LOYOLA UNIVERSITY MARYLAND

— 1852 —

Office of Academic Affairs

February 15, 2023

Secretary of Higher Education
Maryland Higher Education Commission
6 N. Liberty Street
Baltimore, MD 21201
Sent via email: acadprop.mhec@maryland.gov

Dear Secretary:

Loyola University Maryland is pleased to submit a proposal for a new Master of Science in Biological Forensics. The proposed program builds upon the already strong foundation the University has built in the field. Biological forensics is a new type of program and is not to be confused with the more narrowly focused areas of forensic biology or forensic molecular biology.

Employment projections indicate a large increase in demand, both nationally and within Maryland, for the skills students will develop in this program. In addition to developing a range of technical and specific skills to advance students' career options, this degree program will also enhance the broader development of students as whole persons, in a manner consistent with Loyola's mission.

The proposal was approved by Loyola's Academic Senate and the Board of Trustees. The President approved this program, as made evident by his signature on the MHEC Cover Sheet. I approve the proposed program and submit it for your recommendation for implementation. Should the Commission have any questions about the proposal, please contact Mr. David Mack, Academic Program Development Specialist, at 410-617-2317 or dsmack@loyola.edu.

Sincerely,

Cheryl Moore-Thomas

Cheryl Moore-Thomas, Ph.D., NCC
Interim Provost and Vice President for Academic Affairs

dsm

cc: Dr. Stephen Fowl, Dean, Loyola College of Arts and Sciences
Mr. Matthew Power, President, Maryland Independent College and University Association
Dr. Angela Sherman, Vice President for Academic Affairs, Maryland Independent College and University Association

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

Institution Submitting Proposal	Loyola University Maryland

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 # 44766 Payment Amount: 850.00 Date Submitted: 2/15/23

Department Proposing Program	Biology Department		
Degree Level and Degree Type	Master of Science		
Title of Proposed Program	Biological Forensics		
Total Number of Credits	42-46		
Suggested Codes	HEGIS: 40499.00	CIP: 43.0406	
Program Modality	(●) On-campus	( ) Distance Education (fully online)	( ) Both
Program Resources	(●) Using Existing Resources	( ) Requiring New Resources	
Projected Implementation Date (must be 60 days from proposal submisison as per COMAR 13B.02.03.03)	(●) Fall	( ) Spring ( ) Summer	Year: 2023
Provide Link to Most Recent Academic Catalog	URL: https://catalogue.loyola.edu/index.php		
Preferred Contact for this Proposal	Name: David Mack		
	Title: Academic Program Development Specialist		
	Phone: (410) 617-2317		
	Email: dsmack@loyola.edu		
President/Chief Executive	Type Name: Terrence M. Sawyer, J.D.		
	Signature: [signature]	Date: 02/15/2023	
	Date of Approval/Endorsement by Governing Board:	02/15/2023	

Revised 1/2021

LOYOLA UNIVERSITY MARYLAND,

A DEGREE-GRANTING INSTITUTION AUTHORIZED TO OPERATE IN MARYLAND,

PROPOSAL FOR A NEW ACADEMIC DEGREE PROGRAM:

BIOLOGICAL FORENSICS M.S.

Submitted in accordance with state regulations found in COMAR 13b.02.03.

on

February 15, 2023

Loyola University Maryland
Master of Science in Biological Forensics
Executive Summary

Loyola University Maryland proposes a new Master of Science in Biological Forensics program. The biological forensics program will broadly examine all types of biological and ecological evidence related to civil, criminal, and administrative law. The proposed new program provides coursework and training in forensic entomology, forensic microbiology, forensic anthropology, biological forensics, veterinary and wildlife forensics, death investigation, DNA analysis, and fingerprints, in addition to other courses focused on the development of an array of learner and technical skills relevant to a wide range of careers in forensic science and other disciplines. Loyola's curriculum was developed in consultation with the forensic laboratory directors at the Maryland State Police and Baltimore City Police, the Deputy Medical Examiner for Connecticut, and a senior technical leader in the Human Identification Division at ThermoFisher Scientific.

The proposed degree program will enhance the broader development of students' skills in a manner consistent with Loyola's mission. The attributes of a forensic science professional are consistent with those of a Loyola graduate: excellent oral and written communication skills; intellectual curiosity; use of interdisciplinary approaches; critical thinking skills; commitment to life-long learning; and strong moral and ethical character. No matter what task assigned, a forensic investigator seeks only for truth. These attributes are the hallmarks of a Jesuit education, and all students pursuing a degree in biological forensics at Loyola University Maryland would be required to develop and use these learning skills.

There are many forensic programs in the United States, but the University is unaware of any program that provides the unique education in the proposed biological forensics program. Biological forensics is not to be confused with the more narrowly focused areas of forensic biology or forensic molecular biology, which only deal with DNA analysis and forensic serology. This proposed program is also different from a general forensic science, forensic studies, forensic biology, or medical forensics program. The proposed program prepares students for an array of jobs dependent on biological and ecological evidence collection and analyses (e.g., veterinary forensics, ecological evidence, death investigation) underserved by existing programs in Maryland. Thus, the Biological Forensics MS degree will complement rather than compete with other forensic programs in the state. The University believes the proposed biological forensics program will be the first of its kind in the nation and that it will add to Maryland's reputation as a leading destination for the study of forensic science in the United States.

A. Centrality to Institutional Mission 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 proposed program leads to a Master of Science degree in Biological Forensics. The degree program is distinctive in name and in the training offered, yet complementary to the existing Loyola graduate program in forensic pattern analysis. Several of Loyola's undergraduate programs, including forensic studies, biology, biochemistry, and chemistry, also serve as direct pathways to the proposed degree in biological forensics. The curricular path can be completed in two years and will provide training and forensic entomology, forensic microbiology, forensic anthropology, biological forensics, veterinary and wildlife forensics, death investigation, DNA analysis, and fingerprints. In addition to developing a range of technical and specific skills to advance students' career options, this degree program will also enhance the broader development of students' skills in a manner consistent with Loyola's mission. The attributes of a forensic science professional are consistent with those of a Loyola graduate: excellent oral and written communication skills; intellectual curiosity; use of interdisciplinary approaches; critical thinking skills; commitment to life-long learning; and strong moral and ethical character. No matter what task assigned, a forensic investigator seeks only for truth. These attributes are the hallmarks of a Jesuit education, and all students pursuing a degree in biological forensics would be required to develop and use these learning skills. The characteristics of this proposed interdisciplinary program, and the dearth of similar programs in the state and region, render a proposal that can significantly contribute to Loyola's distinctiveness.

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

   Loyola's strategic plan, The Ignatian Compass, outlines several goals for enhancement of student preparation for lifetime contributions to the workplace and society. The plan specifically calls for weaving together vocational discernment and liberal arts education in undergraduate and graduate programs, and places emphasis on the development and availability of graduate programs, including those that enhance the adult student experience.[1] Loyola's Board of Trustees has encouraged the University to develop and implement new undergraduate and graduate programs that are consistent with the institution's Ignatian identity,[2] while addressing one or more strategic goals. The desired outcomes include attracting a larger applicant pool to the University, with the added result of yielding a more diverse student population, a more inclusive community, and to generate new sources of revenue through distinctive degree offerings, especially new graduate programs. The implicit requirement of such programs is to be low impact in terms of resources needed for program development. The proposed MS in Biological Forensics has the potential to achieve several of these desired results by 1) being distinctive in the degree and course offerings compared to any other program in the region, 2) attracting new students to Loyola to pursue the graduate degree, 3) recruitment of prospective students to the undergraduate forensic studies program, who in turn, desire to enroll in the MS program, and 4) redeployment of several existing courses and faculty within the proposed

[1] The Ignatian Compass, https://www.loyola.edu/about/strategic-plan.
[2] Ignatian identity refers to the Jesuit educational heritage founded by St. Ignatius of Loyola.

curriculum, and delivery of many of the new graduate courses in the evenings to encourage working adults to pursue the graduate degree. Several existing graduate courses in the forensic pattern analysis program will be offered as either required or elective courses in the proposed master's curriculum, maximizing current resources.

The proposed program also aims to foster justice through the development of a curriculum that addresses both the strengths and weaknesses of forensic sciences and how this has impacted criminal justice in the United States. This approach has been a hallmark of the existing undergraduate and graduate degrees in the forensic studies program at Loyola. Students are presented with multiple viewpoints concerning forensic science and criminal justice in Baltimore and throughout the United States, and then are asked to participate in dialogue centered on ethics, social justice, policing reform, and reshaping of forensic science practices, analyses, and interpretations. The proposed program will serve as a cornerstone to strengthen and expand partnerships with external agencies, industries, and innovators focused on improving and reforming forensic science practices and policies. This approach to graduate education in forensic science is novel from other programs and will be attractive to a more diverse student population.

