratory Safety	1
* CHM 201 Quantitative Analysis	6
* CHM 205 Organic Chemistry I	5
* CHM 206 Organic Chemistry II	5
* MIB 191 Fundamental Microbiology	5
* MIB 192 Applied Microbiology and Biotechnology	6
SCT 100 Introduction to Microcomputers	3
Science Major	27
BIO 201 Cell Biology and Immunology	6
* BIO 203 Applied Biotechnology and Recombinant DNA	6
* BIO 211 Industrial Cell Culture and Bioseparations	6
* CHM 202 Instrumental Analysis	4
AND	
* BIO 204 Applied Biotechnology	
OR	5
* CHM 203 Applied Instrumental Analysis	

**Students must pass courses with grades of C or better.*

ANALYTICAL CHEMISTRY LABORATORY TECHNICIAN CURRICULUM OUTLINE

Technical Certificate of Credit (Major Code: ANL1)

Credit Required for Completion: 48 quarter credit hours

	Credits
Technical Certificate	48
CHM 1111 Chemistry I	5
CHM 1112 Chemistry II	5
CHM 201 Quantitative Analysis	6
CHM 202 Instrumental Analysis	4
CHM 205 Organic Chemistry I	5
CHM 206 Organic Chemistry II	5
CHM 210 Environmental Biotechnology	5
ENG 1101 Composition and Rhetoric	5
MAT 1111 College Algebra	5
SCT 100 Introduction to Microcomputers	3

BIOLOGICAL SCIENCES LABORATORY TECHNICIAN CURRICULUM OUTLINE

Technical Certificate of Credit (Major Code: BSL1)

Credit Required for Completion: 57 quarter credit hours

			Credits
General Education			30
BIO	1111	Biology I	5
CHM	1213	Survey of Inorganic Chemistry	5
CHM	1214	Survey of Organic Chemistry and Biochemistry	5
ENG	1101	Composition and Rhetoric	5
ENG	1105	Technical Communications	5
MAT	1111	College Algebra	5
Occupational Core			27
BIO	201	Cell Biology and Immunology	6
BIO	211	Industrial Cell Culture and Bioseparations	6
BIO	221	Regulatory Compliance in Biomanufacturing	3
MIB	191	Fundamental Microbiology	5
MIB	192	Applied Microbiology and Biotechnology	6

MOLECULAR BIOLOGY TECHNICIAN CURRICULUM OUTLINE

Technical Certificate of Credit (Major Code: MBL1)

Credit Required for Completion: 55 quarter credit hours

			Credit
General Education			20
* BIO	1111	Biology I	5
* CHM	1111	Chemistry I	5
* ENG	1101	Composition and Rhetoric	5
* MAT	1111	College Algebra	5
Science Major			35
* BIO	201	Cell Biology and Immunology	6
* BIO	203	Applied Biotechnology and Recombinant DNA	6
* CHM	200	Introduction to Laboratory Safety	1
* CHM	201	Quantitative Analysis	6
* CHM	205	Organic Chemistry I	5
* MIB	191	Fundamental Microbiology	5
* MIB	192	Applied Microbiology and Biotechnology	6

REGULATORY COMPLIANCE TECHNICIAN CURRICULUM OUTLINE

Technical Certificate of Credit (Major Code: REG1)

Credit Required for Completion: 49 quarter credit hours

			Credits
General Education			30
BIO	1111	Biology I	5
CHM	1213	Survey of Inorganic Chemistry	5
CHM	1214	Survey of Organic Chemistry and Biochemistry	5
ENG	1101	Composition and Rhetoric	5
ENG	1105	Technical Communications	5
MAT	1111	College Algebra	5

Occupational Core

BIO	221	Regulatory Compliance in Biomanufacturing	4
BIO	222	Quality Assurance and Validation for Biomanufacturing	3
BIO	223	Patents and Technology Transfer	3
CHM	200	Introduction to Laboratory Safety	1
MIB	191	Fundamental Microbiology	5
SCT	100	Introduction to Microcomputers	3

BIOLOGY

Department Code: BIO

BIO 200

Biotechnology Seminar (1-0-1)

Banner Title: Biotechnology Seminar

This seminar class covers topics of special interest to the biotechnology field. Topics may include current events, career orientation, employability skills, laboratory specializations, and facilities tours. Former students and local biotechnology employees present information.

