HARFORD
COMMUNITY COLLEGE

August 11, 2021

James D. Fielder, PhD
Maryland Higher Education Commission
6 N. Liberty Street, 10th Floor
Baltimore, MD 21201

RE: Substantial Modification to Existing Certificate – Biotechnology, Certificate

Dear Dr. Fielder:

Harford Community College (HCC) is proposing a substantial modification to the existing Biotechnology Certificate program. The revised certificate will provide students with the concepts, techniques, and skills needed for entry-level bioscience laboratory work in biotechnology, chemical, and biological laboratories. The 32-credit program is fully compatible with the newly proposed Biotechnology AAS degree program and provides a foundation in principles of the natural and physical sciences and a strong emphasis on biotechnology and analytical techniques and applications.

The skill sets fostered and the goals promoted by the Biotechnology Certificate program closely relate to the mission pursued by HCC. In particular, this program supports the workforce demands and emerging needs in the dynamic landscape of biotechnology, which has been intensified by the current COVID-19 pandemic.

Payment in the amount of $50 to cover administrative fees for new programs will be arriving via U.S. mail. Please contact Alison Amato at aamato@harford.edu or 443-412-2384 with any questions.

Sincerely,

T. A. Sherwood
T. A. Sherwood (Aug 19, 2021 15:19 EDT)

Timothy Sherwood, PhD
Vice President for Academic Affairs

Office Use Only: PP#

Cover Sheet for In-State Institutions
New Program or Substantial Modification to Existing Program

Institution Submitting Proposal	Harford Community College

Each action below requires a separate proposal and cover sheet.

- ○ New Academic Program
- ○ New Area of Concentration
- ○ New Degree Level Approval
- ○ New Stand-Alone Certificate
- ○ Off Campus Program
- ○ Substantial Change to a Degree Program
- ○ Substantial Change to an Area of Concentration
- ◉ Substantial Change to a Certificate Program
- ○ Cooperative Degree Program
- ○ Offer Program at Regional Higher Education Center

Payment Submitted: ◉ Yes ○ No | Payment Type: ○ R*STARS # ◉ Check # | Payment Amount: $50 | Date Submitted: 8/20/2021

Department Proposing Program	STEM	
Degree Level and Degree Type	Certificate	
Title of Proposed Program	Biotechnology	
Total Number of Credits	32	
Suggested Codes	HEGIS: 5407.02	CIP: 41.0101
Program Modality	◉ On-campus	○ Distance Education (*fully online*)
Program Resources	◉ Using Existing Resources	○ Requiring New Resources
Projected Implementation Date	○ Fall ◉ Spring ○ Summer	Year: 2022
Provide Link to Most Recent Academic Catalog	URL: https://catalog.harford.edu/	
Preferred Contact for this Proposal	Name: Alison Amato	
	Title: Coordinator for Curriculum and Program Development	
	Phone: 4434122384	
	Email: aamato@harford.edu	
President/Chief Executive	Type Name: Theresa B. Felder, EdD	
	Signature: [signature]	Date: Aug 19, 2021
	Date of Approval/Endorsement by Governing Board: Aug 19, 2021	

Revised 1/2021

Revised Program Proposal
Certificate in Biotechnology

A. Centrality to institutional mission statement and planning priorities

1. Provide a description of the program, including each area of concentration (if applicable), and how it relates to the institution's approved mission.

The revised Certificate in Biotechnology at Harford Community College (HCC) will provide students with the concepts, techniques, and skills needed for entry-level bioscience laboratory work in biotechnology, chemical, and biological laboratories. The 32-credit program provides a foundation in principles of the natural and physical sciences and a strong emphasis on biotechnology and analytical techniques and applications, as identified by biotechnology industry members as critical for employment. Graduates will acquire proficiency in scientific thinking and communication and hands-on laboratory experience with skills such as pipetting, polymerase chain reaction (PCR), cell-culture techniques, concepts of biomanufacturing, Good Manufacturing Practices, and multiple microbiological, cellular biology, and immunological protocols. The certificate program is suitable for students currently working in biotechnology or medical technology fields or for those who have obtained a bachelor's degree in a science field and want to update their skills with additional training.

Harford Community College (HCC) was established in 1957 as an open-access institution. HCC's mission reads "Grow, Achieve, Aspire, Contribute," (Harford Community College, n.d.) and the college promotes graduation, transfer, individual goal attainment, and career and workforce development. The biotechnology program will directly support HCC's mission by providing students with the training and skills necessary for immediate employment in industry. The skills acquired in the program may be applied to a variety of biotechnology fields, including biomedical research and development, biopharmaceuticals, agricultural biotechnology, and biomanufacturing.

2. Explain how the proposed program supports the institution's strategic goals and provide evidence that affirms it is an institutional priority.

The revised Certificate in Biotechnology aligns with the 2019-2022 Harford Community College Strategic Plan (Harford Community College Strategic Plan, n.d.), specifically, the first two strategies:

1) Establish relevant, flexible options for learning that respond to community needs for growth and prosperity.

2) Create an engaging and inclusive learning experience so ALL students can achieve their goals.

Harford County is located within the BioHealth Capital Region (BHCR), which includes Maryland, Virginia, and Washington, D.C. The BHCR is ranked fourth among the top biopharma clusters in the U.S. based on patents, NIH funding, venture capital, lab space, and number of jobs, with a goal of becoming a top-three cluster by 2023 (Philippidis, 2018, 2021). The region is home to more than 70 federal labs, as well as academic, medical, and research institutions and biotech companies (BioHealth Capital Region, 2019). With more than 300,000 biotechnology employees added in the past ten years, the BHCR workforce is expected to double by 2023 (Thompson et al., 2018).

Therefore, biotechnology is a rapidly growing employment sector with significant demand in Maryland and the surrounding BioHealth Capital Region. The current COVID-19 pandemic has recently intensified demand for skilled professionals in this discipline. The program will produce graduates who can respond to workforce demands, emerging needs, and work productively with the always evolving landscape of biotechnology.

3. Provide a brief narrative of how the proposed program will be adequately funded for at least the first five years of program implementation.

HCC is committed to providing administrative, financial, and technical support for the revised program. The STEM division has one full-time and two part-time regularly budgeted administrative assistants, and the cost of instructional supplies and technical support are included in the operating budget on an ongoing basis.

The program will be staffed by existing full-time tenured and tenure-track faculty members within the biology department at HCC. Some additional salary funds may be used to pay adjuncts to teach the courses taught by these individuals in the past. The current adjunct STEM budgets are sufficient for these expenditures. All equipment purchases for the revised certificate will be funded from the $493,912 acquired from the National Science Foundation Advanced Technology Education (NSF ATE) grant entitled *Expanding pathways from high school into the biotechnology workforce,* award # 2000193 with Jaclyn Madden, M.S., (Biology Faculty) as Principal Investigator and Pamela Pape-Lindstrom, Ph.D., (STEM Dean) and Susan Walker, Ph.D., (Biology Faculty) as co-Principal Investigators.

Other courses within the certificate already exist and are offered on a regular basis at Harford Community College. As the program enrollment grows, related additional tuition and fee revenue will be allocated to the program.

4. Provide a description of the institution's a commitment to:

a) ongoing administrative, financial, and technical support of the proposed program

The biotechnology curriculum was designed to align with industry demands. Under the auspices of the grant award, a biotechnology advisory board has been created. HCC convened a biotechnology advisory board meeting and presented the proposed curriculum to current local industry practitioners of biotechnology. Advisory Board members agreed that the proposed curriculum was appropriate for their industry. This advisory board meeting was held on November 9, 2020, and the following individuals participated.

INDIVIDUAL	ROLE	INSTITUTION
Dr. Pamela Pape-Lindstrom	Dean of STEM	Harford Community College, MD
Jaclyn Madden	Biology Faculty	Harford Community College, MD
Dr. Susan Walker	Biology Faculty	Harford Community College, MD
Breonna Martin	Biology Faculty	Harford Community College, MD
Dr. Annica Wayman	Associate Dean for Shady Grove Affairs	University of Maryland, Baltimore County, MD
John Casner	Executive Director	Northeastern Maryland Technology Council
Dr. James Dillman	Director of Research	U.S. Army Medical Research Institute of Chemical Defense
Dr. Peter Emanuel	Senior Research Scientist for Bioengineering	U.S. Army Combat Capabilities Development Command Chemical Biological Center
Dr. Linnea Fletcher	Biotechnology Director	InnovATEBIO National Biotechnology Education Center, Austin Community College, TX
Dr. Mina Izadjoo	President & Chief Science Officer	Integrated Pharma Services
Dr. Nina Lambda	Assistant Director	Institute of Marine and Environmental Technology
Dr. Amrita Madabushi	Associate Director	National Institute on Aging Training Office
Greg Merril	Chief Executive Officer	Adaptive Phage Therapies
Andrew Renzulli	Supervisor of Science Curriculum, Instruction, and Assessment	Harford County Public Schools

The program will not require additional physical infrastructure, as the current classroom spaces and lab spaces in Aberdeen Hall are sufficient to meet the program needs.

b) continuation of the program for a period of time sufficient to allow enrolled students to complete the program.

This is not applicable as the program is being revised, not discontinued.

