
TOPIC: University of Maryland, Baltimore County: Bachelor of Science in Translational Life Science Technology

COMMITTEE: Education Policy and Student Life

DATE OF COMMITTEE MEETING: Tuesday, November 15, 2016

SUMMARY: The proposed Bachelor of Science in Translational Life Science Technology (TLST) "...responds to the dual needs of improving human health and promoting economic development by preparing students for roles in translational science with career applications in the biomedical and behavioral disciplines. Translational (science) medicine, as defined by the NIH, is the application of knowledge and techniques to clinical practice at the front lines of patient care. It integrates basic knowledge with the aim of optimizing all aspects of patient care."

The curriculum for the program was developed in collaboration with Montgomery College in response to the identified need for a program that incorporated both academic rigor and university-guided, lab-based instruction. The *Education Advisory Board (EAB)* was enlisted to conduct research on the need for a baccalaureate degree in TLST in Maryland. The EAB report key findings guided the program development "...and included information that enrollment in general biotechnology programs typically have shown steady growth, noting that 'Montgomery County represents the highest demand for biotechnical graduates in the entire Mid-Atlantic region' with increases expected... that most employers required biotechnical bachelor's degrees rather than associate's degrees." The collaboration with Montgomery College extends to a fully developed articulation agreement for students who are pursuing the Associate of Applied Science degree in Biotechnology (see attached Appendix B).

Although a few existing programs in the State include similar lower-level course content, the proposed TLST program differs from other programs in the region of Maryland where the program will be offered, in the Upper Level (UL) content, in the UL laboratory work, and in the mathematics, bioinformatics, and professional experience requirements.

It is proposed that during the first two years of implementation, the program would be offered in Montgomery County utilizing facilities at both the Universities at Shady Grove (USG) and at Montgomery College. In the third year, upon completion of the Biomedical Sciences and Engineering Education Facility (BSE), the program will consolidate the course offerings at USG.

ALTERNATIVE(S): The Regents may not approve the program or may request further information.

FISCAL IMPACT: Tuition revenue will provide partial funding. The balance of expenditures will be covered by USM implementation funds in support of academic programs at the Universities at Shady Grove.

CHANCELLOR'S RECOMMENDATION: That the Committee on Education Policy and Student Life recommend that the Board of Regents approve the proposal from University of Maryland, Baltimore County to offer the Bachelor of Science in Translational Life Science Technology.

COMMITTEE RECOMMENDATION: Approval

DATE: November 15, 2016

BOARD ACTION:

DATE:

SUBMITTED BY: Joann A. Boughman

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UNIVERSITY SYSTEM OF MARYLAND INSTITUTION PROPOSAL FOR

 √ New Instructional Program
 Substantial Expansion/Major Modification
 Cooperative Degree Program

University of Maryland, Baltimore County – UMBC
Institution Submitting Proposal

Translational Life Science Technology: Proposal I – to offer the new program
Title of Proposed Program

Bachelor of Science – B.S.

Degree to be Awarded

Fall 2017

Projected Implementation Date

Proposed HEGIS Code

26.1201
Proposed CIP Code

College of Natural and Mathematical Sciences

College in which program will be located

Dr. William R. LaCourse
College Contact

(410) 455-5827
Contact Phone Number

lacourse@umbc.edu
Contact E-Mail Address

Signature of President or Designee

Date

A. Centrality to institutional mission statement and planning priorities

UMBC seeks approval to offer a proposed new Bachelor of Science in Translational Life Science Technology (TLST). UMBC plans to offer the TLST program in Montgomery County. This proposal seeks approval for UMBC to offer the new degree. A separate proposal, submitted simultaneously, seeks approval for UMBC to offer the TLST program off-campus.

Translational (science) medicine, as defined by the National Institutes of Health (NIH), is the application of knowledge and techniques to clinical practice at the front lines of patient care. It integrates basic knowledge with the aim of optimizing all aspects of patient care. The TLST program addresses the dual priorities of improving human health and promoting economic development. The proposed program prepares students for roles in translational science with career applications in the biomedical and behavioral disciplines. The proposed TLST program provides a local response to the growing importance of translational science as evidenced by the \$575 million investment by Congress in 2012 to establish the National Center for Advancing Translational Sciences (NCATS) under the NIH.

UMBC's mission statement describes the institution as one that integrates teaching and research to benefit Maryland citizens, and explicitly mentions "economic development of the State and the region through entrepreneurial initiatives, workforce training, (and) K-16 partnerships" (<http://about.umbc.edu/>). The collaborative TLST degree advances UMBC's commitment to community college partnerships, STEM education, and workforce development. The program supports UMBC's strategic goals by helping the institution to "provide a distinctive undergraduate education" and continuing its work "to build research...education."

B. Critical and compelling regional or Statewide need as identified in the State Plan

The proposed TLST program responds to the crucial need as highlighted in the Maryland State Plan for Postsecondary Education (2013-2017) "to offer a diverse array of high-quality postsecondary opportunities for Maryland residents" so they have the opportunities and support "needed to complete a postsecondary degree, certificate, or training program" while ensuring Maryland attracts "high-quality jobs"...by ensuring that its graduates "have the requisite skills desired by employers" (p. 8). One of the plan's key goals is to increase the number of STEM degrees awarded to students because STEM-related occupations "are closely tied to technological innovation, economic growth, and increased productivity" (p. 12). This plan cites data from the Georgetown University Center for Education and the Workforce (2012) that ranks "STEM jobs as the second fastest-growing occupation category in the nation, behind health care." It further notes that academic preparation in STEM disciplines is "of particular interest to the State" and cites the U.S. Chamber of Commerce report that "Maryland has the second highest concentration of STEM jobs in the nation, and is adding employment opportunities in these areas faster than all but five other states" (p. 12). The proposed TLST program will fill a gap in Maryland higher education while helping to strengthen Maryland's skilled workforce in applied life science technology. Although Maryland possesses one of the largest concentrations of medical and core biotechnology-related companies in the US – specifically in the Montgomery County area-- very few biotechnology undergraduate degree programs in the state train students for direct admission into the life science technology workforce.