Prerequisite: Program admission

Offered Winter term

BIO 201

Cell Biology and

Immunology (3-9-6)

Banner Title: Cell Biology and

Immunology

This course addresses the composition, structure, and function of cells, as well as essential concepts in immunology. Lectures discuss macromolecules, metabolism, growth, communication, development, differentiation, cell division, the cell cycle, cell-mediated and antibody-mediated immune responses, vaccine immunization, and monoclonal antibodies. Additional topics include immunological mechanisms and special cell types. In the laboratory, students perform experiments that require culture and maintenance of cells, study cell types, fluorescence microscopy, metabolism, and isolate and characterize cell components and organelles. Students will also perform protein purification and Enzyme-Linked Immunosorbent Assays (ELISAs).

Prerequisites: BIO 203

Offered Summer and Winter terms

BIO 203

Applied Biotechnology and Recombinant DNA (3-9-6)

Banner Title: Recombinant DNA

The genetic manipulation of cells and organisms generating lines that produce biologically important molecules which have enhanced disease resistance or other desirable traits is the heart of the biotechnology industry. This course provides in-depth knowledge of the structure and function of DNA at the molecular level.

Students will perform fundamental techniques involved in genetic engineering, including restriction analysis, plasmid isolation, generation of recombinant DNA, preparation of gene problems, Southern blot analysis and PCR techniques.

Prerequisite: MIB 192

Offered Fall and Spring terms

BIO 204

Applied Biotechnology (2-9-5)

Banner Title: Applied Biotechnology

This course involves the successful completion of three components. Students fulfill component one by performing a four-week internship in a local biotechnology company or in a research laboratory at a local academic/government facility that relates to the student's career goals. Component two is a directed, though largely independent, four-week laboratory project in the college's Biotechnology teaching laboratory. Students must write and present a technical report relevant to their internship experience (component one) and to the rationale, methodology, results, and conclusions of their independent research project (component two). To satisfy component three, students must research, write, and present a technical report about an assigned, commercially available laboratory research product and a selected class of genetically modified organisms used in biotechnology industries.

Prerequisites: BIO 201, BIO 203, MIB

192, or permission of department

Offered Spring term

BIO 211

Industrial Cell Culture and Bioseparations (3-9-6)

Banner Title: Industrial Cell Culture

This laboratory course teaches the skills needed to serve as a technician in biotechnology production. Students grown and monitor bacterial, yeast, and mammalian cells on a laboratory scale that emulates the large-scale production used in industry. Students will become familiar with the cleaning, sterilization, aseptic inoculation, operation, and monitoring of fermenters and bioreactors. Students then recover and purify proteins pro-

duced by those cell cultures. They recover and purify proteins using centrifugation, ultrafiltration, and chromatography techniques. The course emphasizes the use of current good manufacturing practices (cGMP), and students gain experience following standard operating procedures (SOPs).

Prerequisite: BIO 201

Offered-Fall and Spring terms

BIO 221

Regulatory Compliance in Biomanufacturing (3-3-4)

Banner Title: Regulatory Compliance

This course is an introduction to regulatory agencies and the role of cGMP compliance in manufacturing of drugs, biologics and medical devices. The course initially explores the role of governmental oversight and regulation, particularly by the FDA, during the discovery, development and manufacturing of new products produced by the pharmaceutical and biotechnological industries. Benchmark Congressional Acts (e.g. the Food, Drug and Cosmetic Act) are studied while describing the evolution of the FDA to its present state. Case studies are emphasized. Students are introduced to facilities and processes used in the manufacture and packaging of pharmaceuticals (drugs and biologics) and medical devices. Thus studied are facility design, monitoring systems, cleaning and sterilization, clean room environments, and fill and packaging operations. The course emphasizes how good documentation practices assure the quality and safety of a product as the manufacturing process moves a product down the production pipeline.