B. Critical and Compelling Regional or Statewide Need as Identified in the State Plan

1. Demonstrate demand and need for the program in terms of meeting present and future needs of the region and the State in general based on one or more of the following:
    a. The need for the advancement and evolution of knowledge

The need for the advancement and evolution of competencies and knowledge critical to social and economic progress is an essential driver in the creation of the biotechnology curriculum. As described above, Maryland is currently home to more than 500 biotech and 2,700 life sciences companies (Maryland Department of Commerce, 2019). The bioscience industry continues to grow in Maryland, especially in response to the current COVID-19 pandemic. Life sciences companies with a presence in Montgomery County received nearly $7.7 billion in 2020 in research and development funding from non-profits, private investors, and the federal government (O'Keefe 2021). As these companies expand, they will need to hire employees with foundational knowledge and competencies in biotechnology.

b. Societal needs, including expanding educational opportunities and choices for minority and educationally disadvantaged students at institutions of higher education.

As an open access institution, HCC provides educational opportunities for all students within Harford county and surrounding counties in MD, including military affiliated individuals and working adults, minority students, rural students, and other educationally disadvantaged students. HCC has developed strategies to facilitate the eradication of the attainment gap, including implementation of the My College Success Network (MCSN) and Soar2Success (S2S). Established in July 2014, these programs are a network of services, events, staff, and faculty geared toward empowering and supporting African American students. While the MCSN was created to address achievement gaps in graduation and retention between students of color and Caucasian students, all students, regardless of ethnicity, are welcome to participate.

In 2018, HCC joined Achieving the Dream (ATD), a network dedicated to improving student success, with a particular focus on academic goal attainment, personal growth, and economic opportunity for low-income students and students of color.

Minority and educationally disadvantaged students will benefit directly from this new certificate program. The NSF ATE grant described above includes monies for outreach efforts at Harford County Public high schools that have majority minority enrollments. This outreach has been designed to target high school students and their parents. Currently, HCC is conducting virtual information sessions for students and parents, and some students will travel to campus for an in-person hands on lab activity. These outreach activities for students and families will continue through at least 2023. Beginning in summer 2022, the NSF ATE grant will fund week-long, interactive biotechnology learning experiences,

with lab activities for high school students potentially interested in enrolling in HCC's biotechnology program. Again, students from high schools with majority-minority enrollment will receive preference for participation in these events.

c. The need to strengthen and expand capacity of historically black institutions to provide high quality and unique educational programs.

As stated above, HCC is an open access institution and provides extensive student support services and affordable tuition rates for students that would wish to begin their studies at a two-year institution and then transfer to one of Maryland's four Historically Black Institutions, Bowie State University, Coppin State University, University of Maryland Eastern Shore, or Morgan State University. An internet search on April 17, 2021 showed no biotechnology program at Morgan State University or Coppin State University. The University of Maryland Eastern Shore offers a few biotechnology courses and Bowie State University offers biotechnology as a track within its biology degree. Many of the foundational courses in the revised Certificate in Biotechnology (see complete course listing in Appendix A), such as general biology, and general chemistry I would transfer to any of the four HBIs in the state if students wanted to begin their studies at HCC and then transfer to an HBI.

2. Provide evidence that the perceived need is consistent with the Maryland State Plan for Postsecondary Education (MHEC 2018).

Data from the MHEC Data Book (MHEC 2021) indicate that, in 2019-2020, there was a strong student interest in similar disciplines in the state, with students earning 2,462 associate degrees in health technology and 274 bachelor's degrees in biology. Biotechnology is not listed as a separate category in the Data Book (MHEC 2021).

The revision of the Certificate in Biotechnology addresses several strategies outlined in the 2017-2021 Maryland State Plan for Post-Secondary Education (MHEC 2018), which has identified specific goals and strategies to reduce the amount of personal debt associated with college enrollment. The proposed program supports the following goals and strategies:

Goal 1: "ACCESS: Ensure equitable access to affordable and quality postsecondary education for all Maryland residents." The program serves Goal 1 in the State Plan in that it is designed to support HCC's overall mission as an open access institution with excellent and affordable educational programs. HCC administers its academic programs to meet the goals of effectiveness and efficiency by employing data-driven decision-making that ensures that academic programs are broadly accessibleand offer high quality education at an affordable cost.

The cost to complete 32 credits is greatly reduced by completing these courses at HCC.

This approach could increase financial stability for students. The chart below outlines the cost comparison of completing 32 credits at HCC compared to other 4-year institutions with Biotechnology degrees. Students attending HCC for the 32 credits rather than a 4-year intuition will save between $3936-5792 over the duration of the certificate.

Institution	Rate	Cost 2020-2021	Cost per 16 Credits Plus Fees	Savings Over 2 Years Going to HCC
Harford Community College	In-County	$159/credit plus fees	$2544	
UMBC-Shady Grove[1]	In-State	$324 per credit plus fees	$5184	$5280
UMBC	In-State	$314 per credit plus fees	$5024	$4960
University of Maryland Global College	In-State	$300/credit plus fees ($15/credit)	$4800	$4512
Salisbury University[2]	In-State	$340 per credit plus fees	$5440	$5792
Bowie State University[3]	In-State	$282 per credit plus fees	$4512	$3936
Notes: 1 – UMBC-Shady Grove Translational Life Sciences Technology B.S. Degree. UMBC-Shady Grove does not offer courses for the first two years of a B.S. Degree program. Therefore, the tuition for UMBC is also provided. 2 – Salisbury University offers a B.S. in Biology with a track in Biotechnology 3 – Bowie State University offers a B.S. in Biology with a track in Biotechnology				

Goal 2: "SUCCESS: Promote and implement practices and policies that will ensure student success." The Biotechnology Certificate allows students to enter directly into the workforce. The program addresses "Strategy 6: Improve the student experience by providing better options and services that are designed to facilitate prompt completion of degree requirements" recommends the creation of "focused pathways". The biotechnology program utilizes this framework to create a clear path to graduation, by identifying the courses that a student should take each semester to ensure completion of prerequisites for courses later in the pathway. In addition, this course path facilitates the completion of the certificate in two years. Please see Appendix A for course sequence. The transition to an industry career will be facilitated by internships and curriculum development supported by industry partners on HCC's Biotechnology Advisory Board.

The program also addresses "Strategy 7: Enhance career advising and planning services and integrate them explicitly into academic advising and planning." HCC's revised biotechnology certificate program will support this strategy by embedding information about types of biotechnology careers and instruction on the required skills for those careers in the curriculum of core biotechnology courses. In addition, students will further learn about careers through career exploration fieldtrips, guest speakers, and internships facilitated by our industry partners.

Goal 3: "INNOVATION: Foster innovation in all aspects of Maryland higher education to improve

access and student success." HCC's revised biotechnology certificate program will address this goal via innovative and evidence-based pedagogy and collaboration with industry partners in Maryland.

"Strategy 8: Develop new partnerships between colleges and businesses to support workforce development and improve workforce readiness." As previously described, HCC has convened a Biotechnology Advisory Board, which includes members of industry, four-year institutions, and Harford County Public Schools. Board members provided guidance on the skills and competencies necessary for entry-level employment in Maryland; their feedback was used to inform curriculum development for the proposed program and new courses. In addition, board members have committed to providing opportunities for students to participate in internships. For example, HCC has negotiated an Education Partnership Agreement (EPA) for the creation of cooperative educational opportunities to train students using the Army Biomanufacturing Complex in synthetic biology at the U.S. Army Combat Capabilities Development Command Chemical Biological Center (DEVCOM CBC).

HCC seeks to address "Strategy 9: Strengthen and sustain development and collaboration in addressing teaching and learning challenges" by incorporating Open Educational Resources (OERs) into its programs to offset the cost of college. The HCC OER initiative actively encourages, supports, and sustains the use of OERs and low-cost, assessable formats for all courses as appropriate without compromising quality of content. The STEM division encourages the use of OERs or low-cost materials when feasible to reduce student debt burden.

In addition, the revised biotechnology certificate program will address "Strategy 9" and "Strategy 10: Expand support for research and research partnerships" through course based undergraduate research experiences (CUREs) in several of the biotechnology courses and internships. Participation in research, especially early in the academic career, has been shown to increase retention and completion for students in STEM fields. CUREs provide an opportunity for a larger number of students to participate in authentic research, thereby increasing equity of opportunity and overall student success (Bangera & Brownell, 2014).

B. Quantifiable and Reliable Evidence and Documentation of Market Supply and Demand in the Region and State

1. Describe potential industry or industries, employment opportunities, and expected level of entry (*ex: mid-level management*) for graduates of the proposedprogram.

1. There are more than 41,000 employed in life sciences or biotechnology jobs in Maryland (Eichensehr, 2019). Recent baccalaureate graduates, however, often lack the appropriate training for the existing biotechnology jobs in the region (Thompson et al., 2018). This biotechnology certificate will fill gaps that may exist in some baccalaureate programs such as applied lab skills, and inclusion of content specific to industry (e.g., biomanufacturing, Standard Operating Procedures, and Current Good Manufacturing Practices).

Maryland ranks third in the nation for the number of biological technicians employed, (Maryland Department of Commerce, n.d.), positions which often require an applied focus not found in some baccalaureate programs. Over 750 biotech-related employers have hired students from community college biotechnology programs across the U.S., including over 40 employers in the state of Maryland (InnovATEBIO, 2021; Biotech-Careers, 2021).

