Biotechnology

Industrial Biotechnology

Program Description
This program prepares graduates to work in the biotechnology industry as production technicians. A production technician operates and maintains the equipment used to manufacture protein pharmaceuticals or other products. Students will grow bacterial, yeast, and mammalian cells and recover the proteins that they produce. They will follow good manufacturing practices by maintaining records in order to comply with quality assurance procedures and government regulations. Students in the program must be able to adjust their time to a flexible schedule.

Associate in Science Degree
The Associate in Science Degree can be obtained upon completion of the 22-24 unit major, general education requirements and electives. All courses in the major must be completed with a minimum grade of C or a P if the course is taken on a Pass/No Pass basis.

Program Outcomes
Students who complete the Industrial Biotechnology Associate Degree will be able to:

1. Explain how the structure and function of protein pharmaceuticals and evaluate which protein properties a production facility can exploit to purify a particular protein from other cellular components.
2. Construct a pathway analyzing how a drug or biologic is produced by genetically engineered cells and subsequently purified.
3. Explain how the manufacturer of pharmaceuticals is regulated by the Food and Drug Administration and other international regulatory agencies and how quality systems assure the safety, purity, identity, consistency, potency, and stability of a product.

REQUIRED COURSES	**Units**
BIOT 001 Principles of Biotechnology	3
BIOT 052 Business, Regulatory and Quality Practices in Biotechnology	3
BIOT 062 Cell Culture and Protein Recovery	4
BIOT 063 Biotechnology Instrumentation: Quality Control & Genetic Engineering	4
Select Option A or Option B	8-10
Required Major Total Units	**22-24**

Option A	**Units**
BIO 002 Principles of Cell and Molecular Biology	5
CHEM 001 General Chemistry I	5

Option B	**Units**
BIO 014 Principles of Microbiology	4
CHEM 010 Intermediate Chemistry	4

CSU General Education or IGETC Pattern units	**37-39**
Transferable Electives (as needed to reach 60 units)	**3-7**
Total Degree Units CSU GE or IGETC	**60**

Solano General Education	**21**
Electives (as needed to reach 60 units)	**17-19**
Total Degree Units Solano GE	**60**

** 6 units may be double counted toward both the major area of emphasis and CSU General Education or IGETC Pattern. Consult with a counselor for more information on completing this degree.*

NOTE: Prior knowledge and use of computers is advised, including word processing, spreadsheets, and databases.

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Certificate of Achievement
The Certificate of Achievement can be obtained upon completion of the 18-24-unit major. Each course must be completed with a minimum grade of C or a P if the course is taken on a Pass/No Pass basis.

Program Outcomes
Students who complete the Industrial Biotechnology Associate Degree will be able to:

1. Explain how the structure and function of protein pharmaceuticals and evaluate which protein properties a production facility can exploit to purify a particular protein from other cellular components.
2. In preparation to working at a biotechnology company, a successful student should be able to construct a pathway analyzing how a drug of biologic is produced by genetically engineered cells and subsequently purified.
3. Explain how the manufacturer of pharmaceuticals is regulated by the Food and Drug Administration and other international agencies and how quality systems assure the safety, purity, identity, consistency, potency, and stability of a product.

REQUIRED COURSES	**Units**
BIOT 001 Principles of Biotechnology	3
BIOT 052 Business, Regulatory and quality Practices in Biotechnology	3
BIOT 062 Cell Culture and Protein Recovery	4
BIOT 063 Biotechnology Instrumentation: Quality Control & Genetic Engineering	4
Choose Option A, B or C	4-10
Required Major Total Units	**18-24**

Option A	**Units**
BIO 002 Principles of Cell and Molecular Biology	5
CHEM 001 General Chemistry I	5

Option B	**Units**
BIO 014 Principles of Microbiology	4
CHEM 010 Intermediate Chemistry	4

Option C	**Units**
BIOT 160 Basic Concepts/Methods in Biotechnology	4

NOTE: Prior knowledge and use of computers is advised, including word processing, spreadsheets, and databases.

This is a Gainful Employment Program. For additional information, please visit ***http://www.solano.edu/gainful_employment/*** and select "Industrial Biotechnology."

Biotechnology

Biotechnology Laboratory Assistant

Program Description
This program serves as a Bridge to Biosciences, enabling graduates to enter the Solano College Industrial Biotechnology program or to enter an entry level position in a biotechnology company. It serves as a stackable certificate that may be followed by Industrial Biotechnology Certificate or an Applied Biotechnology Certificate. A Laboratory Assistant may be hired by life science related companies to prepare buffers, prepare media, operate routine laboratory equipment, and to clean glassware.

Certificate of Achievement
The Certificate of Achievement can be obtained upon completion of the 14-unit major with a minimum grade of C or a P if the course is taken on a Pass/No Pass basis.

Program Outcomes
Students who complete the Industrial Biotechnology Certificate of Achievement will be able to:

1. Demonstrate the ability to perform routine laboratory techniques including buffer preparation, media preparation, and aseptic microbial culture.
2. Demonstrate the ability to perform mathematical (algebraic) operations required for calculations important in chemistry and biology.
3. Demonstrate the ability to read and write in a range of writing style categories typical of laboratory and scholarly environments, including lab reports, expository texts, and research-based arguments.

REQUIRED COURSES	**Units**
BIOT 160 Basic Concepts/Methods in Biotechnology	4
MATH 330 Elementary Algebra	5
ENGL 360 Focused English Fundamentals	5
Total Units:	**14**

This is a Gainful Employment Program. For additional information, please visit ***http://www.solano.edu/gainful_employment/*** and select "Biotechnology Laboratory Assistant."