Prerequisite: Program admission

Offered on an as-needed basis for the

Regulatory Compliance Technician technical certificate of credit

BIO 222

Quality Assurance and Validation for Biomanufacturing (2-3-3)

Banner Title: Quality Assurance/Validation

This course provides information on quality assurance and validation principles and applications in the biotech-

nology, biopharmaceutical, and medical device industries. Instructors emphasize manufacturing processes, specific dosage forms, FDA rationale, and documentation requirements.

Prerequisite: Program admission

Offered on an as-needed basis for the Regulatory Compliance Technician technical certificate of credit

BIO 223

Patents and Technology

Transfer (3-0-3)

Banner Title: Patents and Technology Transfer

Students are introduced to the role of patents, one type of intellectual property, in advancing technological innovation and promoting economic development. The requirements for the issue of a patent are described together with the legal rights that are thereby conferred to the patent holder. Topics include the preparation of the patent application and its filing with, and examination by, the United States Patent and Trademark Office. The course explores how the patented invention may be commercialized in the process of technology transfer. Emphasis is placed on the patenting and transfer of technologies pertinent to the biotechnology, pharmaceutical, and medical device industries.

Prerequisite: Program admission

Offered on an as-needed basis for the Regulatory Compliance Technician technical certificate of credit

BIO 1111

Biology I (4-3-5)

Banner Title: Biology I

Biology I is the first part of a 10-hour sequence. It covers cell structure, basic chemistry as applied to biological processes, cellular respiration, photosynthesis, genetics, natural selection, and ecology. Students must pay a \$20 supply fee when registering for this course.

Prerequisite: Program admission

Offered quarterly

BIO 1112

Biology II (4-3-5)

Banner Title: Biology II

BIO 1112 is the second part of a 10-hour sequence of coursework. It covers classification and structural adaptations of all organisms, including prokaryotes, protists, fungi, plants, and animals. The course further divides the classification of animals into vertebrates and invertebrates. Students must pay a \$20 supply fee when registering for this course.

Prerequisite: BIO 1111 with a grade of C or better

Offered quarterly

CHEMISTRY

Department Code: CHM

CHM 200

Introduction to Laboratory Safety (1-0-1)

Banner Title: Intro to Laboratory Safety

This course introduces the principles of laboratory safety in biological and chemical laboratories. Topics include safe lab practices, regulatory agencies, handling, storage, protective equipment, emergency response, and biological hazards.

Prerequisite: Provisional admission

Offered Summer term

CHM 201

Quantitative Analysis (4-6-6)

Banner Title: Quantitative Analysis

Students develop expertise in laboratory measurements and stoichiometry. They also develop skills in wet chemical analysis. This course stresses fundamental theories of quantitative analysis involving gravimetric analysis, volumetric analysis, and instrumental methods such as spectrophotometry.

Prerequisites: CHM 1112 with a grade of C or better, MAT 1111 with a grade of C or better

Offered Fall and Spring terms

CHM 202

Instrumental Analysis (2-6-4)

Banner Title: Instrumental Analysis

This course covers the theory of operation and analytical applications of ultraviolet/visible spectroscopy, infrared spectroscopy, atomic spectroscopy, gas chromatography, and high performance liquid chromatography. Students begin to develop expertise in the techniques involving the operation of many common laboratory instruments. Students will analyze samples using instrumental methods.

Prerequisite: CHM 1112 with a grade of C or better

Offered Fall term

CHM 203

Applied Instrumental Analysis (2-9-5)

Banner Title: Applied Instrumental Analysis

Instructors provide detailed instruction on sampling techniques and absorption characteristics of various compounds. Students receive additional hands-on experience in the operation of laboratory instrumentation. Students complete special projects utilizing and expanding on skills and techniques learned in earlier courses. In some circumstances, students

may receive all or partial credit for this course based on work experience or by completing an appropriate internship.

Prerequisite: CHM 202 with a grade of C or better or permission of department

Offered Winter term

CHM 205

Organic Chemistry I (4-3-5)

Banner Title: Organic Chemistry I

This course is the first of a 10-hour sequence on the organic chemistry of alkanes, alkenes and their substitution products, reactions, nomenclature, functional groups, and electron structure. Students perform hands-on laboratory exercises in organic chemistry. They gain experience in synthesis and techniques relating to isolation and purification and to the identification of organic compounds.