The proposed TLST course of study offers a path to career and post-baccalaureate educational opportunities in bioscience to a diverse community with the important potential of increasing the number and retention of students in STEM. The rigorous academic program is complemented by lab-based instruction to ensure graduates are well prepared for an array of opportunities in Maryland's bioscience community. As a 2 + 2 program, the proposed Bachelor of Science in TLST will attract and encourage community college students to complete their Associate's degrees, earn Bachelor's degrees and pursue careers related to biotechnology and translational science. It also provides a promising new pathway for other Maryland undergraduates with an interest in the biological and life sciences. STEM education was established as a high priority in the University System of Maryland (USM) 2020 Strategic Plan, which called for a 40 percent increase in STEM graduates between 2010 and 2020.

In addition, the proposed TLST program responds to the need to support Maryland's knowledge-based economy and improve the quality of Maryland citizens' lives by "increasing the number of graduates produced in workforce areas that are key to the state's ability to thrive and compete (including STEM...) and...promoting improved health care" (p. 16). Furthermore, the proposed TLST program addresses the statewide goals of developing "seamless articulation and transfer agreements" and promoting programs to "boost training and research in such vital health-care fields" (p. 17).

C. Quantifiable & reliable evidence and documentation of market supply & demand in the region and State

The curriculum for the proposed TLST program was developed in a collaborative relationship between UMBC and Montgomery College (MC) that was started through a comprehensive multi-partner transfer success initiative funded by the Bill and Melinda Gates Foundation. MC faculty designed the first two years of the program at MC and UMBC faculty developed the last two years of the program at UMBC. Conversations between administrators, staff, and faculty of both institutions identified a need and transfer opportunity for a four-year degree in translational life science that incorporated both academic rigor and university-guided, lab-based instruction. The Education Advisory Board of The Advisory Board Company was enlisted to research the need for such a four-year degree in Maryland. The report methodically determined employer demand for bachelor's degrees in translational life sciences in four areas: the mid-Atlantic region, metropolitan Baltimore-Towson, Washington, D.C., and Montgomery County, MD. Key findings of the 2014 EAB report guided the program development and included information that enrollments in general biotechnology programs typically have shown steady growth, noting that "Montgomery County represents the highest demand for biotechnical graduates in the entire Mid-Atlantic region," with increases in program enrollment in biotechnology expected once institutions "offer a bachelor's degree that balances practical skills with theoretical knowledge" (p. 4). The report notes that baseline expectations of employers included competencies in communication, writing, and organizational skills with "proven lab and experimental skills" (pp. 13-14). The report indicated that higher numbers of adult learners were attracted to programs that emphasized commitment and "hard science skills" (p. 16) and that most employers required biotechnical bachelor's degrees rather than associate's degrees (p. 18).

The Bachelor of Science in TLST is a new degree that supports a growing demand for skills and education in the specialized area of applied, translational biotechnology. Although there is limited specific information demonstrating the demand for this program, the need is generally

evidenced in the 2014 EAB report. One comparable position would be that of biological technicians with bachelor's degrees, for which demand is expected to grow 10 percent from 2012 to 2022 and "continued growth in biotechnology and medical research is expected to increase demand for these workers" (<http://www.bls.gov/ooh/life-physical-and-social-science/biological-technicians.htm>). Therefore, UMBC expects students graduating from the TLST Program will have numerous job prospects with promising futures in Maryland and nationally.

D. Reasonableness of program duplication

The proposed new Bachelor of Science in TLST is unique in Maryland. It provides the best fit to the combined market segments for those who reside in Montgomery County and plan to attend a public university and to seek employment in Biotechnology & Medicine.

Although a few existing programs in the State include similar lower-level course content, the proposed TLST program differs from other programs in the region of Maryland where the program will be offered, in the Upper Level (UL) content, in the UL laboratory work, and in the mathematics, bioinformatics, and professional experience requirements.

The MC/University of Maryland, School of Medicine Biotechnology Research Track is offered in the greater Baltimore region and requires upper-level laboratory coursework, professional experience, and courses in biotechnology/bioengineering, but no upper-level credit in bioinformatics or mathematics. In contrast, the proposed UMBC TLST program is planned for the Montgomery County region and requires eight upper-level credits in bioinformatics and mathematics.

The BS in Biotechnology at Stevenson University is offered in the greater Baltimore region and offers no upper-level credits in bioinformatics. In contrast, the proposed TLST program differs by focusing on the Montgomery County region and extending its upper-level emphasis on laboratory instruction, professional experience, biotechnology/bioengineering, and mathematics to include four upper-level credits in bioinformatics.

The UMUC degrees in biotechnology (BS and BTPS) are available to students with AAS degrees from community colleges with which UMUC has articulation agreements (Montgomery College and Baltimore City Community College). The UMUC programs do not include upper level laboratory instruction or upper-level classroom or laboratory courses in bioinformatics, mathematics, biotechnology and bioengineering. UMUC students receive laboratory training through a 6-credit workplace learning internship, which requires affiliation or employment with a biotech research facility. In contrast, the proposed UMBC TLST program provides extensive on-campus applied laboratory and computer-based instruction in addition to its required internships or project-based coursework. UMBC's proposed TLST program also requires upper-level coursework in biotechnology/bioengineering, bioinformatics and mathematics, which are not required in the UMUC degrees.

E. Relevance to implementation or maintenance of high-demand programs at Historically Black Institutions (HBIs)

Three of the Historically Black Institutions (HBIs) in Maryland (Bowie State University, Coppin State University, and the University of Maryland, Eastern Shore) have no engineering programs, and thus no programs of a similar nature to UMBC's proposed TLST program. Morgan State University offers a B.S. degree in Medical Technology but this degree differs significantly from UMBC's proposed TLST program in that the MSU program does not offer upper-level

classroom or laboratory courses in biotechnology and bioengineering. The proposed TLST program will not adversely affect the HBIs because it is a novel degree program offered in a different region of the State. In addition, UMBC anticipates an enrollment of no more than 20 students per year in the TLST program.

F. Relevance to the support of the uniqueness and institutional identities of HBIs

Because UMBC's proposed new TLST program has a strong emphasis on advanced training in key areas of the life sciences, students in the TLST program can be encouraged, based on their interests and desired career paths, to pursue graduate study in the following programs at Maryland's HBIs:

- *Morgan State University's Science (MS), and Bioenvironmental Science (PhD).*
- *University of Maryland, Eastern Shore's Toxicology (MS, PhD), Food & Agriculture Sciences (MS), and Professional Science Master's (PSM.).*

G. Adequacy of curriculum design and delivery to related learning outcomes

Please see Appendix A for a list of the courses included in the proposed UMBC TLST B.S., as well as the course descriptions for the 13 upper-level biotechnology courses included in the program.