Certificate graduates with less than one year of experience can expect to earn between $34,000 and $55,000 in entry-level biotechnology industry positions in Maryland, as demonstrated in the figure below (Salary.com, 2021).

2. Present data and analysis projecting market demand and the availability ofopenings in a job market to be served by the new program.

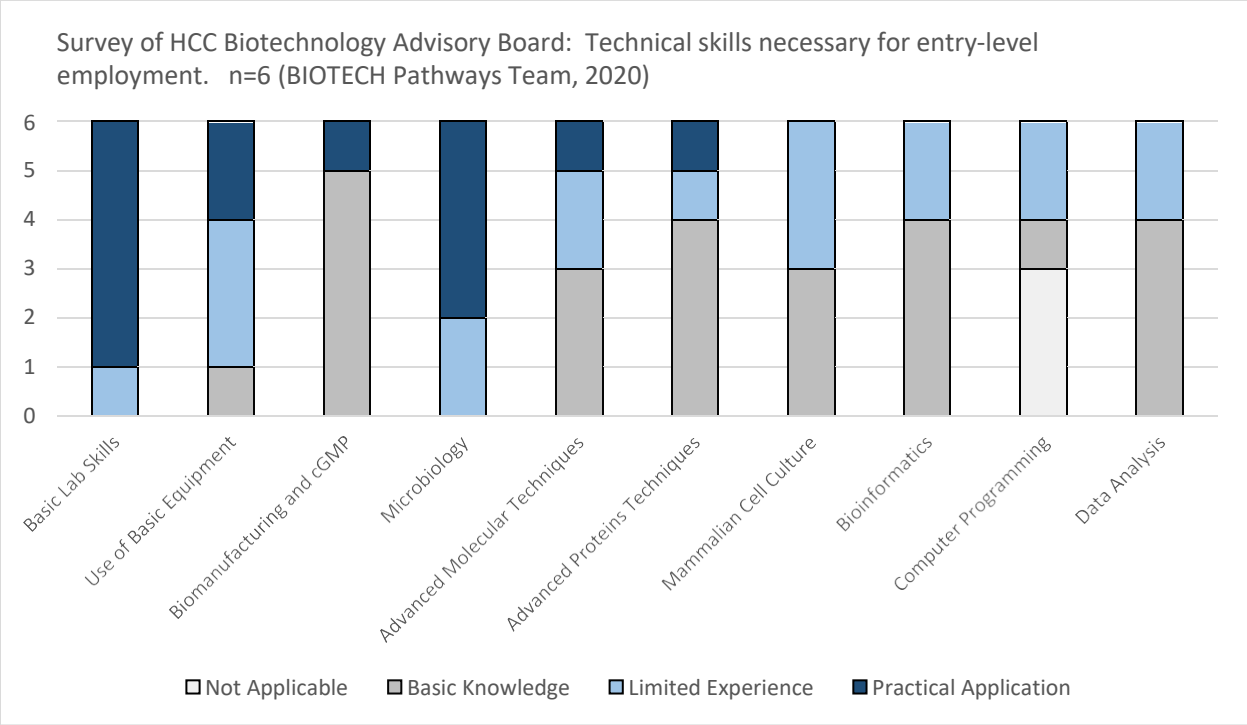
As described in the section above, the biotechnology industry is expected to experience continued growth in Maryland and across the U.S. According to the U.S. Bureau of Labor Statistics, the need for biological technicians and related positions is expected to grow faster than average (2021).

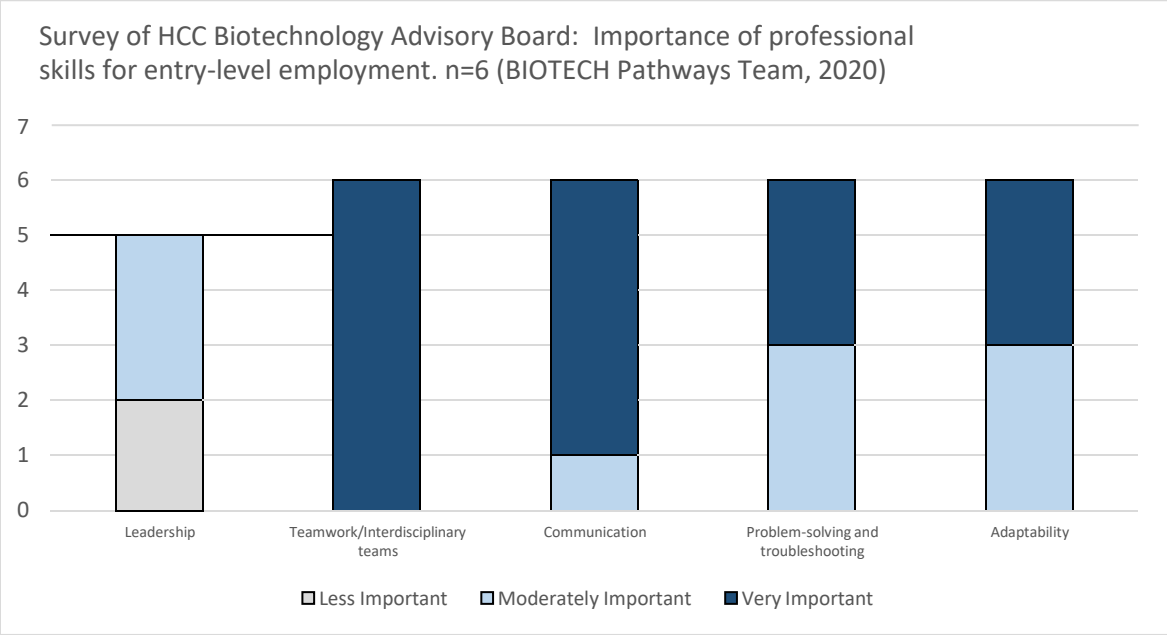
	Employment		Percent Change	Projected Annual Job Openings due to Growth
	2019	2029		
Biological Technicians United States (Bureau of Labor Statistics, 2021)	87,500	91,800	5%	9,400

	Employment		Percent Change	Projected Annual Job Openings due to Growth
	2019	2029		
Maryland employment trend (O*NET 2021)	2,430	2,640	9%	330

3. Discuss and provide evidence of market surveys that clearly provide quantifiable and reliable data on the educational and training needs and the anticipated number of vacancies expected over the next 5 years.

Recent surveys of biotechnology stakeholders from the BioHealth Capital Region found a disconnect between industry needs and student and academia perceptions. First, despite the prominence of the biotechnology industry in the region, most undergraduates were unaware of bioscience career opportunities, and only 8.8% believed they lacked the commercially relevant skills needed to gain employment in the bioscience industry. Similarly, 91.7% of the representatives from academia believed that their graduates were well prepared for industry positions. In contrast, a majority of potential employers found that recent graduates lacked key skills related to the biotechnology industry, including soft skills, commercial experience, technical skills, or background knowledge in the discipline (Thompson et al., 2018). Despite graduating with a bachelor's degree in a life science field, potential employees still lack the skills deemed necessary by biotechnology industry employers. HCC's revised biotechnology certificate program will prepare workers for these entry-level industry positions by focusing on core knowledge and skills identified by the HCC Biotechnology Advisory Board. The revised certificate program provides a method for individuals with a bachelor's degree in life sciences to obtain the applied focus required by the biotechnology industry, which may be missing from some baccalaureate programs. In an internal survey of Biotechnology Advisory Board members, the majority of respondents agreed that essential skills for entry-level employment included basic lab skills, the use of basic biotechnology equipment, and microbial techniques, as well as teamwork and the ability to work in interdisciplinary teams (BIOTECH Pathways Team, 2020). These skills are embedded throughout the proposed biotechnology curriculum.





In addition to this skills gap, the biotechnology sector struggles to overcome a lack of racial diversity in its workforce. Despite representing only 61.3% of the U.S. population in 2016, non• Hispanic/Latino white employees made up 59.7% of biotech company employees, 75% of managers, and 79.1% of boards of directors in a 2018 survey of 54 biotech companies. Similarly, Asian biotech workers were represented at a rate more than three times their share of the U.S. population, while Hispanic/Latino

and Black/African American biotech workers were significantly underrepresented, at only 6.1% and 6.9% of the workforce, respectively (Huggett, 2018).

The discrepancy between academic preparation and industry needs, as well as the need to diversify the biotechnology workforce, present opportunities for community college graduates from biotechnology programs. HCC will address these issues through the revised certificate and by increasing outreach to high school students and their families to provide a meaningful avenue for Harford County residents to take advantage of workforce opportunities in biotechnology.

3. Provide data showing the current and projected supply of prospective graduates.

Biotechnology Enrollment Projections

	Year 1	Year 2	Year 3	Year 4	Year 5
Projected Enrollment	15	20	25	30	40

HCC is also proposing a new A.A.S. in Biotechnology that is being submitted to MHEC via separate documentation and the proposed biotechnology courses specific to the certificate are also part of the A.A.S degree. The projected enrollments include students enrolled in both the revised certificate and the proposed A.A.S. degree.

D. Reasonableness of Program Duplication

1. Identify similar programs in the State and/or same geographical area. Discuss similarities and differences between the proposed program and others in the same degree to be awarded.

The following table identifies similar programs and summarizes key differences in curriculum.