Prerequisite: CHM 1111 with a grade of C or better

Offered Winter and Summer terms

CHM 206

Organic Chemistry II (4-3-5)

Banner Title: Organic Chemistry II

This course is a continuation of CHM 205. Course content includes spectroscopy, aromatic compounds, and a survey of carbonyl compounds and their reactions. Instructors place emphasis on bioorganic compounds as they relate to biological structure and function. Students perform hands-on laboratory exercises to gain additional experience in instrumentation, synthesis, and techniques relating to isolation and purification. They also expand their capabilities related to the identification of organic compounds.

Prerequisite: CHM 205 with a grade of C or better

Offered Spring term

CHM 210

Environmental Biotechnology (4-3-5)

Banner Title: Environmental Biotechnology

This course provides an introduction to concepts related to environmental chemistry pertaining to the study of the sources, reactions, transport, effects, and fates of chemical and biological species in water, soil, and air environments. The course also provides an overview of water and wastewater treatment processes and the laws and regulations pertaining to the management of solid and hazardous wastes, air quality, and water quality. The laboratory component of the course will focus on the techniques and methods used in a basic water and wastewater

laboratory, as well as methods related to environmental sampling and analysis regarding environmental monitoring.
Prerequisite: CHM 1111 with a grade of C or better
Offered Spring term

CHM 1111
General Chemistry I (4-3-5)

Banner Title: General Chemistry I
Chemistry I is the first part of a 10-hour sequence. Instructors introduce basic principles and concepts that explain the behavior of matter. Topics include measurements, atomic structure, chemical bonding, physical states of matter, nomenclature, stoichiometry, and properties of solutions. Students must pay a \$25 supply fee when registering for this course.
Prerequisite: Associate degree program admission
Offered quarterly

CHM 1112
General Chemistry II (4-3-5)

Banner Title: General Chemistry II
CHM 1112 is the second part of a 10-hour sequence. It emphasizes equilibrium theory, solution chemistry, acid-base theory, and nuclear chemistry. Students must pay a \$25 supply fee when registering for this course.
Prerequisites: CHM 1111 with a grade of C or better, MAT 1111 with a grade of C or better
Offered quarterly

CHM 1213
Survey of Inorganic Chemistry (4-3-5)

Banner Title: Inorganic Chemistry
This course provides an introduction to basic chemical principles and concepts which explain the behavior of matter. Topics include measurements and units, structure of matter, chemical bonding, chemical reactions, gas laws, liquid mixtures, acids and bases, salts and buffers, and nuclear chemistry.
Prerequisite: MAT 1111 with a grade of C or better
Offered Fall term

CHM 1214
Survey of Organic Chemistry and Biochemistry (4-3-5)

Banner Title: Organic Chemistry Survey
This course provides an introduction to organic chemistry and biochemistry. Topics include the properties, structure, nomenclature, and reactions of hydrocarbons, alcohols, phenols, ethers, halides, aldehydes, ketones, carboxylic acids, esters, amines, and amides. Also included are the properties, structure, and function

of carbohydrates, lipids, proteins, and enzymes.
Prerequisites: CHM 1213 with a grade of C or better
Offered Winter term

ENGLISH

Department Code: ENG

ENG 1101
Composition and Rhetoric (5-0-5)

Banner Title: Composition and Rhetoric
Students practice various modes of writing ranging from exposition to argumentation and persuasion. The course also explores the analysis of literature and articles about issues in the humanities and in society. The course includes a review of standard grammatical and stylistic usage in proofreading and editing. An introduction to library resources lays the foundation for research. Topics covered in the course include writing analysis and practice, revision, and research. Students write a research paper using library resources and using a formatting and documentation style appropriate to the purpose and audience.
Prerequisites: ENG 099 with a grade of C or better and RDG 098 with a grade of C* or better or placement by diagnostic testing*
Offered quarterly