The goal of UMBC's proposed TLST program is to establish an innovative and practical course of study based in Montgomery County that will educate individuals to be well versed in the foundational concepts of translational science and to be professionally trained in translational research methods. The proposed TLST program is designed as a collaborative, 2 + 2 initiative for community colleges in Montgomery County and surrounding areas, particularly Montgomery College students pursuing an Applied Associate's Degrees in Biotechnology.

Additionally, the proposed TLST program represents a degree-based opportunity for UMBC students to prepare for careers and/or graduate-level education in the translational sciences. It is anticipated that the proposed TLST program will be of interest to current students in the high-enrollment UMBC majors of biology and chemical engineering. The proposed new program also provides a pathway to the existing UMBC Professional Studies PBC focused on Biotechnology, as well as to the Master's in Professional Studies in Biotechnology, which prepares science professionals to fill management and leadership roles.

UMBC's plan to offer the proposed new TLST program in Montgomery County allows the institution to expand its STEM offerings in the evolving direction of translational sciences without placing additional demands on the existing STEM infrastructure and high-enrollment science programs on the UMBC campus.

The comprehensive curriculum of the Bachelor of Science in TLST includes 13 upper-level biotechnology courses offered by UMBC. The proposed program allows UMBC to educate and train students with an optimal balance of "know what" and "know how" as the amounts of laboratory and computer instruction triple the amount in a standard BS in biology, and surpass most BS degrees in biochemistry, biotechnology, or biochemical engineering currently offered in the State of Maryland. Salient features of the TLST Program curriculum are:

- A total of 98 credit hours of instruction in biology, chemistry and biochemistry, biochemical engineering, math and physics courses with segments of the three courses in biochemistry, bioprocessing, and bio-manufacturing incorporating instruction applied at the bench.
- A total of 7 credit hours of computer instruction in software applications and bioinformatics, with an additional three-weeks of computer-based bioengineering instruction.
- A total of 15 credit hours of pure laboratory course instruction, including a two-semester (6 credit) internship or research-project based course.

Careful review by the program planning committee has ensured that all general education requirements and course prerequisites will be met by both native UMBC students and students transferring into the program based on articulation agreements.

H. Adequacy of any articulation

An articulation agreement has been developed between UMBC and Montgomery College for MC students pursuing the A.A.S. degree in Biotechnology. Please see Appendix B for the fully-executed articulation agreement. This agreement will serve as a model for collaborating with other community colleges in the state of Maryland.

I. Adequacy of faculty resources

The College of Natural and Mathematical Sciences at UMBC will administer the TLST program through a full-time Program Director and a full-time Assistant Program Director, both of whom will be located at the Universities at Shady Grove (USG). In addition to the resident faculty from UMBC, two (2) new full-time lecturers and one new assistant professor, all with expertise in Biotechnology, will staff the proposed new program. These positions will be filled upon approval of the proposed program.

See Appendix C for tables of TLST program faculty positions, including those to be hired and the members of the TLST Faculty Advisory Committee, who will support the teaching mission of the TLST program. All TLST faculty will have terminal degrees. At least 50% of the proposed TLST program will be offered by a combination of current UMBC full time faculty and the full time faculty to be hired upon approval of the program.

J. Adequacy of library resources

The Director of the Albin O. Kuhn Library at UMBC, Patrick Dawson, has affirmed that library resources for the proposed new degree are sufficient in light of the proposed budget allocation and the inclusion of two critical resources for this program, which are JoVE: Clinical & Translational Medicine and JoVE: Bioengineering. These two resources offer fully online visualized experiments in areas critical to this program. This will allow students in Montgomery County to have online access to these and other excellent library resources. Students in this program will also have access to library materials in Montgomery County as detailed in a memorandum of understanding with UMBC. Therefore, the UMBC President assures that appropriate library resources are available to support the needs of this program.

K. Adequacy of physical facilities, infrastructure and instructional equipment

The TLST program will be based at the Universities at Shady Grove (USG) in Montgomery County, MD, with parts of the program also offered at Montgomery College (MC). (For details on the locations and facilities, see UMBC's simultaneously-submitted Proposal II for offering the TLST program off-campus, including the memorandum of understanding among UMBC, USG, and MC, attached to Proposal II.) UMBC's Division of Professional Studies (DPS) has an existing infrastructure at USG that includes four onsite staff who coordinate services to the academic programs. DPS is the liaison to the USG staff that plans an essential connecting role to offices and resources on the UMBC campus. Based on the information in Proposal II, the UMBC President assures that appropriate physical facilities, infrastructure, and instructional support are available to support program needs.

L. Adequacy of financial resources with documentation

The project budget for the TLST program is based on the projected five-year student enrollments provided in Table 1. The comprehensive project budget is provided in Appendix D. The source of the funds is USM and tuition. The program budget establishes an administrative structure at USG, provides funds for additional faculty, and provides support for equipment, supplies, and library needs. In addition to teaching and advising duties, the Program Director and Assistant Director, who will be stationed at USG as an administrative arm of UMBC's College of Natural and Mathematical Sciences (CNMS), will be responsible for the daily operation of the TLST program. Lecturers (2) are needed to support the program as it grows. An Assistant Professor (tenure-track) with experience in Biotechnology will augment the content expertise of the TLST program and balance the resource commitment by the UMBC departments supporting the TLST program. Operating expenditures focus on academic support (e.g., professional development of faculty, travel, and library augmentation funds), administrative support (e.g., marketing, website, and technology infrastructure), office supplies and equipment, contractual services (e.g., USG space rental), and student help.

Table 1. Projected Five-Year Student Enrollment

Headcount	Year One	Year Two	Year Three	Year Four	Year Five	
Junior	16	24	32	40	48	
Senior 1		12	18	24	30	
Senior 2			5	7	10	
Total Headcount	16	36	54	71	87	
Graduates		6	14	19	25	
Net new student rate of growth	1	1.5	1.33	1.25	1.25	
Return ratio						
Jr to Sr	0.75					
Sr 1 to Sr 2 (inclusive of grads)	0.4					

M. Adequacy of provisions for evaluation of program consistent with Regulation .15 in COMAR

Faculty Evaluation: All tenured faculty are reviewed each year during the Spring Semester by the

department chair or program head using the Faculty Annual Report. Student Course Evaluation Questionnaires (SCEQs) from the previous two semesters may be included. The general criteria for the Annual Review of tenured faculty include those used for workload and merit pay reviews. It is consistent with the departmental statement of Performance Expectations. A comprehensive faculty review occurs every five years using the components involved for promotion and tenure processes. A favorable review for promotion in rank substitutes for this review.

