UNIVERSITY OF
MARYLAND
OFFICE OF THE PRESIDENT

Main Administration Building
College Park, Maryland 20742
301.405.5803 TEL 301.314.9560 FAX

April 11, 2019

James D. Fielder, Jr.
Secretary of Higher Education
Maryland Higher Education Commission
6 N. Liberty Street
Baltimore, MD 21201

Dear Secretary Fielder:

I am writing to request approval for a new stand-alone Post-Baccalaureate Certificate program in Computation and Mathematics for Biological Networks (COMBINE).

The proposal for the new certificate program is attached. I am also submitting this proposal to the University System of Maryland for approval.

The proposal was endorsed by the appropriate faculty and administrative committees. I also endorse this proposal and am pleased to submit it for your approval.

Sincerely,

Wallace D. Loh
President

MDC
cc: Antoinette Coleman, Associate Vice Chancellor for Academic Affairs
Mary Ann Rankin, Senior Vice President and Provost
Amitabh Varshney, Dean, College of Computer, Mathematical, and Natural Sciences

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

Institution Submitting Proposal	University of Maryland, College Park

Each action below requires a separate proposal and cover sheet.

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

Payment Submitted: ○ Yes ◉ No	Payment Type: ○ R*STARS ◉ Check	Payment Amount: 850	Date Submitted:

Department Proposing Program	College of Computer, Mathematical, and Natural Sciences	
Degree Level and Degree Type	Post-Baccalaureate Certificate	
Title of Proposed Program	Computation and Mathematics for Biological Networks (COMBINE)	
Total Number of Credits	12	
Suggested Codes	HEGIS:	CIP: 27.0306
Program Modality	◉ On-campus	○ Distance Education (*fully online*)
Program Resources	◉ Using Existing Resources	○ Requiring New Resources
Projected Implementation Date	◉ Fall ○ Spring ○ Summer	Year: 2019
Provide Link to Most Recent Academic Catalog	URL: https://academiccatalog.umd.edu/	
Preferred Contact for this Proposal	Name: Michael Colson	
	Title: Senior Coordinator for Academic Programs	
	Phone: (301) 405-5626	
	Email: mcolson@umd.edu	
President/Chief Executive	Type Name: Wallace D. Loh	
	Signature: [signature]	Date: 4-11-2019
	Date of Approval/Endorsement by Governing Board:	

Revised 3/2019

A. Centrality to the University's Mission and Planning Priorities

Description. The University of Maryland, College Park (UMD) Post-Baccalaureate Certificate in Computation and Mathematics for Biological Networks (COMBINE) applies the methods of network science (developed largely within the physics, applied mathematics, and computer science communities) to the study of biological systems from microscopic to macroscopic scales. This certificate program will immerse doctoral students in interdisciplinary education, research, and training that integrates quantitative modeling methods from physics and mathematics with data processing, analysis, and visualization tools from computer science to gain deeper insights into the structural and dynamical principles governing living systems. Participants will utilize a network-based, data-driven approach, focusing on how interaction patterns can give insights into complex biological phenomena. COMBINE prepares students to become experts in the process of transforming raw biological data into useful information from which new biological insights can be inferred, positioning them to pursue a range of Science, Technology, Engineering, and Mathematics (STEM) careers at the nexus of the computer, physical, and life sciences.

In the last decade or so, network science has emerged as a new collaborative field including physicists, applied mathematicians, computer scientists, quantitative biologists, and social scientists. The goal of research in this area is to use networks, representing interaction patterns, to understand the behavior of complex systems. While network science has made significant strides in bringing together researchers from different fields based on common questions, huge cultural and communication barriers still exist that inhibit productive interdisciplinary collaboration. This urgent issue facing today's researchers--coping with the data explosion resulting from the advent of powerful new technologies--demands a transformation. COMBINE accomplishes this mission through its network science approach, which is inherently cross-disciplinary and involves the analysis of complex biological data drawn from a variety of different contexts.

UMD received a National Science Foundation (NSF) grant to develop the coursework for COMBINE, and students have already benefitted from engaging in these courses. In order to have students' efforts be recognized on their transcripts, and in order to institutionalize this program beyond the duration of the grant, UMD is proposing COMBINE as post-baccalaureate certificate program.

Relation to Strategic Goals. According to UMD's Strategic Plan, one of the primary objectives for graduate education is for doctoral programs to "be known for their commitment to excellence and for their comprehensive approach to graduate study including recruitment, mentoring, career preparation, and placement."[1] The proposed certificate program enhances doctoral programs in the life sciences, physical sciences, mathematics, and computational sciences by offering interdisciplinary training in research and communication. The program will train students from different fields to help educate one other so that they may discover the convergence of their differing perspectives, paving the way for ground-breaking new research and preparing them for a diverse set of career trajectories.

[1] University of Maryland, College Park. (May 21, 2008). *Transforming Maryland: Higher Expectations. The Strategic Plan for the University of Maryland.* (p. 15). Retrieved March 5, 2019 from: http://www.provost.umd.edu/SP07/StrategicPlanFinal.pdf.

Funding. The NSF grant funding provides resources needed for the first few years of the program. The academic units engaged in the program have committed to continue offering the courses after the grant expires.

