

Biotechnology is primarily the application of DNA technology. This technology uses DNA sequences from any organism or synthesized and modified genes for transfer to cells across species boundaries to obtain a desired outcome. It has a wide range of applications including medicine, agriculture, forensics and the environment, as well as industrial applications in most of these areas. With this technology, a laboratory may produce vaccines, antibiotics, genetically modified cell lines or nutritionally enriched food products. This technology has the potential to reduce environmental pollution. Crops with genes imported from another source can increase crop yield, be more insect resistant and make its own fertilizer. Transgenic crops may one day reduce tillage farming and thus reduce soil erosion. Both embryonic and adult stem-cell technology in the health sciences relies on biotechnology strategies.

The U.S. Department of Labor reports that while the biotechnology industry has historically employed Ph.D.s and Master Degree graduates, the growing industry trend is to seek baccalaureate and associate degree graduates who can perform routine but essential technical tasks.

The Department of Biological Sciences at Kingsbor

courses. Both Dr. Jahanjir and Dr. McEntee have been faculty participants in CSTEP grants and are committed to recruiting and mentoring more nontraditional students into biotechnology studies.

A dedicated standard biotechnology laboratory of about 800 square feet working area has been created to provide students with essential laboratory training in this field. The acquisition of a80(ddnjT equipetTstreated lsm)

1. Purpose and goals

Biotechnology is primarily the application of DNA technology both practical and theoretical. This technology uses DNA sequences from any organism or synthesized and modified genes for transfer to cells across species boundaries to obtain a desired outcome. It has a wide range of applications including medicine, agriculture, forensics and the environment, as well as industrial applications in most of these areas. With this technology, a laboratory may produce vaccines, antibiotics, genetically modified cell lines or nutritionally

biotechnology and life science progra

Proposed A.S. in Biotechnology

Total Credits: 60

Requirements for Matriculants

COLLEGE REQUIREMENTS 10 Cr (Credits)

Successful completion of CUNY/ACT Tests in Reading and Writing and the COMPASS Math Skills Test with passing examination scores or developmental courses may be required.

ENG 01200	(4 cr)
ENG 02400	(3 cr)
HPE 01200	(3 cr)

DEPARTMENT REQUIREMENTS §

Departmental requirements (Proposed):

Biology: 20 Cr

BIO 13 General Biology I	(4 cr, 6 hrs)
BIO 14 General Biology II	(4 cr, 6 hrs)
BIO 50 General Microbiology or Bio 59 Genetics	(4 cr, 6 hrs)

Graduates of the A.S. in Biotechnology will be deemed to have automatically fulfilled the lower tier core requirements for a Brooklyn College baccalaureate degree with the exception of the foreign language requirement. Students will be required to complete two upper tier courses, from two of the three groups of courses approved effective September 2006. It will be recommended that they select from among the course groups *Exploring Literature* and *Exploring Global Connections*.

Graduates of the A.S. degree program who have not completed at least one year of foreign language study or established an equivalent proficiency may be asked to complete six (6) to eight (8) credits of foreign language coursework or establish an equivalent proficiency in addition to their normal degree requirements. Proficiency may be established based upon high school coursework, native language abilities or examination.

B.S. Degree Requirements for the Biology Major:

All of the following Lecture Courses (2 credits each)

Bio 17 – Cell and Molecular Biology (waived for students completing KCC Bio 63)
Bio 29 – Organismic Biology I (Plants) (waived for students completing KCC Bio 13 and 14)
Bio 34 – Animal Physiology OR Bio 34.1 – Comparative Physiology (either course waived for students completing KCC Bio 13 and 14)
Bio 38 -- Evolution and Ecology
Bio 45 -- Organismic Biology II (Animals)
Bio 52 – Microbiology (waived for students completing KCC Bio 50)
Bio 58 – Genetics (waived for students completing KCC Bio 59)

All of the following Laboratory Courses (2 credits each)

Bio 17.1 -- Eukaryotic Cell Biology and Physiology Lab (waived for students completing KCC Bio 63)
Bio 29.1W – Plant Form and Function Lab (satisfies the BC Writing Across the Curriculum Requirement for the Biology Major)
Bio 45.1 -- Animal Form and Function Lab
Bio 52.2 -- General Microbiology Lab (waived for students completing KCC Bio 50)

Choose from the Elective Courses below in order to satisfy the residency requirement of at least 24 credits taken in the Department of Biology; courses may be added or deleted in the future.