Institution	Program	Degree	Key Differences
Baltimore City Community College (BCCC)	Biotechnology Lab Certificate	Certificate	This program is 41 miles from HCC. The certificate includes 21-23 credits, but only three biotechnology-specific courses. The HCC program requires more biotechnology-specific courses and lab experiences.
Frederick Community College	Biotechnology	Certificate	This program is 87 miles away from HCC. The HCC program requires a course in immunology that is not required by Frederick CC. The program is 35 credits.
Frederick Community College	Biotechnology	Letter of Recognition	This program is 87 miles away from HCC. The Letter of Recognition requires 8

			credits. HCC does not have a similar program.
Hagerstown Community College	Biotechnology	Certificate	This program is 105 miles away from HCC. The certificate requires 22 credits. The HCC program requires courses in cell culture and immunology that are not required by Hagerstown CC.
Montgomery College	Biotechnology	Certificate	This program is 66 miles away from HCC. The Montgomery College certificate program only requires 25 credits. It does not require a biomanufacturing course.
Montgomery College	Biomanufacturing	Certificate	This program is 66 miles away from HCC. The Montgomery College program requires only 19 credits and is focused on biomanufacturing.

The content information and competencies encompassed within the revised HCC biotechnology certificate have wide applicability in diverse sub-disciplines of biotechnology. The information provided above on job growth, job outlook and investment in this sector clearly illustrates a tremendous current need for individuals with skills in biotechnology. The current COVID-19 pandemic has only added to the intensity of the need for skilled workers in this arena. This sizable and fundamental educational need will only be met with the combined efforts of multiple institutions of higher education (Keown, 2021).

2. Provide justification for the proposed program.

Maryland is home to more than 500 biotech and 2,700 life sciences companies (Maryland Department of Commerce, 2019). The bioscience industry continues to grow in Maryland, largely because the state has made growth in the biosciences a priority, with the creation of the Maryland Life Sciences Advisory Board in 2007 and programs and incentives meant to grow the biotechnology industry (Maryland Department of Commerce, 2019; Maryland Department of Commerce, n.d.). To sustain its growth, workforce development must be a priority.

Aberdeen Proving Ground (APG) is the leading employer in Harford County (Maryland Department of Commerce, 2018). The Combat Capabilities Development Command (CCDC) Chemical Biological Center BioSciences Division (including the BioTechnology Branch) at APG conducts basic and applied research supporting chemical and biological defenses. This command has identified synthetic biology and biomanufacturing as a priority. HCC has negotiated an Education Partnership Agreement (EPA) for the creation of cooperative educational opportunities to train students using the Army Biomanufacturing Complex in synthetic biology at the U.S. Army Combat Capabilities Development Command Chemical Biological Center (DEVCOM CBC). HCC also has an established working relationship with the U.S. Army Medical Research Institute of Chemical Defense (MRICD) located at APG. Additionally, the recently established Maryland Defense Technology Commercialization Center (Maryland Deftech) in Harford

County seeks to attract industry partners to Harford County to effectively transfer technology developed at APG to commercial markets. Both APG and Deftech represent potential employers of biotechnicians in Harford County.

The current COVID-19 pandemic has recently intensified demand for skilled professionals in this discipline. As described above, life sciences companies with a presence in Montgomery County received nearly $7.7 billion in 2020 in research and development funding form non-profits, private investors, and the federal government (O'Keefe, 2021); as these companies expand, they will need to hire employees with foundational knowledge and competencies in biotechnology. Significant hubs of biotechnology also exist to the north of HCC in Philadelphia, PA and Wilmington, DE. In 2021, the greater Philadelphia area was ranked seventh in the U.S. as a biotech hub by *Genetic Engineering and Biotechnology News* (Philippidis, 2021).

E. Relevance to High-demand Program at Historically Black Institutions (HBIs)

1. Discuss the program's potential impact on the implementation or maintenance of high demand programs at HBIs

A search on April 23, 2021, for biotechnology programs at the four Historically Black Institutions in Maryland (Bowie State University, Coppin State University, University of Maryland Eastern Shore, and Morgan State University) determined that Coppin State has no course offerings or degree programs in biotechnology. Morgan State University has a 600-level course in Environmental Biotechnology. The University of Maryland Eastern Shore has one course in its school of Agriculture entitled *Introduction to General Biotechnology* (AGRI 288A) and one 400-level, four-credit course in its biology program. Bowie State University has a biotechnology track within its Biology degree that consists of four courses equaling 15 credits. One of these courses is offered at the 200-level (Introduction to Biotechnology), and the other three courses are offered at the 400-level. Thus, the creation of a Certificate in Biotechnology at HCC will have limited impact on high demand programs at HBIs in the state of Maryland.

F. Relevance to the Identity of Historically Black Institutions (HBIs)

1. Discuss the program's potential impact on the uniqueness and institutional identities and missions of HBIs.

The biotechnology certificate will be offered at HCC with a more applied/workforce focus than the current offerings at the HBIs. Therefore, HCC's revised program will have limited impact on the institutional identities and missions of the HBIs in the state of Maryland.

G. Adequacy of Curriculum Design, Program Modality, and Related Learning Outcomes (as outlined in COMAR 13B.02.03.10)

1. Describe how the proposed program was established, and also describe the faculty who will oversee the program.

Research regarding the creation of the biotechnology certificate program was performed by administrators and full-time faculty within the STEM division of Harford Community College. Additionally, we consulted with our biotechnology advisory board (see list of names above), and Prof. Jaclyn Madden has been working closely on course content development with Dr. Linnea Fletcher, the head of the biotechnology program at Austin Community College. In the past, Dr. Fletcher worked at the National Science Foundation, and she is a nationally renowned expert in the field of biotechnology. She is currently the PI for the InnovATE BIO National Biotechnology Education Center. Dr. Fletcher also serves on our advisory board.

The Certificate in Biotechnology was developed in accordance with the College's Curriculum Manual and included assessment of data to support enrollment, consultation with other divisions, and analysis of course transferability to the College's top transfer institutions. Six new courses have been proposed and approved by the curriculum workgroup, including: BIO 128 Introduction to Biotechnology, BIO 211 Microbial Biotechnology, BIO 212 Principles of Biomanufacturing, BIO 213 Cell Culture Techniques, BIO 214 Molecular Techniques, and BIO 215 Immunology Principles and Applications.

The STEM Division faculty, HCC curriculum workgroup, HCC Deans, the Vice President of Academic Affairs, the President of the College, and the Board of Trustees have approved the Certificate in Biotechnology. The full-time faculty members, Prof. Jaclyn Madden, Dr. Susan Walker, and Prof. Breonna Martin will oversee the biotechnology program in collaboration with the Dean of STEM, Dr. Pamela Pape-Lindstrom.

2. Describe education objections and learning outcomes appropriate to the rigor, breadth, and modality of the program.

The Certificate in Biotechnology consists of one course in general biology, one course in general chemistry and six new courses designed for the biotechnology program for a total of 32 credits. See Appendix A for complete course sequence. The courses newly designed for the biotechnology program are BIO 128 Introduction to Biotechnology (BIO 120 General Biology I as a pre-requisite or co-requisite), BIO 211 Microbial Biotechnology (BIO 120 and BIO 128 as pre-requisites), BIO 212 Principles of Biomanufacturing (BIO 120 and BIO 128 as pre-requisites), BIO 212 Cell Culture Techniques (BIO 120 General Biology I as pre-requisite), BIO 214 Molecular Techniques (BIO 120 General Biology I as pre-requisite), and BIO 215 Immunology Principles and Applications (BIO 120 General Biology I as pre-requisite).

The planned modality for the biology/biotechnology courses is for in-person lecture and lab experiences. If concerns with COVID-19 remain at the origination of this program, the lectures for some classes may be conducted via remote, synchronous learning. The lab experiences will remain in-person. The in-person, hands-on lab component of this biotechnology program is critical for the students to gain the lab competencies identified by industry experts and members of the HCC biotechnology advisory board.

Program Learning Outcomes (Goals)

Students who successfully complete the Certificate in Biotechnology will be able to:

2. Explain the basic principles, concepts, and techniques of biotechnology.
3. Apply principles, methods, and quantitative skills to novel problems and situations.
4. Execute biotechnology laboratory tasks utilizing Standard Operating Procedures (SOPs) and Current Good Manufacturing Practices (CGMPs).
5. Demonstrate critical thinking and scientific process skills.
6. Evaluate appropriate sources of scientific information.
7. Analyze the role of biotechnology in society and employ the skills of scientific communication.
8. Demonstrate professional judgement and behaviors that adhere to principles of the responsible conduct of research.

3. Explain how the institution will:

1. provide for assessment of student achievement of learning outcomes in the program.

2. document student achievement of learning outcomes in the program.

Assessment of student program learning outcomes will be implemented throughout the Biology courses required in the Certificate in Biotechnology. Formative, summative, and authentic assessments will be employed. Using the mapping of institutional learning goals to courses, key assignments will be identified in courses to assess student achievement of program learning goals. All course learning outcomes will be assessed once every four years per HCC guidelines. Student artifacts for these identified key assignments are collated and reviewed by faculty to assess how effectively students æ meeting the program learning goals. Data regarding student achievement of the learning outcomes is collated and archived via a learning management system-integrated software solution. This software allows for documenting and archiving data for learning outcomes for each course, as well as student achievement of program goals.