Biotechnology

BIOT 001 Principles of Biotechnology 3.0 Units

Prerequisite: A minimum grade of C in BIO 014, BIO 002 or BIOT 160.
Transferable to UC/CSU
Hours: 48-54 lecture.

Covering topics important in the development, production, recovery, and analysis of products produced by biotechnology. The course traces the path of a drug or biologic from the cell through the production facility, the final processing, and into the human body. It discusses the growth characteristics of the organisms used to produce pharmaceutical proteins, the techniques used in product recovery, and the techniques used in product analysis. Formerly BIOT 051. *(C-ID BIOT 101X)*

BIOT 003 3.0 Units

Fermentation: The Science of Beer and Brewing

Prerequisite: Must be at least 18 years of age to enroll.
Course Advisory: Eligibility for ENGL 001; SCC minimum Math standard.
Transferable to UC/CSU
Hours: 32-36 lecture, 48-54 lab.

Beer making, the oldest biotechnology process, is used to introduce students to the concept of employing living cells to produce a value-added product. The course utilizes brewing principles to explore basic scientific, agricultural, and engineering principles: yeast cell structure and growth, cellular biochemistry including metabolism and fermentation, plant physiology and the agricultural practices used to grow different varieties of barley and hops, the biochemistry of malted barley and hops, the chemical reactions that occur during mashing and brewing, and the basic engineering of brewing equipment and processes. The course also covers business, regulatory, and cultural issues related to brewing. In the laboratory, students will brew beer using modern techniques and equipment. This class is limited to students 18 and over and no one under the age of 21 will be able to taste a fermented product.

BIOT 052 3.0 Units

Business, Regulatory, and Quality Practices in Biotechnology

Course Advisory: Eligibility for ENGL 001 and SCC minimum Math standard.
Transferable to CSU
Hours: 48-54 lecture.

Examine how basic business principles and sound manufacturing procedures assure the quality and safety of a biopharmaceutical as the manufacturing team moves a product down the biotechnology production pipeline. The course explores the role of governmental oversight, Quality Assurance practices, and regulation during the discovery, development, and manufacturing of new products produced by biotechnology. The course includes a discussion of current Good Manufacturing Practices, Good Laboratory Practices, Quality Assurance, Quality Control, and Validation.

BIOT 057 3.0 Units

Synthetic Biology and Algea Biotechnology

Prerequisite: A minimum grade of C in BIO 002 or BIO 014
Transferable to CSU
Hours: 32-36 lecture, 48-54 lab.

Combines two emerging areas in biotechnology through exploration of advances in synthetic biology and algae biotechnology. Synthetic biology applies advanced gene editing techniques for the creation of new organisms. Topics include synthetic DNA synthesis, minimal cells, manipulation of biobricks, gene circuits, CRISPR/Cas and other gene editing tools, and cell free production. These techniques can be utilized to produce biomaterials, DNA for gene therapy, and algae bio-based production. Students isolate, identify, manipulate, grow, monitor, and harvest algae for biofuels, nutraceuticals, industrial enzymes, and therapeutic proteins in the laboratory.

BIOT 062 Cell Culture and Protein Recovery 4.0 Units
Prerequisite: A minimum grade of C in BIO 002, BIO 014 or BIOT 160.
Course Advisory: Eligibility for ENGL 001.
Transferable to CSU
Hours: 32-36 lecture, 96-108 lab.
This laboratory course teaches the skills needed to serve as a technician in biotechnology production. Students grow 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 produced 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 (SOP).

BIOT 063 4.0 Units
Biotechnology Instrumentation: Quality Control & Genetic Engineering
Prerequisite: A minimum grade of C in BIO 014, BIO 002 or BIOT 160.
Course Advisory: Eligibility for ENGL 001.
Transferable to CSU
Hours: 32-36 lecture, 96-108 lab.
Familiarizes students with small scale laboratory practices, both those used in a research laboratory and those used by a quality control department in industry, to analyze the quality of a cell culture process and the purity of protein products produced by cells in culture. The course emphasizes the use of Good Laboratory Practices (GLP) in these analyses. Students will gain experience in techniques used to analyze nucleic acids and in the genetic engineering of cells. They will also gain experience with the common assays used in Quality Control including electrophoresis, High Performance Liquid Chromatography (HPLC), Enzyme Linked Immunosorbant Assay (ELISA), and Polymerase Chain Reaction (PCR) to test products generated using cell culture.

BIOT 065 1.0 Unit
Biomanufacturing Fundamentals
Prerequisite: A minimum grade of C in BIO 002 or BIO 014.
Transferable to CSU
Hours: 8-9 lecture, 24-27 lab.
A short format course that explores the basic biological, chemical, engineering, and regulatory concepts utilized to manufacture products using genetically engineered cells. It covers host strain selection, cell banking and seed train, bioreactor operation and monitoring, recovery and purification techniques, and the regulatory environment required for biomanufacturing of products at a large scale.

BIOT 160 4.0 Units
Basic Concepts/Methods in Biotechnology
Course Advisory: MATH 330 with a minimum grade of C; SCC minimum English standard.
Hours: 32-36 lecture, 96-108 lab.
This course serves as a prerequisite to Solano College's biotechnology courses by giving students knowledge of the basic concepts in biology and chemistry used in biotechnology while also developing the basic laboratory skills required to succeed in the field.