3. Provide a brief narrative of how the proposed program will be adequately funded for at least the first five years of program implementation. (Additional related information is required in section L.

   Implementation of the MS program will require modest resources in terms of faculty, space, and budget. The proposed curriculum encompasses twenty-six total courses (twelve required), of which, only six are new. Two of the proposed new courses do not require technical or laboratory support, minimizing the costs of development and implementation. Thirteen current full and per course faculty will teach at least twenty-one of the proposed courses within the curriculum.

   The dean of the Loyola College of Arts and Sciences has agreed to hire a full-time administrator to serve as the director of program operations and to teach four courses in the program per year. Any other instructors needed will be hired on a per course basis during the first five years of the program.

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

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

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

      The proposed MS program will follow a similar administrative model as used for the current MS in Forensic Pattern Analysis. The biological forensics program will be housed within the Biology Department. The graduate director will provide overall supervision of the program in terms of financial and personnel decisions, in consultation with the department chair. Day-to-day administration of the program will fall under the direction of the director of program operations in consultation with the graduate director and director of forensic studies. Oversight of programmatic and curricular decisions will be provided by the Forensic Studies Steering Committee, and consultation sought from the Forensic Studies Advisory

Board.

Technical support in terms of laboratory and field equipment and instructional opportunities will be provided by the technical staff of the Biology Department under the supervision of the department's Laboratory Manager.

Financial support of instructional initiatives for the MS program will be made by Loyola College of Arts and Sciences and the Office of Academic Affairs via demonstrated need. A separate budget will be developed for the proposed MS program following a typical three-year need-based model.

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:

   To our knowledge, no graduate programs exist in the United States that are focused primarily on biological forensics. Biological forensics broadly examines all types of biological and ecological evidence related to civil, criminal, and administrative law. The proposed new program provides coursework and training in forensic entomology, forensic microbiology, forensic anthropology, biological forensics, veterinary and wildlife forensics, death investigation, DNA analysis, and fingerprints, in addition to other courses focused on the development of an array of learner and technical skills relevant to a wide range of careers in forensic science and other disciplines. While some coursework overlaps with current forensic science graduate (MS) programs, most of these existing programs only address biological evidence in the form of DNA or serology, the traditional topics of forensic biology. Other forms of biological evidence are either briefly covered as part of a single crime scene or death investigation course or are not addressed at all. This, in turn, has led to a shortage of qualified forensics examiners trained to collect, process, and analyze the broad array of biological evidence associated with crime scene and death investigations, as well as in matters of civil and administrative law. To compensate, employers recruit experienced examiners away from other agencies, hire inexperienced employees that must be trained through external programs, or the result is that certain types of biological evidence are simply not processed by that agency or unit. Obviously, the latter means that the potential exists for critical evidence to not become part of the case record.

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

   In 2015, the Maryland State Taskforce on Forensic Science identified critical writing skills, personal skills, and training in ethics as current deficiencies in forensic science education that need to be addressed.[3] Priority 5 and 8 of the 2022 Maryland State Plan for Higher Education encourages colleges to develop new partnerships with businesses to support workforce development, placing a general emphasis on outcomes supporting business-driven credentials and long-term graduate education opportunities.[4] This proposal for a graduate degree in biological forensics details a plan to achieve both goals through a unique and

[3] Maryland Opportunities and Deficiencies in Forensic Sciences, CFEX, May 2015.
[4] Maryland Higher Education Commission https://dlslibrary.state.md.us/publications/Exec/MHEC/ED11-105(b)(3)(i)_2022.pdf

collaborative approach that relies on an interdisciplinary curriculum that integrates coursework from natural and applied sciences and humanities. The proposed degree also is focused on promoting student interest in STEM fields using a thematic curriculum based on forensic topics and weaving a thread that ties undergraduate to graduate education. Promoting interest and literacy in STEM fields represents a national focus to overcome the STEM education crisis that exists in the United States[5]. Despite years of promoting educational reform in STEM fields and growth projections of more than 25% in science and engineering careers by 2020, STEM disciplines have not been attractive to many students. In fact, transformation efforts and increased spending in science and engineering have yielded the opposite outcomes: the number of high school and undergraduate students completing STEM curricula has continued to decline since 1997. Today, less than 60% of high school students initially pursuing a path in science, technology, mathematics or engineering are expected to pursue a STEM degree in post-secondary education, and fewer than 40% of those students will complete a college degree in a STEM discipline.[6] In Maryland, the STEM crisis has resulted in a workforce shortage for careers in the burgeoning BioHealth industries, which includes those focused on forensic-related fields.[7] These trends can be overcome as evidenced by student interest in all things 'forensic.' At the high school level, forensic science has become one of the most demanded science courses in the Maryland public school systems,[8] a phenomenon that has occurred throughout the United States. Consequently, these same students are seeking additional forensic opportunities when choosing colleges and universities for undergraduate and graduate study. By offering an interdisciplinary MS degree that complements the recently developed BA in Forensic Studies, Loyola has the potential to become a preferred destination in the region for forensic education.

C. 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 proposed program.

   Graduates from the proposed MS program will have immediate opportunities to apply for open positions in publicly funded and private forensic laboratories and private industry. There are approximately 2000 medical examiner and coroner offices in the United States that are responsible for medico-legal death investigation. Each of these offices employs multiple death investigators, criminal investigators, and autopsy assistants and technicians. Eighty percent of these offices rely on coroners who employ over 5500 individuals in careers related to medico-legal death investigation.[9] Correspondingly, medical examiner's offices rely on an additional 2000 employees nationwide, including identification directors, who are also employed in other pathology laboratories. Currently, there are 14 American Society of Crime Laboratory Directors (ASCLD) certified forensic laboratories in Maryland, each employing multiple crime scene investigators. Several federal agencies in the region employ multiple crime scene and criminal investigators, including the FBI,

[5] https://www.whitehouse.gov/wp-content/uploads/2018/12/STEM-Education-Strategic-Plan-2018.pdf
[6] US Department of Education (2015).
[7] 2017 surveys conducted by Mid-Atlantic Biology Research and Career Network (http://www.loyola.edu/academics/biology/future/mabrc).
[8] Information obtained from a teacher focus group conducted by the Forensic Educators Committee, CFEX (2017).
[9] Bureau of Labor Statistics Special Report (2004), https://bjs.ojp.gov/content/pub/pdf/meco04.pdf.

Homeland Security, Armed Forces Pathology Institute, CIA, ATF, US Secret Service, Treasury Department, US Postal Services, forensic units with the individual branches of US military, and several additional agencies associated with Washington, D.C., and the surrounding communities. Additionally, career opportunities exist with any private and government agency that performs background checks, as well as with numerous consulting firms engaged in forensic analysis associated with healthcare, identity fraud/personal identification, and criminal investigations domestically and abroad. Table 1 provides a list of broad career fields available to graduates of forensic science programs. Graduates from the proposed MS degree program will have immediate opportunity to pursue entry level positions in death investigation, crime scene investigation, identification directors, technical leads in forensic laboratories, in addition to a wide range of related positions mentioned previously and associated with careers listed in Table 1. Opportunities also exist within the expanding realm of veterinary and wildlife forensics, dealing with cases ranging from animal cruelty, abuse, death investigations, and poaching. Alternatively, the degree may serve to launch graduates toward additional educational opportunities, especially in specialty areas of forensic sciences such as forensic pathology and forensic nursing.

Table 1. Potential career fields for forensic science graduates[10]

Law Enforcement	Policy Analysis
Forensic Laboratories	Social Statistics
Corrections	Allied Health
Rehabilitation	Social Work
Judiciary	Medicine
Forensic industries	Intelligence
Public Policy	Foreign Service
Research	BioHealth industries
Public Administration	Military
Government Research	Civil Service
Elected or Appointed Leadership	Non-Profit
Missing Persons Identification	Consultant
Academia	Cybersecurity, IT, Digital Forensics
Crime Scene Investigator or Technician	Forensic Medicine
Anthropology	Archaeology
Fraud analysis, Identity theft	Private investigator
Coroner/medical examiner	Medical or forensic pathology
Veterinary forensics/animal control/cruelty investigator	Wildlife forensics

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

   Biological forensics addresses any type of biological evidence associated with civil, criminal, or administration law. It is highly interdisciplinary by nature and has become a vital part of the judicial and regulatory system worldwide. Professional forensic scientists, law enforcement personnel, and criminal justice employees all recognize the growing need for highly qualified specialists who can follow established protocols in the collection,

[10] Data from American Academy of Forensic Sciences (AAFS.org).