This table demonstrates how courses will achieve the Certificate in Biotechnology program learning outcomes. See Appendix A for complete course sequence.

Course	Program LOs
BIO 128 Introduction to Biotechnology	Program goals 1, 2, 3, 4, 6 and 7
BIO 211 Microbial Biotechnology	Program goals 1, 2, 3, 4, 5, 6 and 7
BIO 212 Principles of Biomanufacturing	Program goal 1, 2, 3 and 7
BIO 213 Cell Culture Techniques	Program goals 1, 2, 3, 4, 5, 6 and 7
BIO 214 Molecular Techniques	Program goals 1, 2 3, 4, 5, 6, and 7
BIO 215 Immunology and Protein Methods	Program goals 1, 2 3, 4, 5, 6, and 7

4. Provide a list of courses with title, semester credit hours and course descriptions, along with a description of program requirements.

BIO 120 General Biology (GL) (4 credits)

Course Description

An introduction to biology (cellular/molecular) for the science major. Basic biological principles common to plants and animals, cell structure and function, biochemical processes, heredity, cell reproduction, and gene expression are presented. Laboratory emphasizes open-ended experimental methods of inquiry. The course meets for 45 lecture/discussion hours and 45 laboratory hours per semester.

Prerequisite(s): high school chemistry or CHEM 010.

Upon satisfactory completion of this course, the student will be able to:

1. Describe the basic anatomical structures and physiological functions of both plant and animal cells.
2. Explain the four major macromolecules, their building blocks, and functions in biochemical processes of the cell.
3. Compare and contrast the basic interrelationships between living cells and their internal and external environments.
4. Describe the processes of DNA replication, protein expression, and gene regulation in prokaryotes and eukaryotes.
5. Relate the processes involved in cell division with those of inheritance (genetics).
6. Employ basic laboratory techniques during laboratory investigations to gain a better understanding of the interrelationships of living organisms and the biosphere.
7. Identify and locate appropriate types of information for review, evaluate the information, and use the information effectively, ethically, and legally.
8. Recognize ethical issues and practice professional standards common to biologists.

BIO 128 Introduction to Biotechnology

Course Description
This course introduces students to the concepts and techniques of biotechnology, including overviews of the development of biotechnology; career fields; current techniques and applications; and bioethics and responsible conduct of research. Students will conduct self-directed research in areas such as microbiology, virology, and molecular biology. The course meets for 45 lecture/discussion hours and 45 laboratory hours per semester.

Prerequisite(s): C or better in any of the following: High school chemistry OR CHEM 010 OR CHEM 111

Prerequisite that may be taken concurrently
BIO 120 General Biology I

Upon satisfactory completion of this course, the student will be able to:

1. Describe the development, career fields, benefits, and ethical issues of biotechnology.
2. Describe current biotechnology techniques and their applications.
3. Explain the purpose of Good Manufacturing Practices (CGMPs), and utilize cGMP documentation practices, SOPs, and appropriate safety procedures in the laboratory.
4. Conduct a self-directed research project that incorporates microbiology, virology, and molecular biology to characterize the life cycle and phage-host dynamics of phages that they isolate from the environment.
5. Perform standard laboratory calculations and prepare stock solutions, dilutions, and media in the lab.
6. Describe the importance of ethics and the responsible conduct of research in biotechnology and employ these practices in the development and implementation of their own research projects.

BIO 211 Microbial Biotechnology

Course Description
This course introduces students to microbial biotechnology, the use of microbes to generate useful products or degrade wastes. The course includes an overview of the structure, function, genetics, growth requirements, and replication of microbes (bacteria, fungi, and viruses) and their applications in biotechnology. Students will conduct self-directed research in areas including microbiology, virology, and bioinformatics. The course meets for 45 lecture/discussion hours and 45 laboratory hours per semester. Students cannot earn credit in both BIO 205 and BIO 211. Permission of instructor may be required to enroll.

Prerequisite(s):
BIO 120 and BIO 128 or permission of the instructor.

Upon satisfactory completion of this course, the student will be able to:

1. Compare the structures, physiology, genomes, and replication strategies of microbes (bacteria, viruses, fungi) relevant to biotechnology.
2. Describe the methods used to analyze, manipulate, and engineer microbial genes for biotechnology and the applications of these technologies.
3. Explain the processes involved in small- and industrial-scale bacterial or yeast fermentation.

4. Annotate bacteriophage genomes to determine the location and functions of genes and genome features using comparative tools and bioinformatic algorithms.
5. Communicate the results of scientific research in oral and written form.

BIO 212 Principles of Biomanufacturing

Course Description
Discoveries in biotechnology and pharmaceutical companies are being used to manufacture new products for the improvement of health and the diagnosis and treatment of disease. This course introduces students to the biomanufacturing process of biopharmaceuticals, including producing them under Current Good Manufacturing Practices. Students will learn about and practice in laboratory the tools of manufacturing, such as upstream and downstream procedures, as well as safety, quality control, quality assurance, and compliance with local, state, federal, and international biotechnology regulations. The course meets for 45 lecture/discussion hours and 45 laboratory hours per semester.

Prerequisite(s): BIO 120 General Biology I, BIO 128 Introduction to Biotechnology

Upon satisfactory completion of this course, the student will be able to:

1. Describe the role of a biomanufacturing company and the professional functions of employees involved in the development of a biopharmaceutical product.
2. Explain the role of regulatory agencies and regulations common to the biomanufacturing industry.
3. Differentiate between Quality Assurance and Quality Control practices and job functions.
4. Identify different types of documentation and their importance to a Quality Management System and Current Good Manufacturing Practices.
5. Employ the techniques involved in upstream and downstream processing.
6. Demonstrate proficiency with documentation and the hands-on operation, maintenance, and calibration of commonly used and specialized laboratory instrumentations used in biotechnology.

BIO 213 Cell Culture Techniques

Course Description
This course introduces students to the theory and applications of cell culture techniques. Topics in this course include aseptic techniques, media preparation, cell counting and dilution, maintenance and propagation of cell lines, contamination, and the application of various molecular techniques to manipulate and assess cell function in vitro. The course meets for 45 lecture/discussion hours and 45 laboratory hours per semester.

Prerequisite(s): BIO 120 General Biology I

Upon satisfactory completion of this course, the student will be able to:

1. Demonstrate proficiency in mammalian cell culture and the maintenance of cell lines.
2. Perform commonly used calculations in cell culture such as media preparation, cell counting, and cell concentration dilutions.
3. Identify the sources, detection methods, and remediation of contamination.
4. Apply molecular techniques to alter cell function.
5. Analyze recorded data related to the growth, maintenance, and evaluation of cell cultures.
6. Communicate the results of scientific research in oral and written form.

BIO 214 Molecular Techniques

Course Description
This is a research-based course in the theory and methods of molecular techniques used in the study of nucleic acids. This course will emphasize scientific written communication. Lecture topics include nucleic acid isolation and analysis, recombinant DNA cloning, primer design, endpoint and real time PCR, regulation of prokaryotic and eukaryotic gene expression, enzymes used in molecular biology, and synthetic biology. The lab is designed as a Course-Based Undergraduate Research Experience (CURE) for biotechnology students to learn and engage with synthetic biology concepts and practices. Students will design and conduct their own synthetic biology experiments with instructor support.

Prerequisite(s): BIO 120 General Biology I

Upon satisfactory completion of this course, the student will be able to:

1. Model the molecular processes used in biotechnology techniques.
2. Relate transcription and translation to the molecular techniques performed in vitro in a molecular lab.
3. Demonstrate proficiency with techniques such as ligation, restriction enzyme digestion, gel electrophoresis, transformation, plasmid ligation, and DNA quantification.
4. Develop a research proposal to create a synthetic biology device.
5. Utilize the scientific and engineering design processes to design, build, and test a functional synthetic biology device.
6. Communicate project results and analysis via a written scientific report.

BIO 215 Immunology Principles and Applications

Course Description
This course introduces students to the structural and functional aspects of the immune system and their applications in biotechnology. The course includes an overview of innate and adaptive immunity, B and T cell development and function, antigen and antibody structure and interactions, cytokines, MHC complexes, and complement. Lecture and lab will focus on immunological and protein methods used in biotechnology, including protein purification and characterization techniques, SDS-PAGE, Western blots, and ELISA. The course meets for 45 lecture/discussion hours and 45 laboratory hours per semester.

Prerequisite(s): BIO 120 General Biology I

Upon satisfactory completion of this course, the student will be able to:

1. Describe the cells and organs of the human immune system.
2. Distinguish between innate and adaptive immunity.
3. Compare and contrast cellular and humoral immunity.
4. Explain how components of the immune system and immunological techniques are utilized in biotechnology for the development and use of diagnostic and therapeutic products.
5. Demonstrate proficiency with immunological and protein-based laboratory techniques.

CHEM 111 General Chemistry I (GL) (4 credits)

An introduction for students requiring a full year of chemistry. The structure of matter and its behavior from a chemical perspective is presented. Topics include atomic and molecular structure, chemical bonding, stoichiometry, periodic relationships, principles of chemical reactions, and properties of state and solutions. The laboratory illustrates the principles discussed in lecture. Course includes 45 hours of lecture and 45 hours of laboratory per semester.

Prerequisite(s): two units of high school algebra or MATH 017 or Math 023 or Math 026. In addition, it is recommended that students have completed one year of high school chemistry or CHEM 010.