Academic Program Review: Each UMBC program undergoes an academic program review every seven years, the purpose of which is to assess and improve the quality of the program. Following the self-study and visit by external reviewers, an action plan for continuing to enhance the quality of the program is developed and implemented by the chair and senior management, with review by UMBC's faculty governance committees.

Program and Institutional Level Evaluation: The 2009 UMBC Assessment Plan, which delineates roles and responsibilities for learning assessment, requires that academic programs collect data and provide assessment reports to their respective College Deans every two years. The Deans summarize findings in a report that is shared with the Council of Deans. Representatives of the General Education Committee (GEC) join this meeting with the purpose of determining how well the University is assessing and achieving its institutional-level student learning outcomes. The GEC develops a report that captures highlights and proposes recommendations for improvement. The University Assessment Committee, which includes stakeholders across the University, reviews these reports, notes achievements, and makes recommendations for moving forward.

Program-specific evaluation: The TLST program, which will be under the purview of the CNMS, will undergo a biennial assessment that includes review of program learning goals, assessment measures, and student learning outcomes. The results of the program assessment and review will be used to develop strategies for improving the education of TLST majors. A Faculty Advisory Committee, comprised of faculty associated with the TLST program, will lead the assessment efforts under the procedures mandated by the CNMS. In addition, a representative from the TLST program will serve with other CNMS department representatives on the CNMS Student Learning Assessment Advisory Committee (SLAAC). The SLAAC members create templates for general education course and program assessment in the CNMS that are used by each department to create individualized but uniform assessment plans to promote continuous improvement. SLAAC members also serve as assessment liaisons to their departments/programs and help facilitate best practices and the use of the CNMS SLA templates to complete plans. Committee members also facilitate the timely completion of the assessment reports to fulfill the approved plans for the assessment of departmental general education courses and overall program assessment, and serve as the primary contacts between the Dean's Office and the department/program to address questions and/or issues involving the submitted assessment plans. It is the intent of the College to conduct exit interviews with graduating seniors as part of evaluating the TLST program.

UMBC will continue to employ assessment tools and methods in evaluating student outcomes, courses, and faculty consistent with COMAR 13B.02.03.15 expectations and with curriculum review procedures established by UMBC.

N. Consistency with the Commission's minority student achievement goals

UMBC has established a commitment to diversity as one of its core principles for the recruitment and retention of faculty, staff, and students. Founded in 1966, UMBC is a selective, historically diverse, public research university. At UMBC, diversity is defined in its fullest scope, embracing not only racial and ethnic groups and individuals who are or have been underrepresented in higher education, but also including religious affiliation, non-traditional, sexual orientation and gender identity, disability, foreign nationality, non-traditional student status, and other important characteristics. According to USG's Fall 2014 Student Demographics report, the overall enrollment reflected the ethnic mix of Montgomery County with a 37% minority undergraduate enrollment and a 25% minority graduate student enrollment. USG is very diverse as shown by its enrollment of 20% African American students and 17% Hispanic students, overall. The USG student enrollment increased by 3% from 2013 and the student population was reported as 55% female and 45% male.

O. Relationship to low productivity programs identified by the Commission

There is no relationship to a low productivity program.

P. If proposing a distance education program, please provide evidence of the [Principles of Good Practice](#)

No distance learning is included in this proposal.

Appendix A

Course Listings

UMBC Translational Life Science Technology (TLST) B.S. Program

and

Course Descriptions

of the 13 new upper-level courses for the TLST Program

Course Listings: UMBC Translational Life Science Technology (TLST) B.S. Program		
Major		Credits
BTEC 300	Translational Life Science Technology Survey (WI)	3
BTEC 303	Applied Cell Biology	4
BTEC 310	Instrumentation & Methods for the Biotechnology Lab	3
BTEC 330	Software Applications for the Life Sciences	3
BTEC 344	Epidemiology	3
BTEC 350	Statistics for the Life Sciences	4
BTEC 395	Translational Bioinformatics	4
BTEC 430	Translational Biochemistry & Molecular Biology	4
BTEC 444	Translational Cancer Biotechnology	3
BTEC 453	Biochemical Engineering	4
BTEC 462	Bioprocess Design & Control	4
BTEC 470	Advanced Bio-manufacturing	4
BTEC 495	Professional Internship/Project-based Course (3 cr., 2 x)	6
Supporting Courses:		
CHEM 101	Principles of Chemistry I	4
CHEM 102	Principles of Chemistry II	4
CHEM 102L	Introductory Chemistry Laboratory	2
CHEM 351	Organic Chemistry I	3
CHEM 351L	Organic Chemistry Lab	2
BIOL 141	Foundations of Biology: Cells, Energy & Organisms	4
BIOL 142	Foundations of Biology: Ecology and Evolution	4
BIOL 275	Microbiology	3
BIOL 300L	Experimental Biology	2
BIOL 302	Molecular and General Genetics	4
PHYS 111 or PHYS 121	Introductory Physics (algebra-based) or Introductory Physics (calculus-based)	4
General Education Requirements:		
ENGL 100	Composition	3
MATH 155 or MATH151	Applied Calculus or Calculus I	4
Arts & Humanities	Three courses	9
Social Sciences	Three courses	9
Sciences + Lab	Above coursework meet requirements	
Cultural	One course	3
Language	One course at the 201 level	4
Electives	As needed, especially to meet prerequisites	3
	Total Credits	120
	<i>Does not include Physical Education credits</i>	