preservation, analysis, and presentation of a wide range of forensic evidence. Most forensic science programs provide limited training in biological forensics topics (i.e., DNA analysis, forensic serology) or offer no course work at all. The few graduates trained in any aspect of biological forensics are highly sought after by numerous agencies. Presently there are over 400 state, municipal, county, and federal crime laboratories operating in the United States[11], and an estimated 1000 government-funded forensic laboratories operating worldwide, minus China. The Bureau of Justice Statistics estimated over 13,000 full-time personnel were employed in publicly funded crime laboratories in the US as of 2009, representing a 28% increase from the previous census (2002). Another 7500 positions are available in medical examiner and coroner offices and over 1600 private companies perform forensic analysis or testing in the United States[12], providing a wide range of career opportunities for graduates with a MS degree in Biological Forensics. A need for well-trained forensic scientists in the public, private, and academic sectors is expected to increase for the next several decades. In fact, forensic science positions are predicted to demonstrate the fastest growth in terms of total jobs from now until 2024 within the category of Life, Physical, and Social Science occupations, according to the Bureau of Labor Statistics.[13]

Table 2. Market demand for graduates trained in biological forensics and crime scene investigation

	Job Posting Source			
Job description	AAFS	ASCLD	IAI	Indeed
Death investigator	1	0	2	32
Pathologists/autopsy/coroner assistants	32	1	1	40
Forensic analysts	7	2	2	2
Crime scene investigation	0	3	7	2124
Veterinary/wildlife forensics	0	0	0	596
Forensic anthropology	2	0	2	27

Data collected on April 18, 2022. AAFS, American Academy of Forensic Sciences; ASCLD, American Society of Crime Laboratory Directors; IAI, International Association of Identification; Indeed, general job posting site.

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.

The Bureau of Labor Statistics indicates a sixteen percent increase between 2020 and 2030 in forensic science technicians in the United States as indicated in Table 3. Additionally, the Maryland Long Term Occupational Projections (Table 4) indicate a 24.19 % increase in demand for forensic science technicians alone.

Table 3. Employment projections data for forensic science technicians, 2020-30

Occupational Title	SOC Code	Employment, 2020	Projected Employment, 2030	Change, 2020-30	
				Percent	Numeric
Forensic science	19-4092	17,200	19,800	16	2,700

[11] http://www.bjs.gov/index.cfm?ty=pbdetail&iid=4412.
[12] https://www.anab.org/
[13] https://www.bls.gov/opub/mlr/2015/article/occupational-employment-projections-to-2024.htm.

Occupational Title	SOC Code	Employment, 2020	Projected Employment, 2030	Change, 2020-30	
				Percent	Numeric
technicians					
SOURCE: U.S. Bureau of Labor Statistics, Employment Projections program https://www.bls.gov/ooh/life-physical-and-social-science/forensic-science-technicians.htm#tab-6					

Table 4. Maryland Long Term Occupational Projections (2020 – 2030)

Occupation	Number of Openings			
	2020	2030	Change	Pct. Change
Forensic science technicians	434.0	539.0	105	24.19%
SOURCE: Maryland Department, Division of Workforce Development and Adult Learning, Office of Workforce Information and Performance https://www.dllr.state.md.us/lmi/iandoproj/maryland.shtml				

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

Since the inception of the forensic studies minor in 2011 at Loyola, student interest has steadily grown each year from an initial enrollment of 13 at the close of spring term 2012, to 94 students in April 2022.[14] Enrollments in the minor are now larger than all other Loyola College (12) interdisciplinary minors combined, reflecting not only strong student interest, but also a growing reputation that the program meets the career and intellectual needs of participants. The forensic studies minor serves as a recruitment tool for Loyola. The latter has been apparent with the implementation of the forensic studies major in the fall 2018. Table 5 provides enrollments for the forensic studies minor and major at Loyola since AY 2017-2018. Both programs have served as sources of graduate students in the forensic pattern analysis program and are anticipated to draw even more interest to the proposed MS degree in biological forensics.

Table 5. Enrollment data for Loyola's forensic studies major and minor

Year	Forensic studies minor	Forensic studies major	Total
2017-2018	64	N/A	64
2018-2019	68	22	90
2019-2020	73	29	102
2020-2021	61	64	125
2021-2022	56	94	150

In addition, there are over 180 undergraduate programs offering a BS in Forensic Science in the United States, and twice that number in terms of criminal justice, criminology, and

[14] Data provided by the Loyola's Record Office 4/15/2022.

forensic studies degree programs. Within Maryland alone, there are 22 institutions offering 2-year and 4-year degrees in forensic science, forensic studies, criminology, and criminal justice. In other words, there is a large and steady pipeline of potential graduate students for Loyola's proposed program. In addition, the uniqueness of the proposed MS in Biological Forensics is expected to draw students from outside of Maryland and the United States, helping to strengthen the state's growing reputation as a primary destination for forensic science education and training. If this occurs, it will also support Loyola's strategic plan by attracting a larger and more diverse applicant pool to the University, with the added result of yielding new sources of revenue through distinctive degree offerings, especially new graduate programs.

Although we believe the proposed program is unique to the state, we have included a table compiled from MHEC's degree trends website for programs offered in Maryland that are most similar to the proposed biological forensics MS program.

Table 6. MHEC Degree Trends data

School Name	Degree Level	Program Name	CIP	2016	2017	2018	2019	2020
Towson University	MASTERS	FORENSIC SCIENCE	430106	18	15	30	16	16
Univ. of MD, Baltimore	MASTERS	FORENSIC MEDICINE	430106	0	0	9	5	5
Stevenson University	MASTERS	FORENSIC SCIENCES	430106	17	23	18	9	16
Stevenson University	MASTERS	FORENSIC STUDIES	229999	51	48	38	35	35
Stevenson University	MASTERS	FORENSIC SCIENCE	430106	0	0	1	4	16
Stevenson University	MASTERS	FORENSIC INVESTIGATION	430106	0	0	1	7	11

Source: Maryland Higher Education Commission

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.

   At present, no graduate programs exist in Maryland or the region that focus primarily on biological forensics. Biological forensics is not to be confused with the more narrowly focused areas of forensic biology or forensic molecular biology, which only deal with DNA analysis and forensic serology. Loyola's program would be truly distinctive and is anticipated to be one of the first of its type in the United States. The most similar program in the region is the Master of Science in Forensic Medicine degree offered by the University of Maryland, Baltimore (UMB). That program prepares graduates for careers in forensic medicine and emphasizes coursework in forensic pathology, general pathology, forensic autopsy, medico-legal death investigation, forensic toxicology, forensic radiology, forensic odontology, and forensic anthropology. The only overlap in curricula is with a single

course, death investigation. As UMB's website indicates, forensic medicine applies the principles and knowledge of medical sciences and technologies to the purposes of the law, as in determining the cause of death. Their degree is primarily designed for individuals seeking to continue their education toward medical school to become a medical examiner. Maryland's program identifies outstanding candidates for the forensic medicine degree as individuals who can demonstrate proficiency in Anatomy, Physiology and Analytical Chemistry (https://graduate.umaryland.edu/forensicmedicine/Academics/Who-Should-Apply/). None of those courses are pre-requisites for Loyola's proposed new program. Consequently, the biological forensics degree is expected to draw interest from a different cadre of prospective students and not directly compete with the University of Maryland's program in terms of student recruitment, program goals, or student preparation.

Towson University, Stevenson University, University of Baltimore, and George Washington University each offer Master of Forensic Science degrees, but none provide a focus on biological forensics. Significant differences exist between these existing programs from that proposed at Loyola. For example, the MS program at Towson University requires students to concentrate in either forensic chemistry or molecular biology. Stevenson University offers a MS in Forensic Science and a MA Forensic Studies, through online instruction only with no opportunity for dedicated hands-on laboratory and field training, as would be provided through Loyola's proposed program. Similarly, George Washington's MS degree programs have concentrations in Forensic Toxicology and Molecular Biology, and splits coursework between online (up to 50% of degree) and face-to-face. The University of Baltimore offers an MS degree in Forensic Science that is focused on Cyber Investigations. There are various institutions in the state that deliver MS/MA degrees in Criminal Justice, but all those programs are focused on administration of justice, counseling and/or policing. None are forensic science degrees, and no program in the state or region is focused primarily on biological forensics.

Table 7. Graduate programs in Maryland offering biological forensics coursework

Institution	Degree	No. of courses that overlap with biological forensics program	Degree/certificate in biological forensics
Stevenson University	MS Crime Scene Investigation	1	No
	MS Forensic Investigation	0	No
	MS Forensic Science	2	No
	MS Forensic Studies	0	No
Towson University	MS Forensic Science	2	No

Institution	Degree	No. of courses that overlap with biological forensics program	Degree/certificate in biological forensics
University of Baltimore	MS Forensic Science-Cyber Investigations	0	No
University of Maryland-Baltimore	MS Forensic Medicine	1	No

Source: Course information obtained from institution's websites.