Upon satisfactory completion of this course, the student will be able to:

1. Describe atomic theory and differentiate between elements, compounds and mixtures. Explain the law of conservation of mass and the law of definite composition.
2. Utilize stoichiometry to obtain information from and make predictions based on chemical formulas and chemical reactions.
3. Describe atomic and electronic structure of elements as well as describe the structure of the period table and periodic trends.
4. Differentiate the different types of chemical bonds and describe the nature of each.
5. Describe the nature of the gaseous state. Explain the ideal gas law and use it in quantitative calculations.

6. Explain the fundamental differences between the properties of liquids and solids. Interpret a phase diagram and describe the phenomena of phase changes.
7. Describe the properties of a solution and quantitatively describe them.
8. Describe the greenhouse effect, the ozone effect and photochemical smog.

1. Discuss how general education requirements will be met, if applicable.

General education requirements are not applicable for the Certificate in Biotechnology. However, students earning a certificate from HCC must complete or demonstrate exemption from the following courses: ENG 003 Reading and Understanding College Textbooks and ENG 012 Basic Writing, or ENG 018 Integrated Reading and Writing, and MATH 020 Pre-Algebra I.

2. Identify any specialized accreditation or graduate certification requirements for this program and its students.

N/A

3. If contracting with another institution or non-collegiate organization, provide a copy of the written contract.

N/A

4. Provide assurance and any appropriate evidence that the proposed program will provide student with clear, complete, and timely information on the curriculum, course and degree requirements, nature of the faculty/student interaction, assumptions about technology competence and skills, technical equipment requirements, learning management systems, availability of academic support services and financial aid resources, and costs and payment policies.

HCC maintains a comprehensive website that conveys all information about its programs. Students will have access to program requirements, college catalogs, course schedules (which list course modalities), and other relevant information about the program. Following a 2017 comprehensive review of business processes, HCC has begun implementation of projects designed to enhance the student experience. Improvements to workflow provide students with clear, complete, and timely information. For example, the college has adopted new catalog and curriculum software that integrates with both the current Enterprise Resource Planning (ERP) solution, and the degree-auditing and tracking tool provides students with real time information regarding curriculum, course, and degree requirements.

HCC regards faculty interactions with the students as paramount to academic success. All full time faculty maintain at least five reasonably distributed office hours per week during the academic semester. Faculty office hours are posted in the syllabus and in the learning management system. As the COVID-19 pandemic has restricted on campus interactions, faculty meet with students for office hours via videoconferencing platforms such as Zoom or Microsoft Teams.

STEM faculty utilize technology navigation concurrent to student usage during face-to-face course instruction, generate video tutorials for online course delivery, and serve as tech support through virtual and onsite assistance. This technology meets the educational needs of HCC's diverse student population and effectively addresses skill disparities that might otherwise pose a barrier to learning. All HCC courses are required to use the Blackboard Learning Management System (LMS) to provide links to academic support services, financial aid resources, and college policies regarding tuition costs and payment regardless of instructional delivery mode.

5. Provide assurance and any appropriate evidence that advertising, recruiting, and admissions materials will clearly and accurately represent the proposed program and the services available.

Harford Community College's Office of Communications generates promotional materials for academic programs that are used in advertising, recruiting, and admission. Office of Communications staff work closely with staff in Academic Affairs and Student Affairs & Institutional Effectiveness to ensure the accuracy of promotional materials. An annual review process of program brochures has been established to coincide with the release of each academic catalog, as well as a line of communication for any programmatic changes that may occur outside of the annual review cycle.

H. Adequacy of Articulation

1. If applicable, discuss how the program supports articulation with programs at partner institutions. Provide all relevant articulation agreements.

The Certificate in Biotechnology is designed for students with existing baccalaureate degrees who desire to upskill or for entry-level students to go right to work. All courses in the revised certificate are also included in the newly proposed A.A.S. in Biotechnology that is being submitted to MHEC via separate documentation. If a student were to become interested in transfer after completing the Certificate, the General Biology I and the General Chemistry I courses are transferable. The other courses BIO 128, BIO 211, BIO 212, BIO 213, BIO 214 and BIO 215 may be transferable to specific programs at four-year institutions, such as the Translational Life Science Technology Bachelor's degree at UMBC Shady Grove or the Biotechnology Bachelor's Degree program at the University of Maryland Global Campus. HCC has had conversations with Dr. Annica Wayman, Associate Dean for Shady Grove Affairs, regarding articulation of our program to UMBC Shady Grove and she sits on the HCC Biotechnology Advisory Board.

I. Adequacy of Faculty Resources (as outlined in COMAR 13B.02.03.11).

1. Provide a brief narrative demonstrating the quality of program faculty. Include a summary list of faculty with appointment type, terminal degree title and field, academic title/rank, status (full-time, part-time, adjunct) and the course(s) each faculty member will teach in the proposed program.

Harford Community College (HCC) employs highly qualified faculty in all disciplines. All full-time and adjunct faculty have a minimum of an earned master's degree in the discipline in which they teach or a closely related discipline if the area is interdisciplinary, such as biotechnology.

FACULTY NAME	DEGREES EARNED	STATUS	COURSES OF INSTRUCTION
Jaclyn Madden	B.S. Biology - St. Vincent College, Latrobe, PA M.S. Biotechnology - Johns Hopkins University, Baltimore, MD	Full-time	BIO 120, BIO 128, BIO 211, BIO 212, BIO 213, BIO 214, BIO 215
Breonna Martin	B.A. Biological Sciences, University of Delaware, Newark, DE M.S. Biological Sciences - Cell and Organ Systems Concentration, University of Delaware, Newark, DE	Full-time	BIO 120, BIO 128, BIO 211, BIO 213, BIO 214, BIO 215
Susan Walker	B.S., Biology, The Pennsylvania State University, University Park, PA. M.S., Physiology, The Pennsylvania State University, University Park, PA. Ph.D., Physiology, The Pennsylvania State University, University Park, PA.	Full-time	BIO 128, BIO 213, BIO 214, BIO 215

2. Demonstrate how the institution will provide ongoing pedagogy training for faculty in evidence-based best practices, including training in:

a). Pedagogy that meets the needs of the students

b) The learning management system

c) evidence-based best practices for distance education, if distance education is offered.

Harford Community College provides ongoing pedagogical training for full-time and adjunct faculty. Also, funds are available for faculty to participate in professional development opportunities external to the college. In summer 2019, 40 full-time and adjunct faculty participated in the Mobile Summer Scientific Teaching Institute, now called the National Institute on Scientific Teaching. Additionally, HCC hosts the Center for Excellence in Teaching and Learning (CETL), which offers comprehensive professional development and training for all who are engaged in the teaching and learning process at HCC. CETL is intentionally designed to be both a digital and physical hub for innovation, collaboration, and learning transformation through a variety of events and resources to:

- Create faculty teaching and learning communities of practice;

- Celebrate innovation in instruction and scholarship;
- Offer on-going basic and advanced learning management system training;
- Provide resources, facilities, and technology to foster experimentation; and
- Offer opportunities for faculty to gain additional knowledge and hone skills related to technology and pedagogy.

All distance learning courses are reviewed through a collaborative internal review process based upon standards developed at the College through the shared governance process and approved by Faculty Council. Faculty are required to employ evidence-based practices in course design.

When adjuncts are newly hired at HCC, they complete a Teaching Online Academy in Blackboard which produces a certificate documenting successful completion (the training includes summative assessments on which faculty must earn a minimum score). This training teaches about the specifics of the Blackboard Learning Management System and includes best practices in online instruction. All courses at HCC are web enhanced (supported by a Blackboard site) regardless of course modality. Faculty are required to post syllabi and contact information and maintain student grades in Blackboard for all courses (not just online or distance learning courses).

J. Adequacy of Library Resources (as outlined in COMAR 13B.02.12)

1. Describe the library resources available and/or the measures to be taken to ensure resources are adequate to support the proposed program. If the program is to be implemented within existing institutional resources.

The HCC Library is a 25,734 square foot facility located centrally on campus. It is open seven days per week for student access. The library's website provides 24-hour free access to the catalog, databases, subject guides, tutorials, and other resources. Borrowing privileges are available for all students, as well as county residents 18 years or older. The library focuses its collection on a mixture of print, electronic, and video resources to meet the informational and curricular needs of the HCC community. Students have access to full-text journal, magazine, and newspaper articles through the College's subscription databases. Streaming video collections are available through two databases, Films on Demand and Alexander Street Press. Students have access to unlimited resources through the Inter-Library Loan Service, which can deliver titles from almost any academic library in the country.

K. Adequacy of Physical Facilities, Infrastructure and Instructional Equipment (as outlined in COMAR 13B.02.03.13)

1. Provide an assurance that physical facilities, infrastructure and instruction equipment are adequate to initiate the program, particularly as related to spaces for classrooms, staff and faculty offices, and laboratories for studies in the technologies and sciences.

No new facilities are required for this program. Physical resources at HCC offer sufficient space and learning technology to support education. The 352-acre campus has a physical plant of 21 buildings including a performing arts center, an observatory, a 3,000-seat arena and athletic center, and six classroom buildings.