<i>Course Number</i>	<i>UMBC's TLST Program Course Descriptions</i>
BTEC 300	<p>Biotechnology Survey: Legal, Ethical, Regulatory & Biosafety Issues 3 credits – Grading Method: Regular (A-F), WI This course will raise awareness on a range of non-technical topics that frame the field of translational medicine and the biotechnology industry. Weekly meetings will cover topics ranging from legal decisions that affect what products can be patented by the biotechnology industry, to regulatory trends in the US and abroad, to the ethics of genomic mining and manipulation, and synthetic life.</p> <p>Prerequisites (all must be passed with a grade of “C” or better): CHEM 101, PHYS 111, BIOL 142, BIOL 302.</p>
BTEC 303	<p>Applied Cell Biology 4 credits – Grading Method: Regular (A-F) This course will provide an overview of modern cell biology with emphasis on applications in cell-based therapeutics and commercial processes. The course will include a foundation in molecular aspects of cell biology including cell structure, organelle structure and function, protein trafficking, membrane dynamics, cell adhesion, signal transduction, cell cycle control, and cell death. These concepts will be presented in the context of current applications of cell biological approaches in clinical medicine and commercial production of biologicals. The course comprises a 1 CR laboratory component where students will learn hands-on techniques for cell culturing and imaging.</p> <p>Prerequisites: BIOL 302 with a “C” or better.</p>
BTEC 310	<p>Instrumentation & Methods for the Biotechnology Laboratory 3 credits – Grading Method: Regular (A-F) Presented from the perspective of the biotechnology industry, this course will give a systematic, understandable, and practical introduction to basic biotechnology laboratory methods and the principles underlying the operation of common and sophisticated instrumentation. The course is intended for students who are interested in learning how to work in a biotechnology research & development laboratory.</p> <p>Prerequisites (all must be passed with a grade of “C” or better): CHEM 101, MATH 151/155, PHYS 111/121, BIOL 142, BIOL 302.</p>

BTEC 330	<p>Software Applications in the Life Sciences 3 credits – Grading Method: Regular (A-F) This course will provide an overview and basic practical skills in software tools that are used widely in biological research and development in the areas of general productivity, basic data analysis and</p>
	<p>data basing, statistical analysis and programming, analysis and comprehension of high-throughput genomic data, biological sequence analysis and bioinformatics, image analysis and morphometry.</p> <p>Prerequisites (all must be passed with a grade of “C” or better): MATH 151/155.</p>
BTEC 344	<p>Epidemiology 3 credits – Grading Method: Regular (A-F) This course will provide an intensive introduction to epidemiologic concepts and methods for students majoring in Translational Life Science Technology and for others intending to engage in, collaborate in, or interpret the results of epidemiologic research as a substantial component of their career.</p> <p>Prerequisites: BIOL 303 or BTEC 303 with a “C” or better, and STAT 350/355 or BTEC 350 with a “C” or better.</p>
BTEC 350	<p>Statistics for the Translational Life Sciences 4 credits – Grading Method: Regular (A-F) This course will provide an effective introduction to statistical methods used commonly by researchers who engage in, collaborate in, or interpret results of Translational Life Science Technology.</p> <p>Prerequisites for UMBC students (all courses must be passed with a grade of “C” or higher): MATH 150 (or MATH 151/155), BIOL 302.</p>
BTEC 395	<p>Translational Bioinformatics 4 credits – Grading Method: Regular (A-F) This course introduces the emerging field of translational bioinformatics, which encompasses the development of algorithms for biological data analysis and their clinical and research applications. It covers four main topics: biological sequence analysis, biological databases and ontologies, whole- and meta-genome analysis and network biology. It includes a primer on evolutionary theory, high-throughput techniques, sequence statistics and other central concepts in bioinformatics, followed by an overview of the history, translational component and scientific impact of bioinformatics.</p> <p>Prerequisites (all must be passed with a grade of “C” or better): MATH 151/155, BIOL 430 or BTEC 430, STAT 350 or BTEC 350.</p>

BTEC 430	<p>Translational Biochemistry and Molecular Biology 4 credits – Grading Method: Regular (A-F)</p> <p>This is an introductory level course focusing on essential concepts of biochemistry and molecular biology. Topics include the purification and analysis of macromolecules, the transmission of genetic information, and high throughput sequencing. This course also includes a six-week laboratory practicum on extraction, purification and analysis of DNA, RNA and proteins from cultured mammalian cells and E.coli.</p>
	<p>Prerequisites (all must be passed with a grade of “C” or better): CHEM 351, BIOL 303 or BTEC 303.</p>
BTEC 444	<p>Translational Cancer Biotechnology 3 credits – Grading Method: Regular (A-F)</p> <p>This course is designed to provide an in-depth overview of biotechnological aspects of the diagnosis, clinical management, and study of malignant disease. It is designed to provide Translational Biotechnology majors and others whose career path intersects with the course of neoplasia.</p> <p>Prerequisites: BIOL 303 or BTEC 303 (new course) with a “C” or better.</p>
BTEC 453	<p>Biochemical Engineering 4 credits – Grading Method: Regular (A-F)</p> <p>An overview of biochemical and microbiological applications, commercial and engineering processes including: industrial fermentation, enzymology, ultrafiltration, chromatography, and food and pharmaceutical processing. Important principles include: enzyme kinetics, cell growth, energetics and mass transfer. Processes of interest include those that are involved in the formation of desirable compounds and products or in the transformation, or destruction of unwanted or toxic substances.</p> <p>Prerequisites: (all must be passed with a grade of “C” or better): MATH 151/155, PHYS 111/121 and CHEM 351.</p>


**Articulation agreement between UMBC and Montgomery College's
A.A.S. degree in Biotechnology**

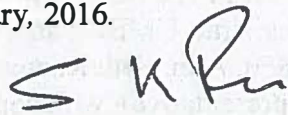
Articulation Agreement


Montgomery College (MC)
Associate of Applied Science in Biotechnology
900 Hungerford Drive
Rockville, MD 20850


University of Maryland, Baltimore County (UMBC)
Bachelor of Science in Translational Life Science Technology (TLST)
1000 Hilltop Circle
Baltimore, Maryland 21250

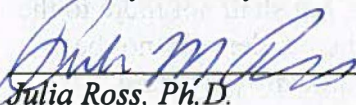
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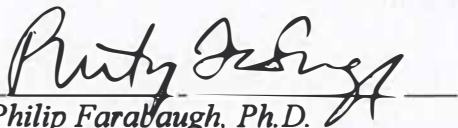

Philip Rous, Ph.D.
Provost and
Senior Vice President for Academic Affairs
University of Maryland, Baltimore County



Sanjay Rai, Ph.D.
Senior Vice President for Academic
Affairs
Montgomery College

Read and Understood

William R. LaCourse, Ph.D.
Dean, College of Natural and Mathematical Sciences
University of Maryland, Baltimore County


Margaret Latimer
Vice President and Provost
Montgomery College


Julia Ross, Ph.D.
Dean, College of Engineering and Information Technology
University of Maryland, Baltimore County


Philip Farabaugh, Ph.D.
Chair, Department of Biological Sciences
University of Maryland, Baltimore County


Brian Reed, Ph.D.
Chair, Department of Chemical, Biochemical, and
Environmental Engineering
University of Maryland, Baltimore County

This agreement is applicable for students enrolled at Montgomery College (MC) upon the execution date of this agreement. This agreement may be modified by the mutual written consent of both parties. This agreement may be terminated by either party by giving notice six months in advance to the other party. Such termination will not affect the participation in the articulated programs of those MC students who have been fully or conditionally admitted to UMBC.