Loyola's curriculum was developed in consultation with the forensic laboratory directors at the Maryland State Police and Baltimore City Police, the Deputy Medical Examiner for Connecticut, and a senior technical leader in the Human Identification Division at ThermoFisher Scientific. Courses in the graduate program, with the exception of non-forensic courses, will be taught primarily by forensic experts in ecological evidence analysis, death investigation, person's identification, and crime scene investigation from the forensic units at the Maryland State Police, Baltimore City and Baltimore County Police Departments, as well as by forensic practitioners in academia and the private sector.

2. Provide justification for the proposed program.

No graduate programs exist in Maryland that are focused primarily on biological forensics (Table 7). There are graduate programs that do exist as forensic biology degrees, but none are offered in Maryland, and those programs have a narrow focus on coursework and training in DNA analysis and forensic serology. Table 8 provides a list of current forensic, criminology/criminal justice or cybersecurity focused programs in Maryland. Current forensic science graduate programs (MS) typically offer one to two courses that overlap with the curriculum of the proposed degree in biological forensics. Most programs offer no course work at all relevant to biological forensics.

Table 8. Graduate programs in Forensic Science and related disciplines in Maryland

College/University	Department	Degree type
Coppin State University	College of Behavioral & Social Sciences	Criminal Justice M.Sc.
Johns Hopkins University	Information Security Institute	Master of Science in Cybersecurity and Security Informatics
Kaplan University	Criminal Justice	Master of Science in Criminal Justice (online)
Stevenson University	School of Humanities and Social Sciences	B.S. to M.S. in Criminal Justice (Forensic Studies)

College/University	Department	Degree type
Stevenson University	School of Humanities and Social Sciences	Master of Science in Forensic Science
Stevenson University	School of Humanities and Social Sciences	Master of Science in Forensic Studies
Towson University	Department of Chemistry	Forensic Science M.S.
University of Baltimore	College of Public Affairs	Criminal Justice M.S.
University of Baltimore	College of Public Affairs	Criminal Justice (M.S.)/J.D. Combined degree
University of Baltimore	College of Public Affairs	Forensic Studies-Cyber Investigations M.S.
University of Maryland Eastern Shore	Department of Criminal Justice	Criminology & Criminal Justice M.S.
University of Maryland Eastern Shore	Department of Natural Sciences	Toxicology M.S.
University of Maryland Baltimore	School of Graduate Studies	Forensic Medicine M.S.
University of Maryland-College Park	Department of Criminology and Criminal Justice	Criminology and Criminal Justice M.A.
University of Maryland-College Park	Department of Criminology and Criminal Justice	Criminology and Criminal Justice Ph.D.
University of Maryland-College Park	College of Public Health	Toxicology M.S. or Ph.D.
University of Maryland Global Campus	Public Safety and Cybersecurity	Digital Forensics and Cyber Investigation M.S.

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

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

   Loyola's program should have no impact on HBIs since no HBI in Maryland offers a graduate program in biological forensics. Loyola's program director will reach out to deans at Maryland's HBI institutions to identify programs that may be open to and benefit from collaborations or articulations with the proposed new biological forensics program, especially for HBCU graduates who are seeking higher degrees in this specific area and that is not available at any HBI in 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

   Loyola's proposed master's of biological forensics program should have no impact on the uniqueness and institutional identities and missions of HBIs since no HBI in Maryland offers a graduate program in biological forensics.

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.

   The director of forensic studies and graduate director of forensic pattern analysis, engaged in conversations with the forensic science laboratory directors from Maryland State Police (MSP) and Baltimore City Police (BCP) regarding critical hiring needs for their respective agencies. He also led Loyola's forensic studies advisory board through a series of strategic planning exercises to consider near and future-term growth of institutions forensic programs. Multiple advisory board members suggested two areas for growth: medico-legal biology and DNA analysis. The forensic studies director conducted formal and informal surveys of current and past students, with the overwhelming majority expressing interest in broad areas related to biological evidence and death investigation. Advisory board members confirmed that this area, biological forensics, represented a gap in current academic programs and that there was (is) strong job potential for graduates in several areas related to forensic investigations.

   Direct oversight of the program will be the purview of the director of program operations, who will work with the director of forensic studies and who will serve as the graduate director for the proposed program, and the forensic studies steering committee to develop, implement, and assess the curriculum and various features of the program. Loyola's forensic studies advisory board will also provide broad oversight of the proposed program. The program will be housed in the department of biology, and the Chair of Biology will provide direct supervision of the graduate director.

2. Describe educational objectives and learning outcomes appropriate to the rigor, breadth, and (modality) of the program.

   The MS program in Biological Forensics provides a framework for graduate students to explore ideas, concepts, technology, and professional practice in collection, processing, and analyzing biological and ecological evidence associated with a range of legal matters, especially in death and criminal investigations. Concomitantly it provides a solid foundation in forensic science and forensic studies complemented by rigorous focus on biological, chemical, and physical concepts and analytical thinking through coursework in biology, forensic science, and statistics. Students will also experience and receive training in professional and ethical approaches to forensic science, including critical and professional writing, presentation of results and expert testimony in court, and ethical and moral components of professional conduct as stewards of forensic science and criminal justice.

The curricular path for the MS degree encourages breadth of understanding, interdisciplinary approaches, critical understanding, team skills, excellent communication skills, and deductive reasoning. Specifically, the program's curriculum will develop and promote skills needed for multiple career paths, including excellent oral and written communication skills, intellectual curiosity, use of interdisciplinary approaches, critical and analytical thinking skills, and commitment to life-long learning. Additionally, the program and its curriculum will emphasize the development of strong moral and ethical character in students.

The Master's curriculum will bestow the following learning and curricular outcomes:

University objectives for learning outcomes specifically supported by the degree program in Biological Forensics:

• Intellectual excellence
• Critical understanding
• Eloquentia Perfecta
• Leadership
• Promotion of justice

Curricular Outcomes specifically supported through the Forensic Pattern Evidence curriculum:
• Students will master current factual content, concepts, theoretical perspectives, and historical trends of different subfields of biological forensics and death investigation.
• Students will demonstrate proficiency in communicating effectively in a variety of formats, including verbal, written, and symbolic channels, relevant to forensic investigation and presentations in the judicial system.
• Students will develop an understanding of the moral, ethical and justice issues surrounding crime and forensic investigation.
• Students will demonstrate a clear understanding of major concepts and techniques used in subfields of biological forensics and death investigation based on their ability to read, interpret, and critically evaluate primary literature; design experiments or conduct independent investigation to test ideas and hypotheses; and interpret data through statistical and graphical packages.
• Students will have received preparation in the professional, practical, and academic aspects of biological forensics to ensure that they would be highly desirable candidates for positions in the field.

A curricular map for the proposed master's degree can be found in **Appendix A**.

3. Explain how the institution will:
    a) provide for assessment of student achievement of learning outcomes in the program

        The director of program operations and the graduate director will work with the forensic studies steering committee and director of forensic studies to develop an assessment plan and cycle for each student learning outcome. The goal is to

implement assessment of all learning goals within the first five years the program. Separate pre- and post-testing will also be performed with each cohort of students to assess the development of professional competencies relevant to biological forensics. Testing will primarily include factual and conceptual understanding, as well as technical proficiencies.

b) document student achievement of learning outcomes in the program

Student achievement of learning outcomes will be documented under the direction of the director of program operations, graduate director, and steering committee. All assessment measures for each program learning objective (PLO), artifacts that are assessed, any form of analyses, and assessment reports generated will be posted online using the centralized software system employed by Loyola. Recommendations for curricular or course changes based on student achievement of specific PLOs will be discussed with the forensic studies steering committee before implementation.

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

The proposed Master of Science in Biological Forensics is composed of a range of 42-46 credits dependent on student course choice. The program requirements include five foundational courses worth a total of nineteen credits. Students additionally choose two courses within the ecological evidence category with a total credit range in this category of seven to nine credits. Students choose one course in person identification for four credits and one course in technical writing for three credits. Students have an additional three program elective courses. Dependent on student choice the total credits for the program electives category range from nine to eleven credits.

All academic requirements (including clinical work), comprehensive exams, thesis (if required), and any additional requirements unique to the department must be satisfactorily completed for a student to be eligible for graduation. All courses taken are considered part of the cumulative QPA, whether they apply to the program or not. Under no circumstances will a student be permitted to graduate if the cumulative QPA is not exactly 3.000 or higher. Students whose QPA falls below 3.000 in the last semester will be placed on probation. These students will be given one semester to raise the QPA to the required 3.000 by taking an additional course(s) above the listed requirements.

