

ABOUT BIOTECHNOLOGY/ BIOMANUFACTURING

Biotechnology, in its broadest definition, takes our understanding of life and uses that to solve problems across a wide variety of areas, including medicine, agriculture and industrial applications. These solutions come in the form of products and services. When bringing a new product or service to market, it will progress through three main stages: research, development, and production. The research and development associate degree prepares students for work in these early stages of the industry, while the biomanufacturing degrees (associate and bachelor's) focus on the later stage of production.

EMPLOYMENT WITH A BACHELOR'S DEGREE IN BIOMANUFACTURING

The bachelor's degree program prepares students for work within the biotechnology industry in the unique environment of biological production where science thrives in partnership with quality and compliance. Typical job titles include:

- (bio)manufacturing technician/associate
- bioprocess technician/associate
- quality assurance technician/associate/specialist
- quality control technician/associate/analyst
- quality specialist/coordinator/inspector
- biological technician
- (bio)production technician/associate
- (bio)manufacturing operator
- laboratory technician
- upstream technician/associate
- downstream technician/associate
- project manager in biomanufacturing/operations.

A 2014 labor market analysis for San Diego County had average entry-level wages for these types of positions at \$22.72 per hour (\$45K annual) and a median salary of \$31.41 per hour (\$63K annual).

For more information, go to
miracosta.edu/btec



MIRACOSTA COLLEGE

Biotechnology Program
miracosta.edu/biotech

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Kathy Thiele at 760.795.6874 or kthiele@miracosta.edu.

VISIT US!

Campus tours can be arranged by calling MiraCosta College's Outreach Office at 760.795.6894 or the Public Information Office at 760.795.6612. You may also request a tour given in Spanish; call 760.795.6894 to make arrangements. Let us show you around our beautiful campuses!

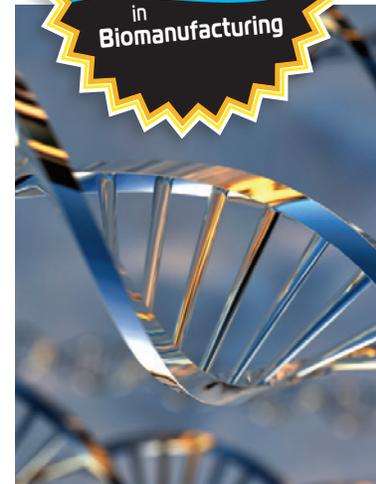
Can't come in person? Visit us online at miracosta.edu

All information in this brochure, including program inserts, is subject to change. Please see the current catalog catalog.miracosta.edu/disciplines/biotechnology for up-to-date information.

This brochure was funded by the Carl D. Perkins Career and Technical Education Improvement Act of 2006 (19-C01-032) awarded to MiraCosta College and administered by the California Community College Chancellor's Office. The District, and each individual who represents the District, shall provide access to its services, classes, and programs without regard to age, ancestry, color, physical or mental disability, pregnancy, gender, gender identity, gender expression, marital status, medical condition, genetic information, national origin, parental status, race or ethnicity, religion, sexual orientation, military or veteran status, or because he or she is perceived to have one or more of the foregoing characteristics, or based on association with a person or group with one or more of these actual or perceived characteristics.

BIOTECHNOLOGY

Bachelor's
Program
in
Biomanufacturing



Shaping Minds for Success.



ABOUT MIRACOSTA COLLEGE

MiraCosta College is an accredited public community college serving the North San Diego County coastal communities of Oceanside, Carlsbad, Encinitas, Cardiff, Rancho Santa Fe, Solana Beach, Del Mar and Carmel Valley.

MIRACOSTA COLLEGE HIGHLIGHTS

- Reasonable tuition*
- Highly qualified faculty members
- Small classes and personal attention from instructors
- Beautiful campuses with new and recently remodeled buildings
- State-of-the-art technology
- Free tutoring in most subjects
- Diverse student organizations and activities
- Concerts, lectures, theatre performances, art exhibits
- Services for disabled students
- Financial aid and scholarships for eligible students
- Plenty of parking

*Bachelor's degree students pay additional tuition (\$84/unit) on all upper division coursework. Non-residents and international students pay fees in addition to the resident enrollment fee. For more information about residency and non-resident fees, contact the Admissions & Records Office at 760.795.6620. Students planning to study in the U.S. on an F-1 visa should contact the International Students Office at 760.795.6897.

HOUSING & TRANSPORTATION

Although MiraCosta College does not provide on-campus housing, rentals are available nearby each campus. Students can view the classified section from the local newspaper at nctimes.com. The Student Activities Office maintains a list of housing options for students; call 760.795.6890.