Students enrolled in the program have access to the HCC Learning Center for tutoring services in math, science, writing, study skills and test taking skills. Additionally, the Test and Assessment Center, Academic Advising and Transfer Services, and Career Services are all resources of the college that may be utilized by individual students or groups of students. For some courses in the STEM division, the HCC Learning Center provides tutors via the Supplemental Instruction program that are directly embedded in the course and work with the faculty member to assist students during class time.

HCC has a full suite of well-equipped laboratory spaces to support lab instruction which are not at capacity. The college will leverage this existing laboratory capacity to support this revised biotechnology certificate program. Additionally, equipment purchased with NSF-ATE grant funding will allow HCC students to utilize equipment including a cell culture incubator, a real-time PCR (qPCR) machine, a fluorescent inverted microscope, and a microplate reader in their own research projects. The grant money also funded the purchase of a –86°C ultra-low temperature freezer for appropriate storage of reagents and microbial materials.

1. Provide assurance and any appropriate evidence that the institution will ensure students enrolled in and faculty teaching in distance education will have adequate access to :

a) An institutional electronic mailing system, and

b) A learning management system that provides the necessary support for distance education.

All faculty and credit-earning students are provided with an institutional e-mail account that integrates with the learning management system. Open-access, comprehensive student support for the learning management system is provided in module format and includes “how to” video and print tutorials, an e-learning Help Desk, links to student services, and tips for success in an online learning environment. Faculty are assigned an e-learning point-of-contact for technical support, a learning management system “trouble-shoot” guide, and access to a Help Desk dedicated line.

Information and Technology Services (ITS) at HCC provide technology support for desktop, laptop and tablet devices provided by the college, classroom computers, and instructional technology, such as SMART Boards, LCD projectors, and DVDs. Wireless access is available throughout the HCC campus. Open-access computer labs located in the library offer a wide selection of computer software and applications for student use, including multimedia production and digital editing capabilities. A resource help desk, staffed by e-learning personnel, is available specifically for student help with online resources.

L. Adequacy of Financial Resources with Documentation (as outline in COMAR 13B.02.03.14)

a. Complete Table and rationale:

Tuition and fee rationale is based upon $133/credit x 16 credits = $2128 + average of $200 in course fees = $2328. Grant revenue is from the NSF ATE DUE Award # 200193. Grant revenues are highest in year one, to fund equipment purchases. Other grant monies are used to support faculty time for course development and outreach events to high school students and their families. Some faculty money from the grant will be used to support a summer camp recruitment experience for high school students interested in biotechnology in years 2 and 3. Additional funds from the NSF in direct participant costs have been removed from the revenue numbers indicated here.

Resource 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)	$0	$0	$0	$0	$0
a. Number of F/T Students	0	0	0	0	0
b. Annual Tuition/Fee Rate[1]	$2328	$2328	$2328	$2328	$2328
c. Total F/T Revenue (a x b)	$	$	$	$	$
d. Number of P/T Students	15	20	25	30	40
e. Credit Hour Rate	$133	$133	$133	$133	$133
f. Annual Credit Hour Rate					

Resource Categories	Year 1	Year 2	Year 3	Year 4	Year 5
g. Total P/T Revenue (d x e x f)[1]	$34,920	$46,560	$58,200	$69,840	$93,120
3. Grants, Contracts & Other External Sources (NSF Award # 200193)	$119,861	$66,584	$51,521	$0	$0
4. Other Sources Consolidated Service Fee	$0	$0	$0	$0	$0
TOTAL (Add 1 – 4)	$154,781	$113,144	$109,721	$69,840	$93,120

[1] $133/credit x 16 credits = $2128 + average of $200 in course fees = $2328.

b. Complete Table

Rationale. The courses in the biotechnology certificate program will be taught by current HCC full-time faculty. Salary expenditures reflect paying one adjunct per semester to teach the course vacated by the faculty member in the first year, with the number of adjunct hires increasing as enrollment in the program increases. The classes are four credits with lecture and lab, so the adjunct rate is approximately $4910 per course. HCC is also proposing a new A.A.S. in Biotechnology that is being submitted to MHEC via separate documentation and the proposed biotechnology courses specific to the certificate are also part of the A.A.S degree and thus the expenditures are shared between the two programs. The projected enrollments include students enrolled in both the revised certificate and the proposed A.A.S. degree.

Equipment purchases for this program will be supported by the NSF ATE award # 200193 for the first two years. Equipment costs after that are expected to be minimal and will be supported by the HCC STEM division operational budget. Library resources are budgeted in the operating budget on an ongoing basis. Expenses such as professional development, travel, memberships, office supplies, communications, data processing, and equipment maintenance are budgeted in the operating budget on an ongoing basis.

Expenditure Categories	Year 1	Year 2	Year 3	Year 4	Year 5
1. Faculty (b + c below)					
a. # FTE	<1	1	1	1	2
b. Total Salary	$9820	$14,730	$14,730	$19,760	$39,280
c. Total Benefits	$6373	$19,119	$19,119	$19,119	$38,238
2. Admin. Staff (b + c below)	$0	$0	$0	$0	$0
a. # FTE	0	0	0	0	0
b. Total Salary	0	0	0	0	0
c. Total Benefits	0	0	0	0	0
3. Support Staff (b + c below)	0	0	0	0	0
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 (NSF Award # 200193)	$67,098	$14,365	$2000	$2000	$2000

Expenditure Categories	Year 1	Year 2	Year 3	Year 4	Year 5
5. Library	$0	$0	$0	$0	$0
6. New or Renovated Space	$0	$0	$0	$0	$0
7. Other Expenses	$0	$0	$0	$0	$0
TOTAL (Add 1 – 7)	$83,291	$48,214	$35,849	$40,879	$77,518

M. Adequacy of Provisions for Evaluation of Program (as outlined in COMAR 13B.02.03.15)

1. Discuss procedures for evaluating courses, faculty, and student learning outcomes.

Faculty are evaluated annually by the STEM division dean using the following core components: instruction observations, syllabus, final examinations, assessment instruments or strategies used to evaluate course objectives and academic outcomes, data reports and written critiques of student surveys of instruction, participation records of college assignments, professional development activities, and college and community service activities.

2. Explain how the institution will evaluate the proposed program's educational effectiveness, including assessments of student learning outcomes, student retention, student and faculty satisfaction and cost effectiveness.

HCC has a college-wide, systematic plan for evaluation of all degree and certificate programs, and courses that will be utilized to evaluate the biotechnology program. The College supports the review of curriculum as a significant component of an overall educational effectiveness plan. Program reviews lead to program and course improvements that are based on sustained information gathering and analysis, provide insight for needed resources, and ensure superior educational programs that meet student and community needs. Program reviews assess how well the program has achieved its objectives, suggest potential approaches to enhance this effort, and address and fulfill accreditation requirements as prescribed by Middle States.

The program evaluation process includes faculty and staff within and outside of the program, students, advisory board members, representatives from resource areas in the college, and other communities of interest. This review process provides a consistent framework for evaluating a program's educational effectiveness and includes the use of a comprehensive data management system to systematically collect and report student learning outcome assessments and collaboration with the Office of Institutional Research, Planning, and Effectiveness regarding student retention and completion data, faculty and student satisfaction, and program cost-effectiveness. All programs and their options/tracks,

including A.A.S. (career), certificate, A.A. /A.S./A.F.A. (transfer) degree programs, and programs such as General Education, Information Literacy, and Distance Learning are evaluated every three to five years on a planned cycle.

N. Consistency with the State's Minority Student Achievement Goals (as outlines in COMAR 13B.02.03.05)

1. Discuss how the proposed program addresses minority student access & success, and the institution's cultural diversity goals and initiatives.

HCC has a history of promoting diversity and creating an environment that is open and inclusive for students, visitors, and employees. HCC embraces differences, respects intellectual and academic freedom, promotes critical discourse, and encourages sociocultural and global awareness.

HCC has developed strategies to address the eradication of the attainment gap, including implementation of the My College Success Network (MCSN) and Soar2Success (S2S). Established in July 2014, these programs are a network of services, events, staff, and faculty geared toward empowering and supporting African American students.

In 2018, HCC joined Achieving the Dream (ATD), a network dedicated to improving student success, with a particular focus on academic goal attainment, personal growth, and economic opportunity for low-income students and students of color.

O. Relationship to Low Productivity Programs Identified by the Commission

1. If the proposed program is directly related to an identified low productivity program, discuss how the fiscal resources (including faculty, administration, library resources and general operating expenses) may be redistributed to this program.

This revised program is not directly related to an identified low productivity program.

P. Adequacy of Distance Education Programs (as outlined in COMAR 13B.02.03.22)

1. Provide affirmation and any appropriate evidence that the institution is eligible to provide Distance Education.

HCC is an approved institution of the National Council for State Authorization Reciprocity Agreement (NC-SARA). As a NC-SARA institution, HCC is approved to offer distance learning courses to students who reside in other NC-SARA approved states. At this point in time, HCC is unable to admit students from California, as California is not a participating member of NC-SARA.

2. Provide assurance and any appropriate evidence that the institution complies with the C-RAC guidelines, particularly as it relates to the proposed program.

HCC complies with C-RAC guidelines for the Evaluation of Distance Education. The College's e-learning Department and the Distance Learning Committee (DLC) ensure online learning offered by HCC aligns with the College's mission to provide accessible, innovative, and learner-centered education to promote individual goal attainment, as well as career and workforce development. Both the DLC and e-learning have worked together to develop a formal Quality Matters review for courses as well as an internal review process for all new and existing online classes at HCC to ensure a high quality and rigorous educational experience for all online students.