Master of Science in Biological Forensics
(42 – 46 Credits)

Biological Forensics Foundation

BL 655	Biological Forensics	5 credits
FO 530	Introduction to Criminalistics	3 credits
FO 677	Death Investigation	4 credits
FO 600	Crime Scene Investigation	4 credits
FO 700	Statistics in Forensic Science	3 credits

Ecological Evidence (select two courses)

BL 651	Forensic Entomology	5 credits
FO 680	Forensic Microbiology*	4 credits
FO 645	Veterinary and Wildlife Forensics*	3 credits

Person's Identification (select one course)

FO 715	Forensic Anthropology*	4 credits
FO 725	Forensic DNA Analysis*	4 credits
FO 610	Introduction to Fingerprints	4 credits

Technical Writing (select one course)

WR 625	Professional Writing	3 credits
WR 626	Technical Writing	3 credits

Electives (select three course) 9-11 credits

BL 628	Bioterrorism	3 credits
BL 773	Special Topics in Forensic Biology: Cold Case Investigations	3 credits
FO 630	Biological and Forensic Science Laboratory Quality Assurance	3 credits
FO 650	Forensic Pattern Evidence	3 credits
FO 675	Mock trial in Forensic Pattern Evidence	3 credits
FO 690	Topics in Forensic Science	3 credits
FO 695	Crime Scene and Evidence Photography	3 credits
FO 710	Advance Topics and Techniques in Fingerprints	3 credits
FO 730	Intro to Forensic Business Management*	3 credits
FO 750	Forensic Cognitive Psychology	3 credits
FO 752	Errors in Forensic Science and Wrongful Convictions	3 credits
FO 790	Biological Forensics Internship	4 credits
FO 791	Biological Forensic Research	4 credits
GB 705	Leading and Managing People	3 credits
PL 611	Bioethics	3 credits
ST 681	Probability and Statistics	3 credits

Master of Science in Biological Forensics
Proposed course sequence

Year One

Fall	**Spring**
FO 530 Introduction to Criminalistics (3)	FO 600 Crime Scene Investigation (4)
FO 610 Introduction to Fingerprints (4)	WR 626 Technical Writing (3)
BL 655 Biological Forensics (5)	BL 651 Forensic Entomology (5)
WR 325 Professional Writing (3) *or*	FO 715 Forensic Anthropology (4) *or*
Elective	Elective

Year Two

Fall	**Spring**
FO 677 Death Investigation (3)	FO 700 Statistics in Forensic Science (3)
FO 680 Forensic Microbiology (4) *or*	FO 725 Forensic DNA Analysis (4)
Elective (3/4)	FO 645 Veterinary and Wildlife Forensics (3) *or*
Elective (3/4) *or*	Elective
WR 625 Professional Writing (3)	

Notes:

1. Foundation courses will be offered every year, as well the technical writing courses.
2. Ecological Evidence and Person's Identification courses will be offered at least once every other year; more frequently depending on student enrollments.
3. Most elective courses will be offered every year.

Course Descriptions

BL 628 - Bioterrorism (3.00 cr): A survey of the history and biology of bioterrorism and biowarfare agents. The course focuses on the cellular and molecular biology of organisms identified by the Centers for Disease Control and Prevention as bioweapons. Emphasis is placed on scientific communication (student-led lectures) and reading/understanding of relevant scientific literature.

BL 651 - Forensic Entomology w/lab (5.00 cr): Forensic entomology is the application of basic and applied principles of insect biology and the collection of entomological data in such a manner that it can be used as evidence in criminal investigations to aid in resolving legal issues that are either criminal or civil in nature. Lectures explore the use of insects in the science of forensic entomology and its impact on death scene investigation, neglect, or abuse; contamination of food products and other marketable goods; and subsequent litigation. Laboratories focus on techniques associated with death scene investigation, particularly in the collection and identification of arthropods found on a corpse. *Some field trips may be associated with the laboratory portion of the course.*

BL 655 – Biological Forensics w/lab (5.00 cr): An introduction to the role of biology in forensic sciences. Topics include biological evidence, influences of invertebrates, vertebrates and microorganisms on legal matters, and in-depth discussion of body fluid analyses. Labs examine techniques associated with biological evidence analyses.

BL 773 – Special Topics in Forensic Biology – Cold Case Investigations (3.00 cr): An examination of current topics in forensic biology with an emphasis on the use of primary literature. Students lead group discussions and/or make oral presentations.

FO 530 - Introduction to Criminalistics (3.00): An introduction to the problems and techniques of scientific examination of forensic physical evidence with emphasis on documentation and interpretation of physical patterns. Emphasis is placed on the theoretical bases of methods of comparison and their influence on scientific interpretation of evidence. Topics include scientific photography, imprints, impressions, tool marks, gunshot residue, cordage and textile examinations. Laboratory exercises include forensic photography, analysis of fingerprints, hair, gunshot residue, and footwear outsole patterns.

FO 600 - Crime Scene Investigation (4.00 cr): An introduction to the basic procedures and practices used in crime scene investigation including documentation and processing, methods for recovery and processing of physical and trace evidence, and procedures for establishing chain of custody and continuity of evidence. Legal and ethical requirements associated with crime scene processing will also be examined. Some field trips may be required.

FO 610 - Introduction to Fingerprints (4.00 cr): An introduction to the biology of fingerprints and the basics of fingerprint analysis and comparisons. Focuses on basic patterns used in fingerprint comparisons and classifications of each fingerprint type, including Henry, National Crime Information Center, and Integrated Automated Fingerprint Identification System pattern classification codes. Also introduces techniques commonly associated with collecting 10-print cards and latent print examination in various scenarios.

FO 630 - Biological and Forensic Science Laboratory Quality Control and Assurance (4.00 cr): Introduction to theory and practice of quality assurance to include quality control/assurance, management, and application of statics, as applied in bioscience industry and forensic laboratory environments. Standards associated with ALCOA, ASCLD-LAB and ISO accreditation and professional certification procedures are emphasized.

FO 645 – Veterinary and Wildlife Forensics (3.00 cr): Exploration of the applicability and importance of forensic science in veterinary and wildlife investigations, including an introduction to the scientific and forensic method, crime scene analysis and processing, types of evidence, evidence collection, and field analyses. Methods of forensic analysis relevant to cases of animal cruelty, neglect and abuse, wildlife conservation and poaching will be examined.

FO 650 - Forensic Pattern Evidence (4.00 cr): An examination of topics and techniques used in firearms and toolmarks analysis, shoe print and tire tread analysis, and bloodstains pattern evidence. Techniques associated with the evaluation of question documents will also be discussed.

FO 675 - Mock Trial for Forensic Pattern Evidence (3.00 cr): Introduction to the policies, practice, and procedures of a criminal trial. Students participate in a mock criminal trial, using live action role play and other techniques to understand the role of the forensic practitioner in evidence presentation in court, learn how to work with statutes and precedents and rules of evidence, and experience direct and cross examination when presenting forensic evidence.

FO 677 – Death investigation (3.00 cr): An examination of the procedures for conducting investigations of various types of human death and the investigator's role throughout the investigative process. Discussions will focus on the manner of death, including, homicide, suicide, accidental, natural, and undetermined, including examples of each and investigative characteristics.

FO 680 – Forensic Microbiology (4.00 cr): Investigates the application of microbiology to legal issues, specifically focusing on the use of microbes to determine the cause of death, postmortem changes in the corpse, estimation of the postmortem interval, and microbiome and necrobiome DNA analysis.

FO 690 - Topics in Forensic Science (3.00 cr): Select topics in forensic science are examined to increase the breadth and depth of understanding of a given subject. May include student presentations depending on topic.

FO 695 - Crime Scene and Evidence Photography (3.00 cr). It is already in the catalogue: Students engage in a variety of practical exercises while exploring concepts and techniques used in various forensic disciplines. The fundamentals of proper lighting and composition are reinforced through crime scene and evidentiary photography examples, such as footwear impressions, chemically processed latent fingerprints, and bloodstain patterns. The course includes the use and operation of digital single lens reflex (DSLR) cameras, electronic flashes, and tripods, which are provided. Prior photography experience is not required.

FO 700 – Statistics in Forensic Science (3.00 cr): Introduction to statistical analyses associated with various forensic science disciplines, including methods associated with DNA analysis and pattern analysis. The course will also explore forensic data or evidence that is challenging to analyze statistically and address what forms of statistical analysis can be applied in each scenario.

FO 710 - Advanced Topics and Techniques in Fingerprints (4.00 cr): Examines advanced topics and identification techniques used in fingerprint development for processing crime scenes and evidence for latent prints, focusing on latent print development and preservation, including crime scene processing and blood prints.

FO 715 – Forensic Anthropology (4.00 cr): An introduction to the basic knowledge of human anatomy and osteology, including human remains recovery and laboratory processes that are required of a forensic anthropologist, especially for person's identification.