Any notice to be given hereunder shall be given in writing by U.S. mail or via reputable overnight courier (e.g., Federal Express, DHL, etc.). Notice shall be deemed received upon delivery to the party to whom the notice is directed or to its agent, in the case of UMBC to: UMBC, 1000 Hilltop Circle, Baltimore, Maryland 21250, Attn: Dr. Philip Rous, Provost, with copies to Dr. Diane Lee, Vice Provost and Dean, Undergraduate Academic Affairs, Dr. Yvette Mozie-Ross, Vice Provost, Enrollment Management and Planning, and Pamela Hawley, Acting University Registrar, UMBC ; and, in the case of MC to: 900 Hungerford Drive, Rockville, Maryland 20850, Attn: Seth Kamen, Articulation, Transfer, and Academic Services Manager (or designated representative), with copies to Dr. Sanjay Rai, Senior Vice President for Academic Affairs; and Margaret Latimer, Vice President and Provost, Germantown. Notwithstanding the foregoing, in the event that this Agreement provides that any notice must be directed to a person other than the person designated for the receipt of notice in the preceding sentence, then notice must be directed to such other person in order to be effective hereunder.

This Agreement embodies the entire agreement and understanding among the parties hereto relating to the subject matter hereof and may not be changed orally, but only by an instrument in writing signed by all parties hereto. No representation, warranty, undertaking or covenant is made by any party hereto except as contained herein and any others are specifically disclaimed. This Agreement shall be governed by and construed in accordance with the internal laws of the State of Maryland (i.e., without regard to its conflicts of law rules). This Agreement shall be binding upon the parties hereto and their respective successors, but shall not inure to the benefit of any third party beneficiary. This Agreement and any rights hereunder may not be assigned by either party without the prior written consent of the other, and any purported assignment without consent shall be null and void and of no effect whatsoever. This Agreement may be executed in any number of counterparts, each of which shall be deemed an original, but all of which together shall constitute one and the same Agreement.

This Articulation Agreement continues on the next page.

Articulation Agreement

Montgomery College (MC)
Associate of Applied Science in Biotechnology
900 Hungerford Drive
Rockville, MD 20850

University of Maryland, Baltimore County (UMBC)
Bachelor of Science in Translational Life Science Technology (TLST)
1000 Hilltop Circle
Baltimore, Maryland 21250

This agreement is initiated this day, 19 February 2016 between Montgomery College, 900 Hungerford Drive, Rockville, MD 20850, hereafter "MC," and the University of Maryland Baltimore County, a constituent institution of the University System of Maryland, and agency of the State of Maryland, hereafter "UMBC," to facilitate the transfer of students earning the Associate of Applied Science degree in Biotechnology at MC to UMBC in pursuit of the Bachelor of Science degree in Translational Life Science Technology.

I. PURPOSE

The purpose of this Articulation Agreement (the "Agreement") is to establish a collaboration between UMBC and MC in an effort to facilitate the transfer and degree completion of students earning the Associate of Applied Science in Biotechnology at MC to the Bachelor of Science degree in Translational Life Science Technology at UMBC.

This agreement serves to develop a transfer pathway with degree requirements for the completion of both an associate's degree and bachelor's degree. The agreement also seeks to ensure the maximum potential for student success.

This Agreement also serves as a Memorandum of Understanding between both institutions for the purpose of clarifying roles and responsibilities in this partnership.

II. ACCEPTANCE OF CREDITS

1. All courses meeting general education requirements at MC will transfer and be applied towards the general education requirements at UMBC.
2. A maximum of 60 credits will transfer from MC, a 2-year degree-granting institution. Coursework originating from non-partner institutions will be evaluated on a course by course basis.
3. Upon matriculation to UMBC, MC students must satisfy all general education, graduation and major requirements as outlined in the UMBC Undergraduate Catalog under which they matriculate.
4. MC students must earn a minimum of 30 credit hours of coursework at UMBC.

5. UMBC courses offered at USG via this program articulation agreement may be used to satisfy this requirement.
6. UMBC requires a minimum of 120 credit hours to attain a bachelor's degree.

III. ACADEMIC PLANNING

1. Students should work closely with their academic advisor at MC to develop an academic plan to ensure a seamless transition.
2. Students and advisors are encouraged to utilize a variety of advising resources including the UMBC Undergraduate Catalog, departmental websites, as well as ARTSYS (the USM online articulation database), to ascertain transferability of coursework.

IV. ADMISSIONS

1. The UMBC Admissions Committee evaluates transfer applicants on the basis of their academic record at previous institutions. Cumulative grade point average, performance trends, strength of curriculum and performance in courses related to the intended area of study are considered.
2. Applicants successfully completing the articulated program with a 2.0 or better grade point average who have not subsequently matriculated at any other institution of higher education will be guaranteed transfer admission to UMBC. A history of acts identified in the Federal Campus Security Act may disqualify a candidate for guaranteed admission.

V. ACADEMIC ADVISING

1. Following admission to UMBC, students will have access to numerous advising tools including an Advising Profile, a Transfer Credit Report and a Degree Audit detailing prior coursework, transferability and applicability to UMBC general and university requirements.
2. Prior to matriculation to UMBC, all new students are required to attend the mandatory new student orientation program. During orientation, students will meet with an academic advisor to review prior coursework, discuss academic interests and goals, and develop an academic plan.
3. Upon matriculation, students will be assigned an advisor in their area of study. Students are strongly encouraged to meet with their advisor periodically. Students are required to meet with their advisor prior to registering for subsequent semesters.