The North County Transit District (NCTD) serves MiraCosta College. NCTD BREEZE buses and the SPRINTER service the Oceanside Campus. For current bus schedule, call 800.266.6833.

FINANCIAL AID

MiraCosta College offers a number of financial aid programs and scholarships for qualifying applicants. For additional information, contact the Financial Aid Office at 760.795.6711.

BIOTECHNOLOGY AT MIRACOSTA

Our beginnings. MiraCosta has been offering biotechnology classes since 1990, taught by experienced faculty and industry experts focused on workforce training. Since its inception, the Biotechnology program has been generously supported by state and federal grants and the local industry. MiraCosta's Biotechnology Department served as the Southern California Biotechnology Center from 1996 to 2001, where it developed cutting edge curriculum, accepted donations from industry on behalf of the region, performed outreach to local high schools, and coordinated with local and statewide initiatives with respect to biotechnology workforce development.

New program in biomanufacturing. The success of our Research and Development centered program attracted the attention of IDEC Pharmaceuticals in 2002 as they sought to assist in the development of a new training program to address the unique needs of biologics production: process scale, process control, and compliance. This was a skill-set largely underdeveloped in San Diego County. With the support of the college and key leadership at IDEC (and later Biogen Idec and Genentech), new curriculum was developed to complement our existing program and offer an educational program unlike any other in this region. In recognition of the partnerships and years of service to the local community, the college was designated by the US Department of Labor as a Center of Excellence in Bioprocessing.

Our facility. Biogen Idec recognized the need to have a dedicated immersive environment to conduct the training necessary for this new bioprocessing curriculum. They donated almost \$400,000 to the college to support the remodel of a new facility and to attract the lead faculty member. In partnership with many local biotechnology industry veterans, the facility was designed, constructed and opened to classes in 2006. The 3,500-square foot facility boasts \$1-million in state-of-the-art equipment, underscoring the hands-on approach MiraCosta has taken to train highly qualified technicians for local industry.

New bachelor's degree program. MiraCosta College is one of only 15 California community colleges recently authorized to offer a bachelor's degree program. Upper-division coursework for the biomanufacturing bachelor's degree began in fall 2017. The degree program prepares students for work within the biotechnology industry in the unique environment of biological production where science thrives in partnership with quality and compliance.

WHAT ARE YOU LOOKING FOR?

- If your goal is to earn a bachelor's degree in biomanufacturing, you can take freshman and sophomore-level courses at MiraCosta College and then apply for admission to the bachelor's degree program.
- If your goal is to start a career or advance in your present career, consider enrolling in one of our certificate programs. You'll gain marketable entry-level skills by earning a Certificate of Proficiency or Certificate of Achievement. Most coursework can also be applied to an associate degree or the bachelor's degree in biomanufacturing.

LABORATORY SKILLS

Laboratory Skills Program

This certificate of proficiency is designed to meet the increasing need for trained and competent associates in laboratory environments. The required courses provide students with fundamental laboratory skills to start or enhance a career in the biosciences. Students completing this certificate can expect employment utilizing their technical skills in the performance of tests and routine tasks inherent to a wide range of laboratory environments. This certificate is intended for the development of general laboratory skills as well as professional growth for those already employed in the industry.

Preparation for the Program

Students will be prepared to succeed in courses in biotechnology by taking the following prerequisite coursework or eligibility as determined by the appropriate placement process:

- ★ ENGL 50 Introduction to College Composition or equivalent
- ★ MATH 64 Intermediate Algebra
- ★ CHEM 140 Preparation for General Chemistry: For Science Majors

See list of certificate coursework on reverse side.



Certificate of Proficiency in Laboratory Skills

Required courses:

		Units
BIO 105	Introductory Biology: Biotechnology in Society	3
BTEC 110	Basic Techniques in Biotechnology	4
BTEC 120	Business and Regulatory Practices in Biotechnology	3
Total Units		10

To learn more about careers in biotechnology, please visit miracosta.edu/btec.

Courses listed are subject to change. Please check requirements in the current college catalog at catalog.miracosta.edu/disciplines/biotechnology or speak with a MiraCosta College general counselor.

BIOPROCESS TECHNOLOGY

Bioprocess Technology Program

This certificate of achievement provides a foundation in, and practical application of, the technologies employed by biotechnology companies engaged in the production of cell-derived products from small to large scales. Through a combination of applied lecture and hands-on laboratory instruction, students acquire the confidence, competence, and compliance for technical work in a regulated environment.