FO 725 – DNA analysis (4.00 cr): An introduction to the evaluation of biological evidence in criminal matters using DNA technologies, including the methods routinely used for the isolation of DNA from cells and techniques applied to DNA quantitation, electrophoretic separation, as well as data analysis, interpretation and reporting.

FO 730 – Introduction to Forensic Business Management (3.00 cr): An examination of business tools needed by forensic laboratory directors and managers to increase the efficiency and effectiveness of their management decision making.

FO 750 – Forensic Cognitive Psychology (3.00 cr): Introduction to the application of cognitive psychology to the improvement of forensic science policy and practice. Students examine current challenges for the forensic science community, including the contribution of forensic science errors

to wrongful convictions and the increasing demand for forensic examinations to produce probative results in criminal trials.

FO 752 – Wrongful Convictions and Errors in Forensic Science (3.00 cr): Performs reviews of cases associated with wrongful convictions and elucidates causative factors related to scientific validity, testimony standards, laboratory management, professional development, system issues, and legal professionals and frameworks. Students learn to analyze common factors across forensic disciplines and jurisdictions, perform root cause analyses, and develop systemic reforms.

FO 790 – Biological Forensics Internship (4.00 cr): A capstone experience in biological forensics or related field in which a student may arrange an internship with a faculty sponsor to engage in an in-depth exploration of a topic associated with forensic, death, or criminal investigation. *Generally completed during second year of the program; students should secure a faculty sponsor and obtain the approval of the forensic studies director by the end of first year.*

FO 791 – Biological Forensics Research (4.00 cr): A capstone experience in biological forensics or related field in which a student may arrange research with a faculty sponsor to engage in an in-depth exploration of a topic associated with forensic, death, or criminal investigation. *Generally completed during second year of the program; students should secure a faculty sponsor and obtain the approval of the forensic studies director by the end of first year.*

GB 705 - Leading and Managing People (3.00 cr): Develops knowledge and skills for effectively leading and managing people and teams in organizational settings. This course teaches how to create and manage conditions that promote the performance, well-being, and commitment of employees and teams in the workplace. Topics include effective leader behaviors, power and influence, team composition, setting goals and direction, job design, supportive relationships, coaching employees and teams, fostering an adaptive and innovative culture, managing personal and career development, and developing a higher purpose for how to lead employees and teams. Pedagogical methods include class discussions, case studies, group exercises and discussions, and individual reflections.

PL 611- Bioethics (3.00 cr): A study of the moral problems and uncertainties connected with biomedical research. Theoretical questions on the nature of morality and methodological foundations of science lead to a discussion of current topics, such as recombinant DNA, cloning, organ transplants, definitions of death, and death therapy.

ST 681 – Probability and Statistics (3.00 cr): Random experiments, probability, random variables, probability density functions, expectation, descriptive statistics, confidence intervals, hypothesis testing, and simple linear regression. *Closed to students who have taken ST 510 or ST 565.*

WR 625 - Professional Writing (3.00 cr): Prepares students interested in business, the humanities, and STEM fields for writing in the workplace. Using workplace technology, such as the Microsoft Office Suite, students produce memos, résumés, cover letters, reports, proposals, and presentations. These projects require students to consider the purpose, audience, and context of professional settings when writing on the job. Students also learn how to use text and visuals together in order to create clear and persuasive documents. For team projects, students collaborate with clients or community partners to develop experiential skills. During the semester, students deliver presentations to refine public speaking skills.

WR 626 - Technical Writing (3.00 cr): Helps students prepare for jobs that require detailed technical writing. Using industry-standard technology, such as Adobe Creative Suite and social media, students produce standard workplace documents, as well as instructions and technical descriptions, and legal documents. Students learn about project management, workplace ethics, and research methods for usability testing and user experience (UX) projects. Students collaborate in teams with clients or community partners to develop high-impact, visually dynamic documents such as grant proposals, websites, and multimedia applications. During the semester, students deliver presentations to refine public speaking skills.

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

   As a master's program general education requirements do not apply.

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

   No specialized accreditation is required for the program.

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

   The proposal does not include contracting with another institution or non-collegiate organization.

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

   All program requirements, including pre-requisites, curriculum, administration, financial aid, and any other relevant information will be maintained on the program's website and in the graduate catalogue. The program director will be responsible for ensuring that the webpage remains current and that students are informed of any changes. Individual course requirements will be clearly delineated on syllabi, as well as in catalogue descriptions prior to registration. The program director will also be available to discuss program/course requirements and university services during office hours or by appointment.

   Loyola provides support services that include an Office of Technology Services, Counseling Center, Disability Support Services, Financial Aid Office, the Loyola-Notre Dame Library, a National Fellowships Office, The Study, the Writing Center, and many other support services to assist students for success. As mentioned above, Loyola's website provides the appropriate program costs and student support resources, including required consumer information disclosures.

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

   The proposed MS in Biological Forensics will be marketed using a variety of approaches that target current undergraduate students interested in the graduate program, as well as incumbent workers employed in regional forensic laboratories.

   Loyola University Maryland has a dedicated Office of Marketing and Communications. Loyola endorses and adheres to ethical principles and codes of conduct published by various national organizations. These include the Public Relations Society of America (PRSA) Code of Ethics, the National Association for College Admission Counseling (NACAC) Statement of Principles of Good Practice, the National Association of Student Financial Aid Administrators (NASFAA) Statement of Ethical Principles and Code of Conduct for Institutional Financial Aid Professionals, American Association of Collegiate Registrars and Admissions Officers (AACRAO) Professional Practices and Ethical Standards, the NAFSA: Association of International Educators Statement of Ethical Principles, and the Association for Institutional Research (AIR) Code of Ethics, which are followed by the Office of Marketing and Communications, the Admission Office, the Office of Financial Aid, the Records and Admissions Offices, the Office of International Programs, and the Office of Institutional Research, respectively. Furthermore, the institution provides clear and accurate program information on the University's website.

   Loyola's Enrollment Management team will be sent all the relevant information for the program and works closely with academic departments and the Academic Advising and Support Center to ensure that advertised information is clear and accurate. The academic department's website will be a major resource for students. At Loyola, all websites are maintained by the individual departments. This helps to ensure that content is accurate and relevant for anyone who visits a department website.

H. Adequacy of Articulation

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

No formal articulations have been developed with partner institutions.

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 faulty member will teach (in this program).

   The faculty assembled to teach in the proposed master's program have significant experience teaching undergraduates and graduate students at Loyola and other institutions in Maryland. Ten of the thirteen faculty are full-time professors or instructors, eight have direct training in one or more areas of forensic science, and nine have experience teaching

and mentoring graduate students. Two of the faculty have extensive experience developing and implementing graduate and undergraduate programs in forensic science.

Table 9. Faculty

Faculty	Degree	Appointment	Status	Course(s)
Tiffany Curtis – Writing	PhD Writing	Professor	Full-time	WR 625, WR 626
Joseph Farrell – Philosophy	PhD Philosophy	Professor	Full-time	PL 611
Tatiana Anderson – Crime Scene Investigator, Howard County Police	MS Forensic Science	Instructor	Per course	FO 600
Rana DellaRocco – Chief, Forensic Services, Baltimore City Police	MS Forensic Science	Instructor	Per course	FO 530
Rachelle Fobes – Latent Print Examiner, Baltimore City Police	MS Forensic Science	Instructor	Per course	FO 610, FO 710
Jon Fried – Director of Program Operations, FPA	MS Forensic Science	Instructor	Full Time	FO 675, FO 690
Dana Keiter – Trace Evidence, Baltimore City Police	MS Forensic Science	Instructor	Per course	FO 630
Suzanne Keilson – Engineering Science	PhD Mechanical Engineering	Professor	Full-time	ST 681
Diane Lawder – Forensic Scientist Advanced (Trace Evidence/Questioned Documents), Maryland State Police	MS Criminal Justice	Instructor	Per course	FO 677, FO 690
John Morgan – Private consultant, Department of Justice	PhD Mechanical Engineering	Instructor	Per course	FO 700, FO 730, FO 750, FO 752
David Rivers – Director Forensic Studies, Graduate Director, FPA	PhD Entomology	Professor	Full-time	BL 651, BL 655, BL 773, FO 500, FO 791

Faculty	Degree	Appointment	Status	Course(s)
Christopher Thompson -- Biology	PhD Immunology	Professor	Full-time	BL 628, FO 680
Alan Thoms-Chelsey – Biology, Forensic Studies	PhD - Physiology	Instructor	Full-time	FO 677, FO 725
TBD[1] – Director of Program Operations, Biological Forensics		Instructor	Full-time	FO 645, FO 675, FO 690, FO 715, FO 725, FO 791, FO 792
TBD[2] – per course instructors		Instructor	Per course	FO 690, FO 700, FO 725, FO 730, FO 792, FO 792

[1]Anticipated hire following approval of MS proposal by Loyola University Maryland.