Bio 15 – Field Studies in Botany 4 credits
Bio 25 – Field Studies in Zoology 4 credits
Bio 26 – Developmental Biology Lecture 3 credits
Bio 27.5 – Molecular Biology of Development 4 credits
Bio 33 – Bioinformatics 2 credits (not open to students completing KCC Bio/CIS 60)
Bio 39.1 – Cell Culture Techniques 3 credits (not open to students completing KCC Bio 57)
Bio 55.1 – Recombinant DNA Lecture 3 credits (not open to students completing KCC BIO 58)
Bio 62.5 – Ecology 4 credits
Bio 73.1, 73.2 –Research I and II (or 83.1, 83.2 – Departmental Honors Courses) 3 credits each

Chemistry Requirements

The following Chemistry Courses or their equivalents are required

Chem 1, 2 – General Chemistry I and II 5 credits each (waived for students completing KCC CHM 11 and CHM 12)
Chem 51,52– Organic Chemistry I and II 5 credits each

Mathematics Requirements

The following Mathematics Courses or their equivalents are required

Math 2.9 – Precalculus Mathematics 3 credits
Math 3.3 – Calculus I 3 credits

Highly Recommended Additional Courses for Majors intending to earn advanced degrees in selected fields. Department faculty should be consulted:

General Physics I and II 5 credits each

Course distribution for A.S. in Biotechnology by semester:

Semester I		Semester II	
Fall	Winter module	Spring	Summer module
ENG 12 - 4 cr		ENG 24 - 3 cr	
BIO 13 - 4 cr		BIO 14 - 4 Cr	
CHM 11 - 4 cr		CHM 12 - 4 cr	

Course distribution for B.A. Degree in Biotechnology by semester:

Semester V		Semester VI	
Fall	Winter	Spring	Summer
BIO 29.1W – 2 cr		BIO 27.5 – 4 cr	
Elective: (BIO 52** or 58 – 2 cr)		BIO 38 – 2 cr	(* BIO 15 – 4 cr., is only offered in summer.
CHM 50 – 5 cr		Elect (BIO 39.1 or 55.1) – 3 cr	It may be taken in place
MAT 2.9 – 3 cr		MAT 3.3 – 3 cr	of elective otherwise
BIO 52.2** – 2 cr if needed		* Elective – 3 cr	taken in Fall or Spring.)
* Elective – 3 cr			
Total Credits = 15 or 17		Total Credits = 15	

Semester VII		Semester VIII	
Fall	Winter	Spring	Summer
BIO 33 – 2 cr		BIO 26 – 3 cr	(* BIO 25 – 4 cr ., is
BIO 45 – 2 cr		BIO 62.5 – 4 cr	only offered in summer.
BIO 45.1 – 2 cr		BIO 73.2 – 3 cr	May be taken in place
BIO 73.1 – 3 cr		* Electives – 5 cr	of elective taken in
* Electives – 6 cr			Fall or Spring.)
Total Credits = 15		Total Credits = 15	

Total credits at Brooklyn College = 60 credits

Course distribution for B.S. Degree in Biotechnology by semester:

Semester V		Semester VI	
Fall	Winter	Spring	Summer
BIO 29.1W – 2 cr		BIO 27.5 – 4 cr	
BIO 52 or 58 – 2 cr	-.Tt708 – 2 r		

Articulation with Brooklyn College:

The faculties of the Department of Biological Sciences, Kingsborough Community College, and the Department of Biology, Brooklyn College, have collaborated on the articulation of the A.S. in Biotechnology curriculum with the B.A. and B.S. in Biology curricula at Brooklyn College. This was facilitated through close consultation with Arthur Zeitlin, Department Chairperson, Professors of Biology, Peter Pilchman and Sarwar Jahangir, and Associate Dean Loretta DiLorenzo with Brooklyn College Professors of Biology, John Blamire and Ronald Eckhardt, and the Office of the Provost, Brooklyn College. The total of 60 credits required for the A.S. in Biotechnology will transfer to Brooklyn College and an additional 60 credits at Brooklyn College to complete the requirements for B.A. or B.S. in Biology.

5. Faculty

For over 15 years Dr. Sarwar Jahangir has taught in universities and colleges in the United States, Canada, India and Bangladesh. His research has focused on molecular genetics. As a result of funding from the National Oceanic and Atmospheric Association (NOAA), he developed a domesticated stock of transgenic lake sturgeon from a bacterial gene. He developed a biotechnology laboratory at Richard Stockton College of New Jersey. He has served as an advisor to Bangladesh Agricultural University in the development of a biotechnology course and laboratory. He was a visiting Assistant Professor at Wabash College, Indiana, teaching classical, molecular and advanced genetics involving biotechnology. He was again funded by NOAA for silver hake stock determination using microsatellite DNA. He was a visiting professor at Brooklyn College where he studied dedifferentiation of melanocytes in vitro for use in human neurotherapy. Currently, he is Assistant Professor of Biology at KCC and is teaching, conducting research and developing the biotechnology curriculum. His current research seeks to identify microsatellite DNA in bluefish for population determination. He is also co-funded for a CSTEP grant. Recently, he completed a research project at St. Vincent's Medical Center and NY Medical College, developing a recombinant vaccinia virus containing human interleukin-2 gene and obtaining US FDA approval for its application in human vaccination against melanoma (skin cancer).