Careers in Bioprocess Technology

Bioprocess technologies encompass the operation of specialized equipment and instrumentation used to produce biopharmaceuticals or reagents utilized by biotechnology, pharmaceutical, and academic research labs. Students learn to grow a variety of cells, express a biomolecule of interest, and recover the desired biomolecule through a series of purification steps. They learn to follow good manufacturing practices by maintaining records in order to comply with quality system requirements and government regulations. This certificate is designed for bioprocess-technician skill development as well as professional development for those already employed in the industry.

Preparation for the Program

Students will be prepared to succeed in courses in biotechnology by taking the following prerequisite coursework or eligibility as determined by the appropriate placement process:

- ★ ENGL 50 Introduction to College Composition or equivalent
- ★ MATH 64 Intermediate Algebra
- ★ CHEM 140 Preparation for General Chemistry: For Science Majors

Students are advised to complete a college-level general biology course (BIO 105) before enrolling in biotechnology classes.

See list of certificate coursework on reverse side.

Certificate of Achievement in Bioprocess Technology

Required courses:

		Units
BTEC 110	Basic Techniques in Biotechnology	4
BTEC 120	Business and Regulatory Practices in Biotechnology	3
BTEC 211	Technical Writing for Regulated Environments	1
BTEC 221	Bioprocessing: Cell Culture and Scale-up	1.5
BTEC 222	Bioprocessing: Large Scale Purification	1.5

Select at least one course from the following: 1

BTEC 210	Data Analysis with Excel
BTEC 292	Internship Studies
BTEC 299	Occupational Cooperative Work Experience

Total Units 12

This bioprocessing certificate of achievement can be used as a starting point for the biomanufacturing certificate of achievement and associate degree and ultimately lead to the bachelor's degree in biomanufacturing at MiraCosta College. Please visit miracosta.edu/bachelors for details.

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RESEARCH & DEVELOPMENT

Research & Development Program

The Research and Development certificate of achievement is designed to meet the increasing need for entry-level laboratory technicians, especially in the field of research and development. Technicians in this field must be proficient in the application of scientific methodology to solve problems. They must learn and implement laboratory procedures and use specialized laboratory equipment. Competency in organizational, computational and communication skills is required. This program is designed to give students the theoretical background and practical experience necessary to be a bench-level scientist in both academic and industrial settings.

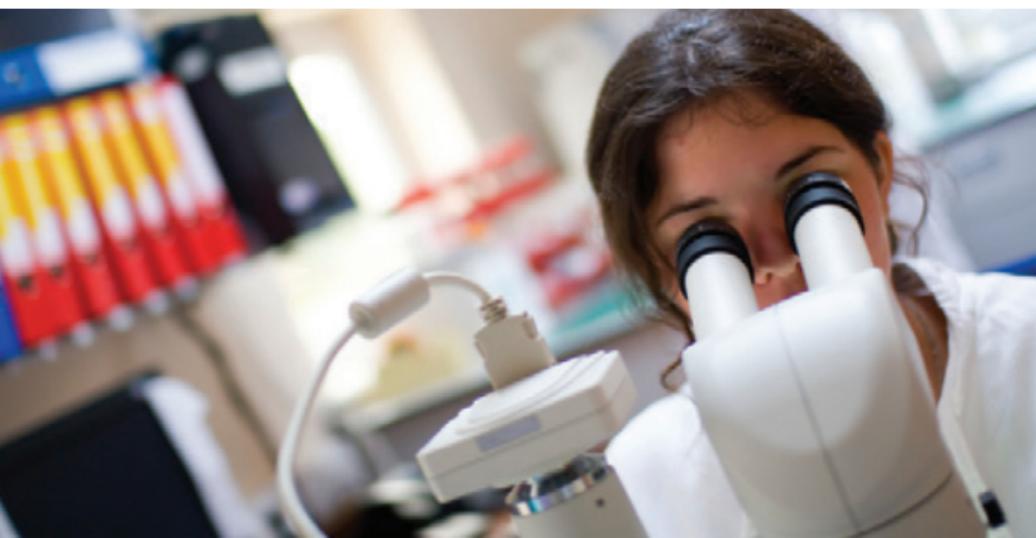
Careers in Research & Development

Graduates of the research and development program can expect to be employed in various capacities, including quality control, applied research, product development, analytical testing, and academic (basic) research.

Associate Degree in Research & Development

Students may earn an associate degree in research and development by completing the certificate of achievement and the general education courses required for MiraCosta College's associate degree. Students should meet with a counselor to identify required courses and to develop a written educational plan for the degree.

See list of certificate coursework on reverse side.