ENG 1102
Literature and Composition (5-0-5)

Banner Title: Literature and Composition
This course emphasizes the ability of students to read literature analytically and meaningfully and to communicate clearly. Students analyze the form and content of literature in historical and philosophical contexts. Topics include reading and analysis of fiction, poetry, and drama; research, and writing about literature.
Prerequisite: ENG 1101 with a grade of C or better
Offered quarterly

ENG 1105
Technical Communications (5-0-5)

Banner Title: Technical Communications
This course emphasizes practical knowledge of technical communications techniques, procedures, and reporting formats used in industry and business. Topics include reference use and research, device and process description, formal technical report writing, business correspondence, and oral technical report presentation.
Prerequisite: ENG 1101 with a grade of C or better
Offered quarterly

MATHEMATICS

Department Code: MAT

MAT 1111
College Algebra (5-0-5)

Banner Title: College Algebra
This course emphasizes techniques of problem solving using algebraic concepts. Topics include fundamental concepts of algebra, equations and inequalities, functions and graphs, systems of equations, analytic geometry, and optional topics, including sequences, series, and probability.
Prerequisite: MAT 097 with a grade of C or better and/or MAT 099 with a grade of C* or better or placement by diagnostic testing*
Offered Quarterly

MICROBIOLOGY

Department Code: MIB

MIB 191
Fundamental Microbiology (3-6-5)

Banner Title: Fundamental Microbiology
This course aims to provide students majoring in biotechnology with an introduction to the principles and techniques of microbiology and its current applications in research and industry. The course includes a survey of different major groups of microbial organisms, cell structure and function, microbial growth and control, microbial metabolism and genetics, and human exploitation of microbes and their products, including microbial biocontrol. Students gain laboratory proficiency in methods used in modern microbiology by focusing on aseptic media preparation and culture techniques for different microbes, microscopy, microbial isolation and identification, as well as genetic techniques, including bacterial transformations.
Prerequisite: BIO 1111 with a grade of C or better
Prerequisite/Corequisite: CHM 1111
Offered Fall and Spring terms

MIB 192
Applied Microbiology and Biotechnology (3-9-6)

Banner Title: Applied Microbiology/Biotech
This course introduces the concepts of biotechnology and fundamental laboratory skills associated with research, development, quality control, and production. Lectures will provide students with an introduction to the practical applications of organisms and their components and how they can be used to improve health, agriculture, and the environment.

Laboratory activities provide hands-on training in three fundamental areas of biotechnology: media preparation and culture of bacteria, preparation of recombinant DNA and analysis, and characterization and separation of proteins.

Prerequisites: CHM 1111, MIB 191

Offered Summer and Winter terms

PSYCHOLOGY

Department Code: PSY

PSY 1101

Introduction to Psychology (5-0-5)

Banner Title: Introduction to Psychology

This course emphasizes the basics of psychology. Topics include the science of psychology; social environments; life stages; physiology and behavior; personality; emotions and motives; conflicts, stress, and anxiety; abnormal behavior; and perception, learning, and intelligence.

Prerequisites: ENG 099 with a grade of

C or better and RDG 098 with a*

grade of C or better or placement*

by diagnostic testing

Offered quarterly

SCIENCE AND TECHNOLOGY

Department Code: SCT

SCT 100

Introduction to

Microcomputers

(1-4-3)

Banner Title: Intro to Microcomputers

This course introduces the fundamental concepts and operations necessary to use microcomputers. Course content emphasizes basic functions and familiarity with computer use. Topics include computer terminology and an introduction to the Windows environment, networking, word processing, spreadsheets, presentation graphics, and databases.

Prerequisite: Provisional admission

Offered quarterly

SPEECH

Department Code: SPC

SPC 1101

Public Speaking

(5-0-5)

Banner Title: Public Speaking

This course introduces the fundamentals of oral communication. Topics include selection and organization of materials, preparation and delivery of individual and group presentations, and analysis of ideas presented by others, and professionalism.

Prerequisites: ENG 099 with a grade of

C or better and RDG 098 with a*

grade of C or better or placement*

by diagnostic testing

Offered quarterly