[2]Initially will need two courses covered by per course instructor(s).

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

    a) Pedagogy that meets the needs of the students

    Loyola currently offers two formal university-wide teaching enhancement workshops each year for all faculty, as well as numerous less formal pedagogical opportunities throughout the year. Several workshop sessions are dedicated to pedagogical training for faculty and instructors, including discussions of best practices for promoting student learning. In 2018 Loyola established Teaching Fellows who act as learning communities to research, incorporate, and disseminate best practices. Cohorts of teaching fellows have been formed for high-impact teaching practices, equity and inclusion, and digital teaching and learning. The forensic studies director is also on the editorial board for the Journal of Forensic Science Education (https://jfse-ojs-ttamu.tdl.org/jfse/index.php/jfse/index), a newly launched publication by the Council of Forensic Science Educators focused on promoting best educational practices in undergraduate and graduate forensic science programs. He will direct faculty in the MS program to the journal and specific articles relevant to Loyola's program and students. In addition, the professional and technical writing courses offer service-learning optional projects, which is a recognized high-impact practice pedagogy.

    b) The learning management system

    Loyola uses the Moodle learning management system and has a fully staffed technology center. Support includes a help line for faculty, several Moodle specialists, and Moodle training workshops to help faculty use Moodle effectively. The institution also provides an Office of Digital Teaching & Learning that provides additional support and training, including support and training for face-to-face courses that supplement learning with digitally enhanced supports.

    c) Evidenced-based best practices for distance education, if distance education is

offered.

The program is not a distance education program, however, at least three courses will be taught on-line. All Loyola courses are designed to meet university requirements and expectations. This includes any course taught through a distance education modality. Instructors of this course and any future distance learning class will be informed of pedagogical workshops, webinars and/or other venues for continuing education in best practices in evidence-based instruction. As with any mode of instruction, instructors will be expected to stay current in their field and appropriate teaching practices.

Additionally, Loyola's Office of Digital Teaching and Learning's instructional designers are available to collaborate in the development of on-line classes. Loyola follows Quality Assurance Standards for Online Education Programs including adhering to C-RAC guidelines.

J. Adequacy of Library Resources (as outlined in COMAR 13B.02.03.12).

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, include a supportive statement by the President for library resources to meet the program's needs.

Books

LNDL and other USMAI libraries provide access to 1,126 titles categorized as "Forensic Science" under Library of Congress subject headings. Roughly half of the available titles were published 2010-2022.

Library staff recommend adding 51 print and 30 eBook titles to the collection over a three-year period to cover the biological focus of the new courses and program. Books in this subject area average $50 for print and $75 for ebooks, totaling $1,617 in year one and $5,047 with inflation over three years

Journals

The library provides full-text access to the following key journals in this field:

Through current journal issue

- Anil Aggrawal's Internet Journal of Forensic Medicine and Toxicology (2000-present)
- Forensic (1998-present)
- Forensic Science International (2000-present)
- Journal of Forensic and Legal Medicine (2007-present)
- Journal of Forensic Research and Crime Studies (2014-present)
- Science & Justice (2000-present)

Select years or publisher embargoed content

- Forensic Examiner (2001-2013)
- Forensic Toxicology (2006-2009)
- International Journal of Legal Medicine (1997-present [Full Text Delay: 1 year])
- Journal of Forensic Practice (2003-present [Full Text Delay: 1 year])

- Journal of Forensic Psychiatry and Psychology (2003-present [Full Text Delay: 18 months])
- Toxicology International (2008-2015)

Staff recommend adding one title and providing access to another via interlibrary loan (ILL):

Journal of Forensic Sciences – $841 (Wiley); 2022 subscription rate

International Journal of Legal Medicine – $4,549 (Springer); 2022 subscription rate; ~$50/article via ILL

Databases

LNDL subscribes to several databases that would support this program including American Chemical Society Publications, Criminal Justice Abstracts, Homeland Security Digital Library, NexisUni, PubMed, ScienceDirect Freedom Collection, ForensicCnetBase, SciFinder Scholar, SciTech Premium Collection, TOXLINE, American Academy of Forensic Science Reference Library, National Criminal Justice Reference Service Abstract Database, TOXNET, and Web of Science.

Recommended Expenditures

Total expenditures for the proposed Biological forensic master's program shown in the following chart

Resource	Year 1	Year 2	Year 3	Total for 3 Years	Annual Inflation
Print Books *(total 51)*	$ 867	$ 902	$ 938	$ 2,706	4%
eBooks *(total 30)*	$ 750	$ 780	$ 811	$ 2,341	4%
eJournals	$ 1,125	$ 1,170	$ 1,216	$ 3,511	4%
Databases	$ -	$ -	$ -	$ -	
Annual Total	**$ 2,742**	**$ 2,851**	**$ 2,965**	**$ 8,558**	

Technology Support

LNDL offers a wide variety of technology that would support the program's instruction, including virtual reality (VR), 3D printers, a recording studio, Viz Wall with touch screen capacity, video editing software, 360 cameras, drone, and a large format printer. Potential uses for this technology include using VR to explore crime scenes, utilizing the Viz Wall for large scale projection of fingerprint or ballistic patterns, or 3D printing objects for analysis.

Research & Instruction Support

The Research and Instruction unit offers online and face-to-face scheduled consultations and assistance via 24/7 chat, the Help Desk, phone, and e-mail to support the research needs of these students. Because this is a graduate program and students will likely be unfamiliar with the Library, the Health and Natural Sciences Librarian can collaborate with faculty to develop just-in-time research instruction. Additionally, existing library tutorials can be embedded into the learning management system to orient students to general Library services and resources.

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. If the program is to be implemented within existing institutional resources, include a supportive statement by the President for adequate equipment and facilities to meet the program's needs.

   Many of the resources required for the program already exist. Seven of the required and thirteen of the elective courses in the proposed curriculum are existing classes developed originally as graduate (for the forensic pattern analysis MS program) and undergraduate courses. The undergraduate courses will be modified to initially accommodate up to six total graduate students. Loyola currently possesses the necessary classroom and laboratory space to accommodate these existing courses, and the appropriate instructional resources, as well as faculty offices that are already in place.

   Of the remaining courses in the curriculum, five (FO 645, FO 677, FO 680, FO 700, and FO 725) do not require new resources to implement. The remaining new courses (FO 715) will be able to utilize many of the materials available for BL 655. The new courses can be offered as evening classes either within instructional laboratory space in the Biology Department, or in classrooms within the Donnelly Science complex.

   Only one new full-time administrator/faculty member (Director of Program Operations) will be hired for the program. An office will need to be secured within the Donnelly Science complex, as the individual will serve as the graduate director for the new program and teach several courses. Initially, the graduate director may be housed in one of the shared affiliate offices within the Biology Department.

2. 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

      Students are provided with an electronic mailing system and other technologies listed above in section G8. The institution has several computer labs and utilizes Moodle as the learning management platform.

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

      Only three courses (FO 530, FO 750, and FO 752) will rely on distance learning as the primary mode of instruction. All students enrolled in the courses will have access to communications through the Inside Loyola portal. Similarly, the course will be delivered through the Moodle system, to which all Loyola faculty and students have access. In addition, the Office of Technology services provides technical support for all students with email accounts and use of Moodle. The Office of Digital Technology provides separate support for distance education courses to all students enrolled in an on-line course.

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

1. Complete Table 1: Resources and Narrative Rationale. Provide finance data for the first five years of program implementation. Enter figures into each cell and provide a total for each year. Also provide a narrative rationale for each resource category. If resources have been or will be reallocated to support the proposed program, briefly discuss the sources of those funds.

   Narrative Rationale - Tuition and Fee Revenue
   FTE growth is projected conservatively based on Loyola University Maryland enrolled undergraduates and market demand. Anticipated revenue outpaces expenses after the first year of the program.

TABLE 1: PROGRAM RESOURCES

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)	133,110	320,876	411,730	505,200	601,286
a. Number of F/T Students	8	18	22	26	30
b. Annual Tuition/Fee Rate	16,638.75	16,878	17,139	17,400	17,661
c. Total F/T Revenue (a x b)	133,110	303,804	377,058	452,400	529,830
d. Number of P/T Students	0	2	4	6	8
e. Credit Hour Rate	765	776	788	800	812
f. Annual Credit Hour Rate	11	11	11	11	11
g. Total P/T Revenue (d x e x f)	0	17,072	34,672	52,800	71,456
3. Grants, Contracts & Other External Sources	0	0	0	0	0
4. Other Sources (-Scholarship & Discounts)	(12,645)	(30,483)	(39,114)	(47,994)	(57,122)
TOTAL (Add 1-4)	120,455	290,393	372,616	456,206	544,164

Notes:

2.a. First cohort estimated to include 8 students and each subsequent cohort adds 2 more new students.