Certificate of Achievement in Research & Development

Required courses:		Units
BIO 105	Introductory Biology: Biotechnology in Society	3
BIO 204	Foundations of Biology: Biochemistry, Cell Biology, Genetics, and Molecular Biology	4
or BIO 204H	Foundations of Biology: Biochemistry, Cell Biology, Genetics, and Molecular Biology (Honors)	4
BTEC 110	Basic Techniques in Biotechnology	4
BTEC 120	Business and Regulatory Practices in Biotechnology	3
BTEC 180	Biostatistics	4
or MATH 150	Calculus and Analytic Geometry I	5
or MATH 150H	Calculus and Analytic Geometry I (Honors)	5
BTEC 210	Data Analysis with Excel	1
CHEM 150	General Chemistry I: For Science Majors	5
or CHEM 150H	General Chemistry I: For Science Majors (Honors)	
CHEM 151	General Chemistry II: For Science Majors	5
or CHEM 151H	General Chemistry II: For Science Majors (Honors)	
ENGL 100	Composition and Reading	4
or ENGL 100H	Composition and Reading (Honors)	4
Select at least 2 electives from below:		2
BTEC 201	Advanced Cell Culture	
BTEC 203	Techniques in DNA Amplification	
BTEC 204	Recombinant DNA	
BTEC 206	Principles of Separation and HPLC	
BTEC 207	Techniques in Immunochemistry and ELISA	
BTEC 292	Internship Studies	
BTEC 299	Occupational Cooperative Work Experience	
Total Units		35–36

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BIOMANUFACTURING

Biomanufacturing Program

Biomanufacturing leverages the understanding of biology to manufacture products or perform services that impact health, agriculture, the environment, and industrial needs.

The biomanufacturing certificate of achievement expands on the basic foundation acquired in the bioprocess technology certificate to further prepare entry-level technicians for employment in the regulated environment of biomanufacturing. Technicians in this field must learn and implement laboratory procedures and use specialized laboratory equipment in the production of a cell-based product. Competency in organizational, computational, and communication skills is required. This program is designed to give students the theoretical background and practical experience necessary to work effectively in biomanufacturing at the entry level as well as to prepare them for advancement to the baccalaureate degree in biomanufacturing at MiraCosta College.

Careers in Biomanufacturing

Graduates of this certificate program can expect to be employed in various capacities, including quality control, quality assurance, production, process development, and analytical testing.

Associate Degree in Biomanufacturing

Students may earn an associate degree in biomanufacturing by completing the certificate of achievement and the general education courses required for MiraCosta College's associate degree. Students should meet with a counselor to identify required courses and to develop a written educational plan for the degree.

See list of certificate coursework on reverse side.



Certificate of Achievement in Biomanufacturing

Required courses:

Units

BIO 105	Introductory Biology: Biotechnology in Society	3
BTEC 110	Basic Techniques in Biotechnology	4
BTEC 120	Business and Regulatory Practices in Biotechnology	3
BTEC 180	Biostatistics (or equivalent)	4
BTEC 210	Data Analysis with Excel	1
BTEC 211	Technical Writing for Regulated Environments	1
BTEC 221	Bioprocessing: Cell Culture and Scale-up	1.5
BTEC 222	Bioprocessing: Large Scale Purification	1.5
CHEM 150 or CHEM 150H	General Chemistry I: For Science Majors General Chemistry I: For Science Majors (Honors)	5
CHEM 151 or CHEM 151H	General Chemistry II: For Science Majors General Chemistry II: For Science Majors (Honors)	5
ENGL 100 or ENGL 100H	Composition and Reading Composition and Reading (Honors)	4

Select 2 courses from the following:

2

BTEC 201	Advanced Cell Culture
BTEC 203	Techniques in DNA Amplification
BTEC 204	Recombinant DNA
BTEC 206	Principles of Separation and HPLC
BTEC 207	Techniques in Immunochemistry and ELISA
BTEC 292	Internship Studies
BTEC 299	Occupational Cooperative Work Experience

Total Units

35

The biomanufacturing certificate of achievement and associate degree forms the lower-division preparation for the bachelor's degree in biomanufacturing at MiraCosta College. Please visit miracosta.edu/bachelors for details.

To learn more about careers in biotechnology, please visit miracosta.edu/btec.

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BACHELOR'S DEGREE IN BIOMANUFACTURING

Bachelor's Degree Program

The biomanufacturing baccalaureate develops the skills, abilities, and knowledge for students to work in the unique environment of biological production where the science thrives in partnership with quality and compliance.

Admission & Eligibility Requirements

The biomanufacturing BS degree builds upon the college's associate degree program in biomanufacturing. This degree will allow students who complete the associate degree or equivalent coursework from other colleges to enter as juniors and earn a baccalaureate.