VI. SCHOLARSHIPS AND FINANCIAL AID

1. Students transferring from MC to UMBC who meet application deadlines, and academic and financial requirements applicable to all students, may be eligible for consideration for the following scholarships offered by UMBC:
 - a) The Academic Achievement Award for Transfers (AAAT) - awarded to community college transfers on the basis of academic accomplishment. Awards of up to \$2,500 for each of two academic years may be used for full- or part-time study. Students must have completed 35 or more college level credits at the time of application to be eligible for consideration.

- b) Phi Theta Kappa (PTK) Scholarship - awarded to community college transfers on the basis of academic accomplishment. Awards range from \$2,000 to \$2,500 per year for two academic years may be used for full- or part-time study. Students must submit proof of PTK membership to be eligible for consideration.
- c) Transfer Student Alliance (TSA) - awarded to community college transfers from eligible 2-year partner institutions who will complete the associate's degree and meet all other program requirements. Awards of \$1,500 dollars for each of two years of full-time study.

VII. ONGOING COLLABORATION

1. In the spirit of articulation, faculty representatives from both institutions will meet regularly to engage in ongoing discussion to enhance and strengthen this collaboration.
2. In an effort to strengthen this partnership, UMBC's College of Natural Sciences with the Biological Sciences faculty may serve as resources, as available, to MC Biotechnology Program students and faculty by serving as guest lecturers, workshop/seminar facilitators and other program exchanges.
3. In an effort to strengthen this partnership, MC agrees to provide focused advising to Life Science majors and communicate program changes in a timely manner to avoid disruption to student progress toward degree completion.

VIII. PROGRAM ARTICULATION AGREEMENT

The following details a recommended course of study for students earning the Associate of Applied Science degree in Biotechnology at MC transferring to UMBC in pursuit of the Bachelor of Science degree in Translational Life Science Technology. Where noted, course equivalencies, general education and major applicability are indicated.

MC Course Number	MC Course Title	MC Credits	UMBC Equivalency	UMBC General Education Requirement	UMBC Credits	Notes
Foundation and Distribution Courses						
ENGL101 Or <i>Behavioral and Social Sciences Distribution</i>		3		LLE Or SS	3	Students should take ENGL101 only if it is required. Otherwise, it is suggested that students take a course designated to transfer to UMBC as a Social Science^
ENGL102 Or ENGL103	Critical Reading, Writing, and Research Or Critical	3	ENGL100	EN	3	

MC Course Number	MC Course Title	MC Credits	UMBC Equivalency	UMBC General Education Requirement	UMBC Credits	Notes
	Reading, Writing and Research in Workplace					
MATH170 Or MATH181 or MATH150	Calculus for the Life Sciences I Or Calculus I Or Elementary Applied Calculus	4	MATH155	M	4	
COMM 112 or COMM 108	Business and Professional Speech Communication Or Fundamentals of Human Communication	3	SPCH100	AH	3	COMM108 is pending as AH requirement at MC
BIOL150	Principles of Biology I	4	BIOL141 + BIOLLAB	SL	4	
Arts or Humanities Distribution	See Catalog, ARTD or HUMD	3-4		AH	3-4	
Behavioral and Social Sciences Distribution	See Catalog	3-4		SS	3-4	
Total Foundation and Distribution Requirements		23-25			23-25	
Program Requirements						
BIOT110	Introduction to Biotechnology	2	LL Elective		2	(Proposal out to change this course to 3 credits)
BIOT120	Cell Culture and Cell Function	3	LL Elective		3	
BIOT200	Protein Biotechnology	4	LL Elective		4	

MC Course Number	MC Course Title	MC Credits	UMBC Equivalency	UMBC General Education Requirement	UMBC Credits	Notes
BIOL210	Microbiology	4	BIOL275	S	4	
BIOL222	Principles of Genetics	4	BIOL302		4	
BIOT230	Basic Immunology and Immunology Methods	4	LL Elective		4	
BIOT240	Nucleic Acid Methods	4	LL Elective		4	
CHEM 131	Principles of Chemistry I	4	CHEM 101 + LLE LAB	SL	4	
CHEM 150	Essentials of Organic and Biochemistry	4	CHEM124		4	
Total Program Requirements		33			33	
Program Elective Requirements						
PHYS203 or PHYS233	General Physics, Physics for Life Sciences	4	PHYS111		4	PHYS233 recommended, prerequisite requirement may need to be met.
Total Program Elective Requirements		4			4	
Total Number of Credits Required for Associates degree		60-62			60-62	

MC Course Number	MC Course Title	MC Credits	UMBC Equivalency	UMBC General Education Requirement	UMBC Credits	Notes
Maximum Number of Transfer Credits Applied Towards Bachelor's degree					60	
Minimum Number of Credits Remaining for Completion of 120 Credits Required for B.S. in TLST degree					60	

Symbol	Title	UMBC Graduation Requirements	Number of courses taken at MC that satisfy UMBC Graduation requirements	Number of courses still needed to satisfy UMBC Graduation requirements
EN	English Composition	1	1	0
AH	Arts & Humanities	3	2	1
SS	Social Sciences	3	2^	1^
C	Culture**	1	0	1
L	Language*	201 Level	0	201 Level
M	Mathematics	1	1	0
S	Science	1	1	0
SL	Science (plus lab)	1	2	0
PE	Physical Education	2	0	2


* Completion of a foreign language through the 201 level or demonstrated proficiency at that level. For example: completion of level 4 at high school level, AP, IB or CLEP credit or completion of a language through the 201 level at a regionally accredited college or university. Shady Grove Foreign Language Transfer Credit Limit Exemption allows students to transfer up to 6 credits of foreign language beyond

the 60 credit limit, provided that one of those courses is at the 201 level. Language credits may be completed after matriculation at UMBC at Shady Grove.


** UMBC General Education transfer exception allows for 1 language course to satisfy the culture requirement upon transfer if at least 2 language courses are transferred from MC to UMBC. Language credits may be completed after matriculation at UMBC at Shady Grove.

^Credit count is assuming that students placed out of ENGL101 at MC.

Signatures of principals for this agreement:


Philip Ross, Ph.D.

Provost and
Senior Vice President for Academic Affairs
University of Maryland, Baltimore County


Sanjay Rai, Ph.D.