All faculty are provided Blackboard course sites for each of their courses and are required to complete Blackboard basic training or demonstrate competency through a "Blackboard Veterans" quiz developed internally. In addition to the required training, course syllabi, contact information, and college closing information must be included on all course sites. To further facilitate student success in online learning environments, the DLC developed and implemented common nomenclatures for online course menus to standardize terminology used in courses across campus. An "Online Readiness Check" was also developed as a tool to assess the readiness of students interested in enrolling in online courses.

The e-Learning department also provides professional development training that focuses on enhancing online instruction for all faculty throughout the year. In response to the COVID-19 pandemic which forced virtually all instruction online, the HCC e-learning staff have updated the online professional development training in Blackboard, resulting in a very robust professional development sequence. The current available training includes the Blackboard basic training (described above), the Teaching Online Academy, the Teaching Online Academy: Next Level, Quality Assurance training and Quality Matters training.

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Appendix A: Harford Community College Catalog Page

Proposed Required Courses, Course Sequencing

Certificate in Biotechnology Course Sequence			
Course (Fall Year 1)	**Credits**	**Course (Spring Year 1)**	**Credits**
BIO 120 General Biology I	4	BIO 211 Microbial Biotechnology	4
BIO 128 Introduction to Biotechnology	4	CHEM 111 General Chemistry I	4
Total	**8**	**Total**	**8**
Course (Fall Year 2)	**Credits**	**Course (Spring Year 2)**	**Credits**
BIO 212 Principles of Biomanufacturing	4	BIO 214 Molecular Techniques	4
BIO 213 Cell Culture Techniques	4	BIO 215 Immunology and Protein Methods	4
Total	**8**	**Total**	**8**
Total Credits = 32			

Program Goals

1. Explain the basic principles, concepts, and techniques of biotechnology.
2. Apply principles, methods, and quantitative skills to novel problems and situations.
3. Execute biotechnology laboratory tasks utilizing Standard Operating Procedures (SOPs) and Current Good Manufacturing Practices (cGMPs).
4. Demonstrate critical thinking and scientific process skills.
5. Evaluate appropriate sources of scientific information.
6. Analyze the role of biotechnology in society and employ the skills of scientific communication.
7. Demonstrate professional judgement and behaviors that adhere to principles of the responsible conduct of research.

Current

BIOTECHNOLOGY CERTIFICATE

Award: Certificate in Biotechnology
No. of credits required: 34
For more information: *Contact Associate Professor Jaclyn Madden, 443-412-2046,* jmadden@harford.edu *(August 15 - June 15);* stem@harford.edu*; or Admissions, 443-412-2109.*

Program Description

The Biotechnology Certificate program prepares students in the techniques and skills needed for entry-level bioscience laboratory work. By stressing the basic principles of the natural and physical sciences, with strong emphasis on biotechnology and analytical techniques and applications, the program prepares students for semiprofessional employment in biotechnology, chemical, and biological laboratories. The certificate also lays the foundation for more advanced education in the sciences, and will allow students with a previous degree in the sciences to obtain the skills necessary for employment in the rapidly-expanding biotechnology sector. The bioscience/biotechnology industry is expected to continue to experience growth and to remain a high priority in Maryland.

Program Goals

Upon completion of the Biotechnology Certificate, the student will be able to:

1. Describe and explain concepts in biotechnology and the biomanufacturing process.
2. Practice professional integrity and competency integral to biotechnology research, industry, and ethics.
3. Design, organize, and manage a laboratory notebook including protocols and experimental results.
4. Perform basic laboratory skills essential for following Standard Operating Procedures (SOPs), Good Laboratory Practices (GLPs), and laboratory safety.
5. Collect, analyze and interpret scientific data, using computer technologies and established research and statistical methods.
6. Use and apply the scientific method to develop, organize, execute and interpret experiments in a logical and timely manner.
7. Communicate effectively in oral and written English.
8. Evaluate the effects of biotechnology on society.
9. Illustrate the potential for teamwork by working effectively with others.
10. Employ laboratory methods and techniques required by emerging technologies in the field of biotechnology.

Certificate Requirements

Students earning a certificate from HCC must complete or demonstrate exemption from the following courses: ENG 003 Reading and Understanding College Textbooks and ENG 012 Basic Writing, or ENG 018 Integrated Reading and Writing, and MATH 020 Pre-Algebra I. See graduation requirement details in this catalog for further information.

Required Courses

Code	Title	Credits
BIO 120	General Biology I (GL)	4
BIO 124	Foundations of Biotechnology	3
BIO 125	Laboratory Methods for Biotechnology	1
BIO 208	Genetics	4
BIO 126	Advanced Techniques in Biotechnology	4
BIO 127	Biomanufacturing and Biosafety	2
CHEM 111	General Chemistry I (GL)	4
CHEM 112	General Chemistry II A (GL)	4
MATH 216	Introduction to Statistics (GM)	4
Biotechnology Certificate Electives (p. 1)		4

Biotechnology Certificate Electives

Select four credits from the following:

Code	Title	Credits
BIO 205	Microbiology (GL)	4
Select one of the following: [1]		1-4
BIO 191	Independent Study: Biology	
BIO 192	Independent Study: Biology	
BIO 193	Independent Study: Biology	
BIO 194	Independent Study: Biology	
BA 210	Business Computer Applications	3
CHEM 204	Analytical Chemistry	4

[1] For the Independent Study: Biology course contact STEM division dean for more information.

Note: It is recommended that students complete the required courses for the biotechnology certificate in the sequence they are listed.

Appendix B: Best Practices for HCC Online Courses

Faculty Presence

Faculty should have an active presence that encourages student involvement in the online course environment. Courses that adhere to this practice will typically include several of the following:

- Expectations of availability and turn-around time are clear
- There is evidence that instructors will regularly engage with students in various course activities.
- Faculty intends to provide frequent and substantial feedback
- A personable faculty introduction is included
- A welcome is clearly visible upon first logging into the course

Start-Up Information & Navigation

Course navigation guidance, including start-up information, is readily available. The course is well organized and easy to navigate. Courses that adhere to this practice will typically include several of the following:

- A location, clearly evident upon logging into the course, labeled "start here," includes information the student should view prior to starting the course selected by the instructor such as welcome letter, syllabus, instructor information, student expectations/tips for success, etc.
- The syllabus is complete and easy to access
- Navigation is clear, simple, and user friendly
- The course schedule is summarized in one location
- Organization and sequencing of the course content is logical and clear
- Required instructional materials are easily located
- Links to other parts of the course and external sources are accurate and up to date
- FAQs or help for technological issues are available

Content

Instructional rigor is equal to that of a face-to-face course. It is delivered to address different learning styles and reinforced through various tools. Courses that adhere to this practice will typically include several of the following:

- Instructional content should include more than one of the following: readings, online lectures, videos, simulations, case studies, games, discussion forums, study guides, practice problems, pretests, homework, etc.
- Activities promoting a sense of engagement and community are included, such as scavenger hunt, ice breakers, collaborative exercises, discussion boards, etc.
- The pace of the course is appropriate to the course content and level
- Clear information and instructions are provided regarding the access of required course materials
- Appropriate media supports course content and adds interest
- Any materials which are not required are clearly marked as optional
- Written material is professional and uses language appropriate to the course topic and level
- Copyright ownership is followed and clearly documented

- All course components are visually and functionally consistent with each other

Active Learning

The course provides a variety of opportunities for interaction that support active learning. Courses that adhere to this practice will typically include several of the following:

- The course includes activities which provide opportunities for students to interact with the teacher, with each other, and with the content
- Activities are included which do not have a single right answer
- Challenging tasks are presented
- Sample cases and assignments are used as a template
- Expectations for student participation in the course activities are clear
- Activities and assessments encourage students to apply, analyze and evaluate course content
- Students are encouraged to create new understandings as demonstrated on course assessments
- Students have input to the learning environment, for example, due dates, assessment formats, course content, etc.

Assessment

Various forms of assessment occur throughout the course, in accordance with the HCC attendance policy, and measures student achievement of Student Learning Objectives and/or competencies. Courses that adhere to this practice will typically include several of the following:

- Forms of assessment should include more than one of the following: quizzes, papers, discussions, self-checks, projects, tests & exams, presentations, case studies, labs, skill assessments, etc.
- Assessments clearly align with Student Learning Objectives
- Instructions, student expectations, and grading standards are clearly stated, this may include the provision of sample assignments
- The course grading policy and grading calculations are stated clearly
- The gradebook is visible to students and there are clear instructions on how students can access their grades and feedback, preferably using the Blackboard Grade Center
- The gradebook is current

Accessibility

Course design reflects a commitment to accessibility and usability throughout the course. Courses that adhere to this practice should include the following:

- Course content is in compliance with the Americans with Disabilities Act
- The course design facilitates readability (e.g., color, font, use of white space, length, background, etc.)
- Necessary technology is easily obtainable
- Course media is easy to view and operate
- Technology used in the course supports achievement of the Student Learning Objectives
- Hardware and software requirements are clearly stated, and students are given information about downloading necessary software

- Information directing students to methods of accessing institutional support services; including technology, accessibility, and academic support is included