Eligibility Requirements for Admission:

- A. Overall GPA of 2.0 for all coursework
- B. Completion of the following science prerequisites with no grade less than a C minus (or P) on a 4.0 scale:
 - General biology (BIO 105 or equivalent)
 - BTEC 110
 - BTEC 120
 - BTEC 210
 - BTEC 211
 - CHEM 150/150H
 - CHEM 151/151H
- C. Completion of the following prerequisites with a grade of C minus (or P) or better on a 4.0 scale:
 - ENGL 100
 - Statistics (BTEC 180 or equivalent)

Qualified applicants will be selected for admission based on a comprehensive review process that gives additional weight to the following:

- * Math and science GPA
- * Completion of BTEC 221 and 222
- * Completion of an associate degree in research and development, biomanufacturing, or equivalent
- * Completion of additional BTEC, BIO, CHEM or PHYS courses
- * Completion (or partial completion) of CSU-GE or IGETC
- * Employment in the biotech industry, including internships
- * Relevant life experiences or special circumstances such as disabilities, low family income, first generation college student, veteran status, and other criteria. For specifics on the comprehensive review process, see miracosta.edu/bachelors.

See list of certificate coursework on reverse side.

Bachelor's Degree in Biomanufacturing

Required upper-division coursework:		Units
BTEC 300	Supply Chain and Enterprise Resource Planning in Biomanufacturing	3
BTEC 310	Biomanufacturing Process Sciences	5
BTEC 320	Design of Experiments for Biomanufacturing	4
BTEC 330	Advanced Topics in Quality Assurance and Regulatory Affairs	4
BTEC 340	Six Sigma and Lean Manufacturing	3
BTEC 360	Design of Biomanufacturing Facilities, Critical Utilities, Processes, and Equipment	3
BTEC 400	Bioprocess Monitoring and Control	4
BTEC 410	Methods in Quality, Improvements, Investigations, and Audits	4
BTEC 460	Capstone Seminar in Biomanufacturing Technologies	3
BTEC 470	Capstone Seminar in Biomanufacturing Quality	3
BIO 340	Molecular Mechanisms of Disease	3
BUS 302	Leadership and Personal Development	3
PHIL 302	Bioethics	3
Total Units		45

Careers in Biomanufacturing

This degree program explicitly emphasizes the applied, quantitative analysis of biomanufacturing process design and performance. The program prepares graduates for employment in technical or quality positions in the manufacturing sector of the biotechnology industry, which includes biotherapeutics, diagnostics, supplies and services, and industrial products.

Tuition

Lower-division coursework currently costs \$46 per unit and upper-division coursework will cost an additional \$84 per unit, with an estimated total cost of the 4-year program of about \$10,000. Additional fees include health services, parking and student center. There will also be costs associated with books and materials.

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Representative 4-Year Plan

Topic	Year 1		Year 2		Year 3		Year 4	
English/ Communication	Area 1A: ENGL 100 (4U)	Area 1B (3-4U)		Area 1C (3U)				
Math	MATH 64 (4U)*	BTEC 180 (4U)						
Sciences (Prep for major and GE-Area 5)	BIO 105 (3U) CHEM 140 (4U)		CHEM 150 (5U)	CHEM 151 (5U)				
Major Courses		BTEC 110 (4U)	BTEC 120 (3U) BTEC 210 (1U)	BTEC 211 (1U) BTEC 221# (1.5U) BTEC 222# (1.5U) 200-level BTEC elective courses (2U)	BTEC 300 (3U) BTEC 360 (3U)	BTEC 310 (5U) BTEC 330 (4U) BTEC 340 (3U)	BTEC 320 (4U) BTEC 400 (4U) BTEC 410 (4U)	BTEC 460 (3U) BTEC 470 (3U)
Arts & Humanities GE-Area 3	One course (3U)	One course (3U)	One course (3U)					
Social & Behavioral Sciences GE-Area 4		One course (3U)	One course (3U)	One course (3U)				
Upper-Division GE					BIO 340 (3U)	BUS 302 (3U)	PHIL 302# (3U)	
Electives	Electives to meet 120-unit requirement for the degree							
<p>U=Units. All shaded requirements may be shifted between semesters to balance unit load. *Units are not bachelor's degree applicable. #Alternative scheduling options are available on the biotechnology program website for students completing their lower division at other institutions and for veterans who need to maintain full-time status during Year 3 and the fall term of Year 4.</p>								
TOTAL SEMESTER UNITS (MINIMUM): 120								