Senior Vice President for Academic
Affairs
Montgomery College

Approved for Legal Sufficiency
UMBC
Office of the General Counsel



Appendix C

TLST program: Faculty Positions (to be hired after program approval as per budget)		
Program Director	Montgomery County	Full-time: Ph.D. or other terminal degree; expertise in Applied Biotechnology and Program Administration – will provide TLST Instruction
Assistant Program Director	Montgomery County	Full-time: Ph.D. or other terminal degree; expertise in Applied Biotechnology, Program Administration or Curricular Management or Student Advising – will provide TLST Instruction
Assistant Professor	UMBC Biological Sciences	Full-time: Ph.D.; researcher in Applied Biotechnology or other TLST area – will provide TLST Instruction
Lecturer	Montgomery County	Full-time: Ph.D. expertise in TLST areas
Lecturer	Montgomery County	Full-time: Ph.D. expertise in TLST areas
<p>TLST Faculty Advisory Committee Members (Charged to supervise or provide TLST Course Delivery and Assessment)</p>		
Dr. Charles M. Bieberich	Professor, Biological Sciences	
Dr. Mauricio Bustos	Associate Professor, Biological Sciences	
Dr. Maria José Castellanos	Lecturer, Department of Chemical, Biochemical, and Environmental Engineering	
Dr. William R. LaCourse	Dean, College of Natural and Mathematical Sciences Professor Chemistry and Biochemistry	
Dr. Antonio Moreira	Vice Provost for Academic Affairs, Professor, Department of Chemical, Biochemical and Environmental Engineering, Director of the Biochemical Regulatory Engineering Program	

Appendix D. Projected Budget for UMBC's proposed BS in Translational Life Science Technology at The Universities at Shady Grove

TABLE 1: RESOURCES					
Resources Categories	(Year 1)	(Year 2)	(Year 3)	(Year 4)	(Year 5)
1.Reallocated Funds	\$0	\$0	\$0	\$0	\$0
2. Tuition/Fee Revenue (c+g below)	\$135,790	\$319,219	\$498,365	\$664,010	\$847,432
a. #F.T Students ¹	10	23	35	45	56
b. Annual Tuition/Fee Rate ²	\$9,471	\$9,756	\$10,049	\$10,350	\$10,661
c. Annual Full Time Revenue (a x b)	\$94,710	\$224,388	\$351,715	\$465,750	\$597,016
d. # Part Time Students ³	6	13	19	26	31
e. Credit Hour Rate ⁴	\$395	\$407	\$419	\$431	\$444
f. Annual Credit Hours	104	233	350	460	564
g. Total Part Time Revenue (d x e x f)	\$41,080	\$94,831	\$146,650	\$198,260	\$250,416
3. Grants, Contracts, & Other External Sources	\$0	\$0	\$0	\$0	\$0

¹ This reflects both new and continuing students.

² USG Full-Time tuition and mandatory Fees

³ This reflects both new and continuing students.

⁴ USG Part-Time tuition and mandatory fees per credit

4. Other Sources ⁵	\$584,038	\$545,559	\$557,425	\$419,648	\$432,238
TOTAL (Add 1 - 4)	\$719,828	\$864,778	\$1,055,790	\$1,083,658	\$1,279,670

TABLE 2: EXPENDITURES					
Expenditure Categories	(Year 1)	(Year 2)	(Year 3)	(Year 4)	(Year 5)
1. Total Faculty Expenses					
(b + c below)	\$384,038	\$488,659	\$596,419	\$614,311	\$632,740
a. # FTE ⁶	3	4	5	5	5
b. Total Salary	\$288,750	\$367,413	\$448,435	\$461,888	\$475,745
c. Total Benefits	\$95,288	\$121,246	\$147,984	\$152,423	\$156,995
2. Total Administrative	\$0	\$0	\$0	\$0	\$0
Staff Expenses (b + c below) ⁷					
a. # FTE	0	0	0	0	0
b. Total Salary	\$0	\$0	\$0	\$0	\$0
c. Total Benefits	\$0	\$0	\$0	\$0	\$0
3. Total Support Staff	\$0	\$0	\$0	\$0	\$0
Expenses (b + c below) ⁸					

⁵ This shows the support that USM has committed to providing to the TLST program in Years 1 - 5.

⁶ Faculty Lines for Year 1 include the Program Director, Assistant Program Director for Curriculum and Advising and a tenure track Assistant Professor. In Year 2, one lecturer is added. In Year 3, an additional lecturer is added.

⁷ Administrative Staff expenses are paid through UMBC's contribution for academic and administrative support at USG. This contribution is included in the line for Other Expenses.

⁸ Support Staff expenses are paid through UMBC's contribution for academic and administrative support at USG. This contribution is included in the line for Other Expenses.

a. # FTE	0	0	0	0	0
b. Total Salary	\$0	\$0	\$0	\$0	\$0
c. Total Benefits	\$0	\$0	\$0	\$0	\$0
4. Equipment ⁹	\$0	\$0	\$0	\$0	\$0
5. Library	\$15,000	\$15,900	\$16,854	\$17,865	\$18,937
6. New or Renovated Space ¹⁰	\$0	\$0	\$0	\$0	\$0
7. Other Expenses ¹¹	\$354,903	\$311,696	\$388,899	\$261,269	\$283,981
TOTAL (Add 1 - 7)	\$753,941	\$816,255	\$1,002,172	\$893,445	\$935,658

⁹ Equipment will be provided by Montgomery College in Years 1 and 2 and by the new Biomedical Sciences and Engineering Education Facility in Year 3 and beyond.

¹⁰ Space, including labs, will be provided by Montgomery College in Years 1 and 2 and by the new Biomedical Sciences and Engineering Education Facility in Year 3 and beyond.

¹¹ Other expenses includes a faculty start-up package for one tenure track faculty in Years 1 - 3, funding for honorariums, travel, supplies, fixed charges such as association dues, subscriptions and rental charges, funding for an annual symposium on Translational Life Sciences and UMBC's contribution towards academic and administrative support. UMBC's contribution for academic and administrative support is for the operations at USG. This contribution is the justification for having no Administrative or Support Staff Expenses. The budget for supplies was increased in Years 3 -5, since, after the move to the USG campus, the program will need to purchase supplies rather than use Montgomery College's supplies.