2.b. and 2.e. Annual tuition calculated by $765/cr with each student, on average, taking 21.75 credits/year; annual tuition increases of ~1.5% ($765, $776, $788, $800, and 812 for Year 1 through Year 5, respectively).

2.f. P/T students estimated to take, on average, one-half the number of credits of F/T students.

4. Scholarships estimated using the average graduate program's values from the University's budget model, ~9.5%.

2. Complete Table 2: Program Expenditures and Narrative Rationale. Provide finance data for the first five years of program implementation. Enter figures into each cell and provide a total for each year.

Narrative Rationale – Program Expenditures
Loyola College has the existing faculty expertise, personnel, and instructional space to add this program to its academic offerings. Moderate new expenditures will be necessary during implementation and the first year of the program, but overall, projected revenue exceeds projected expenses after the first year of the program.

TABLE 2: PROGRAM EXPENDITURES:					
Expenditure Categories	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
1. Faculty (b + c below)	23,382	24,083	72,717	74,898	77,145
a. Number of FTE	0.5	0.5	1	1	1
b. Total Salary	18,000	18,540	55,936	57,614	59,342
c. Total Benefits	5,382	5,543	16,781	17,284	17,803
2. Admin. Staff (b + c below)	96,126	99,010	102,059	105,121	108,274
a. Number of FTE	1	1	1	1	1
b. Total Salary	74,000	76,220	78,507	80,862	83,288
c. Total Benefits	22,126	22,790	23,552	24.259	24,986
3. Support Staff (b + c below)	10,067	10,370	10,689	22,018	22,679
a. Number of FTE	.25	.25	.25	.5	.5
b. Total Salary	7,750	7,983	8,222	16,937	17,445
c. Total Benefits	2,317	2,387	2,467	5,081	5,234
4. Technical Support and Equipment	55,000	25,000	26,250	27,562	28,941
5. Library	2,742	2,852	2,966	3,084	3,208
6. New or Renovated Space	0	0	0	0	0
7. Other Expenses	0	0	0	0	0
TOTAL (Add 1 – 7)	187,317	161,315	214,681	232,683	240,247

Notes:

1. Yr 1 and Yr 2 – 4 per course faculty. Yr 3 and beyond will require one Assistant Teaching Professor to cover additional sections required as enrollment increases; average salary estimated to be 52,725 in Yr 1. 3% salary increases year-to-year.
   Loyola's benefits, including FICA, averages 29.9% in Yr 1. Likely increases to 30.0% in Yr 3.
2. Director of Program Operations for Biological Forensics salary based on similar positions at Loyola. 3% salary increases year-to-year. Loyola's benefits, including FICA, averages 29.9% in Yr 1. Likely increases to 30.0% in Yr 3.
3. Salary, 31,000 in Yr 1, based on similar Laboratory Technical Assistant positions at Loyola. 3% salary increases year-to-year. Loyola's benefits, including FICA, averages 29.9% in Yr 1. likely increases to 30.0% in Yr 3.
4. New equipment and additional supplies for the laboratory sections estimated to be 55,000 in Yr 1. Supplies and replacement of equipment in Yr 2. 5% increases year-to-year.
5. Cost estimate received from LNDL: Yr1: Books and eBooks – 1,617; eJournals – 1,125
   Library estimates a 4% increase in costs year-to-year.

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.

   Loyola University Maryland utilizes several mechanisms for evaluating courses, including student course evaluation, faculty peer evaluations, and faculty annual updates. The latter require faculty to perform self-evaluation of courses and teaching effectiveness, and to provide evidence of achieving student learner outcomes. In turn, all of these assessment vehicles are evaluated by department chair and dean. In the case of Loyola's proposed biological forensics programs, a review will be performed annually by the director of forensic studies with the director of program operations and the graduate director.

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.

   Program level assessment will be performed using assessment plans developed specifically for the MS degree in Biological Forensics. Assessment will rely on establishing a timeline for assessment of each program learner outcome identified in Appendix A. Direct evidence of student learning will be collected by the director of program operations and graduate director, along with the measures used for assessment and samples of student work, and reviewed by the directors, steering committee, and deans. The results of the assessment will be used for continual improvement of the program. All assessment measures, assessment cycle, artifacts used for assessment, including student achievement of the program learning outcomes, and any reports will be maintained in the centralized software system used by Loyola for program level assessment. Institutional evaluation will occur in accordance with the University's and Middle State's accreditation timelines. The cost-effectiveness of the program will be reviewed annually by the dean using data generated by the University's budget model and graduate program-specific budget models.

   Each department at Loyola is required to submit an annual report, which includes progress towards previous year's goals and a complete assessment report. The reports are evaluated by the dean's office annually, and the dean meets with the chair each year to discuss departmental progress. Programs also engage in academic program review on a seven- year cycle at Loyola.

N. Consistency with the State's Minority Student Achievement Goals (as outlined 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.

Loyola University Maryland has a strategic focus on enhancing equity and inclusion for the university community. The University is committed, through its mission and core values, to creating a community that embraces and celebrates the inherent value and dignity of each person. The strategic plan goal to enhance equity and inclusion guides faculty and administrators' work toward promoting inclusive academic excellence. Specifically, teaching practices identified by AAC&U as highly impactful for the success of all students are being incorporated more fully in academic and cocurricular programs across the University. The provost has invested in related professional

development by funding cohorts of faculty fellows to explore, employ, disseminate, and support high-impact teaching strategies. Faculty Fellows for High-Impact Practices (HIPs) are represented in all three schools, including the School of Arts and Sciences. Following a similar model, a cohort for Equity & Inclusion Fellows and a cohort for Digital Teaching and Learning has been established.

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.

   The proposed program is not a 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.
2. Provide assurance and any appropriate evidence that the institution complies with the C-RAC guidelines, particularly as it relates to the proposed program.

   The proposed program is not a distance education program but does offer a few courses through distance education.

   The development of online courses at Loyola University Maryland is based on industry best practices as well as institution-specific quality benchmarks and Loyola abides by C-RAC Guidelines.

   The Office of Digital Teaching & Learning, composed of instructional designers and multimedia technicians, is charged with ensuring the highest quality standards in online teaching and learning. In this way, Loyola University Maryland's online course design, development, and delivery frameworks are consistent with, while also extending beyond, the recommendations of and standards set forth by the industry leading standards-based frameworks of Quality Matters and the Online Learning Consortium Quality Scorecard, while also incorporating the Community of Inquiry framework to further define and inform measures of quality.

Appendix A.

Biological Forensics Curriculum Map

Institutional learning aim	*Program learning aim*	*Course(s)*
Master the skills, methods, and knowledge appropriate to the discipline	Students will master current factual content, concepts, theoretical perspectives, and historical trends of different subfields of biological forensics.	BL 651, BL 655, FO 530, FO 600, FO 610, FO 645, FO 677, FO, 680, FO 700, FO 715, FO 725, FO 791, FO 792
Synthesize knowledge using interdisciplinary approaches		
Disseminate and communicate information effectively	Students will demonstrate proficiency in communicating effectively in a variety of formats, including verbal, written, and symbolic channels, relevant to forensic investigation and presentations in the judicial system.	BL 651, BL 655, FO 530, FO 600, FO 610, FO 645, FO 677, FO, 680, FO 700, FO 715, FO 725, FO 791, FO 792, WR 625, WR 626
Comprehend the ethical principles appropriate to the discipline, have the ability to identify ethical dilemmas, and understand the frameworks for selecting and defending the right course of action	Students will develop an understanding of the moral and ethical issues surrounding crime and forensic investigation.	BL 651, BL 655, FO 530, FO 600, FO 610, FO 645, FO 677, FO, 680, FO 700, FO 715, FO 725, FO 750, PO 752, PL 611
Consider issues of justice in making decisions		
Access, analyze and evaluate information effectively	Students will demonstrate a clear understanding of major concepts and techniques used in subfields of forensic pattern evidence based on their ability to read, interpret, and critically evaluate primary literature; design experiments or conduct independent investigation to test ideas and hypotheses; and interpret data through statistical and graphical packages.	BL 651, BL 655, FO 530, FO 600, FO 610, FO 645, FO 677, FO, 680, FO 700, FO 715, FO 725, FO 791, FO 792
Acquire the tools to continue professional development and life-long learning	Students will have received preparation in the professional, practical, and academic aspects of biological forensics to ensure that they would be highly desirable candidates for positions in the field.	BL 651, BL 655, FO 530, FO 600, FO 610, FO 645, FO 677, FO, 680, FO 700, FO 715, FO 725, FO 791, FO 792