Dr. Jahanjir will teach BIO 58, *Recombinant DNA Biotechnology* (4 cr. 6 hrs), and BIO 57, *Cell & Tissue Culture, and Cell Cloning*, (4 cr 6 hrs) and also work as the Director for the Biotechnology program. Other courses in the Biotechnology program are regularly offered and will not draw other faculty from their current teaching responsibilities. Some adjunct teaching may be required to cover Professor Jahanjir's current departmental teaching load when he assumes the directorship of the program.

Dr. Cathy McEntee has an excellent record of teaching molecular and cellular biology at Brooklyn College. Dr. McEntee completed her graduate work at the Medical College of Pennsylvania. She studied the regulation of gene transcription in yeast mitochondria under Dr. Hudson, who served as her graduate advisor. Dr. McEntee completed her postdoctoral research in the Department of and R8on of gene transcriptn in yet of aad

6. Facilities, Laboratory Equipment and Supplies

A biotechnology laboratory of about 800 square feet working area has been created to provide students with essential laboratory training in this field. Each laboratory bench has all the following supply-line connections: hot water, ambient temperature water, reverse osmosis water, double-distilled and de-ionized sterile water, gas, a vacuum line, and air (moisture, dust and lint free). We have one refrigerated high speed Sorvall centrifuge and a fixed angle rotor with adaptor, a desktop high speed refrigerated Perkin Elmer centrifuge, sets of precision micropipettes, agarose electrophoretic systems, one PAGE electrophoretic unit, a Miniblotter Western Blotting apparatus, one PCR Sprint Thermal Cycler, DNALinker, UV Transilluminator with camera, Polaroid gel photographic units, autoradiography cassettes, Mettler Toledo Precision Balance, a pH meter, LabConco Water purification Station, two laminar flow hoods for mammalian cell culture, one bacteria cell culture hood, inverted microscopes connectable through USB cable to PC computers, one temperature adjustable shaker, temperature adjustable incubators for cell culture, -80oC freezer, -23oC walk-in freezer room, 4oC walk-in refrigerated room, vacuum pu

until the fourth year and plateau by the fifth year. These revenue gains will offset the cost of initial and ongoing supply and equipment needs.

PROJECTED¹ EXPENDITURES FOR THE PROPOSED PROGRAM

Expenditures	1 st Year	2 nd Year	3 rd Year	4 th Year	5 th Year
Faculty ³					
New Resources ⁴	\$10,000	\$10,750	\$11,557	\$12,424	\$13,356
Equipment ⁵					
New Resources ⁴					

PROJECTED¹ REVENUE RELATED TO FOR THE PROPOSED PROGRAM

<i>REVENUES</i>	1 st Year	2 nd Year	3 rd Year	4 th Year	5 th Year
<i>TUITION REVENUE</i> ³					
01. FROM EXISTING SOURCES ⁴	-----	-----	-----		
02. FROM NEW SOURCES ⁵	22 X \$1,540X 2 = \$ 67,760	42 X \$1,540X 2 = \$ 129,360			
03. TOTAL	\$ 67,760	\$ 129,360			

Outcomes Assessment

Student learning and other outcomes of the A.S. in Biotechnology will be reviewed and assessed as part of the Department of Biological Sciences Assessment Plan for all programs and courses. The plan includes the articulation of course objectives and the identification of measures to determine the degree to which they have been achieved. Each year, the Biotechnology Program Director and faculty will focus on selected learning outcomes to assess and, based on the results, plan strategies for improving them.

In the fifth year of the program, the A.S. in Biotechnology will be subject to the same formal periodic review established by the college for all academic programs. The formal review process consists of a self-study based on established guidelines. These self-studies include: enrollment figures, students' skill levels, course performance data, student retention rates, number of certificates or degrees awarded and job placement or transfer trends among program graduates. A self-study report is submitted by the department to an outside evaluator who then visits the program on-site and submits a written evaluation of the two-day visit to the college. Based on the evaluator's recommendations for improving the program, a plan of action will be implemented. These annual and periodic assessments will be ongoing.