Institutional Commitment. The program will be administered by the Institute for Physical Science and Technology (IPST) within the College of Computer, Mathematical, and Natural Sciences (CMNS). The administrative infrastructure for the program already exists as the coursework and coordination for the program began when the NSF grant was received. In the event that the program is discontinued, the courses will be offered for a reasonable time period so that enrolled students can finish the program. The faculty and administrative infrastructure will still be in place to work with students who have not finished the program.

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

Need. COMBINE is designed to support the careers of STEM scientists who will be able to tackle complex problems in academic, industry, and government settings. This is in line with the state's priorities to increase the number of STEM degrees awarded to students in order to satisfy growing demand in STEM-related fields. Specifically in the context of the proposed program, the demand for jobs that require (big) data analysis is expected to increase. This includes several industries, including biotechnology/biomedicine, which our biology-focused program can enable. The use of connectivity and artificial intelligence by various industries is also expected to grow and our network-focused curriculum prepares students to tackle problems in these areas.

State Plan. COMBINE aligns with the *Maryland State Plan for Postsecondary Education's* emphasis on innovation in teaching and learning as represented in the *Plan's* Strategy 9: "Strengthen and sustain development and collaboration in addressing teaching and learning challenges."[2] One of the program's main objectives is to prepare students to tackle complex cross-disciplinary problems by carefully integrating approaches from different fields. The goal is to move beyond the ad-hoc combination of skills that characterizes many interdisciplinary interactions and to cultivate specific skills that are readily transferable and highly applicable to multiple disciplines.

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

The proposed program is for doctoral students pursuing degrees in either the life sciences, physical sciences, mathematical sciences, or computational sciences. The program's intent is not to deliver more doctoral students in these areas, but to better equip these future researchers to apply network science to complex, multi-disciplinary issues and be able to communicate these complex scientific

[2] Maryland Higher Education Commission. (2017). *Maryland Sate Plan for Postsecondary Education: Increasing Student Success with Less Debt, 2017-2021.* (p. 70). Retrieved March 11, 2019 from: http://www.mhec.state.md.us/About/Documents/2017.2021%20Maryland%20State%20Plan%20for%20Higher%20Education.pdf.

ideas to diverse audiences. The program is optional for Ph.D. students. We expect 14 students to be enrolled in the program annually.

D. Reasonableness of Program Duplication

An analysis of MHEC's program inventory uncovered no other post-baccalaureate certificate program similar to the proposed program.

E . Relevance to Historically Black Institutions (HBIs)

No such program currently exists at any of Maryland's Historically Black Institutions (HBIs).

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

The proposed program builds on doctoral programs that already exist at UMD. Accordingly, the proposed program would not have an impact on the uniqueness or institutional identity of any Maryland HBI.

G. Adequacy of Curriculum Design, Program Modality, and Related Learning Outcomes

Curricular Development. COMBINE was developed in response to an NSF Research Traineeship program call for proposals. A team of faculty members from different disciplines in the computer, mathematical, engineering, physical, and natural sciences developed a curriculum that would help students cope with the massive increase of data that resulted from new technologies.

Faculty Oversight. Michelle Girvan, Professor of Physics, will serve as faculty director. An independent advisory board will provide input on the program to Dr. Girvan.

Educational Objectives. COMBINE's overarching goal is to build a new model for graduate education that intentionally and thoughtfully prepares students for scientific research at the interface of the physical/ mathematical, computer, and life sciences, while simultaneously providing the necessary training so that they may readily translate research experiences to a diverse set of potential careers. The program's training elements focus on the following:

1. Integrated, interdisciplinary problem solving: through coursework from multiple disciplines and weekly interdisciplinary seminar, the program will prepare students to tackle complex cross-disciplinary problems by carefully integrating approaches from different fields.
2. Communication to diverse audiences: a major focus of our program will be to train students to effectively communicate complex scientific ideas to diverse audiences, including both scientists from disparate fields and non-scientists from industry and the general population.

Learning Outcomes. The program's specific learning outcomes are as follows:

- Survey important research results in network science. This will be achieved primarily through PHYS798T (Interdisciplinary Communication for Data Driven Science) and assessed through class presentations and participation.
- Learn methods of network analysis. This will be achieved primarily through CMSC828O and will be assessed through student performance on problem sets.
- Develop an appreciation and understanding of the questions and methods of other fields. This will be achieved primarily through discipline-bridging coursework (chosen from a list of existing UMD courses) and assessed through performance therein.
- Apply methods of network analysis to biological data. This will be assessed through the evaluation of the final projects in CMSC828O and the final paper in PHYS798N.
- Develop interdisciplinary communication skills for:
    a. Oral presentations. Included as parts of CMSC828O, PHYS798N, PHYS798U. Assessed through instructor created rubrics.
    b. Poster presentations. Included as part of PHYS798N. Assessed through instructor created rubrics.
    c. Developing manuscripts. Included as part of PHYS798N. Assessed through instructor created rubrics.

Institutional assessment and documentation of learning outcomes. Student learning outcomes assessment in graduate programs is directed by the Graduate Outcomes Assessment Committee. Established in 2011, this committee is comprised of representatives from each college and school.

Course requirements. In addition to completing their Ph.D. degree requirements, certificate program students are required to complete the following curriculum: At least 12 credits total with 8 credits from COMBINE core courses and 4 credits from elective discipline-bridging coursework: (A) one regular (3 or 4 credit) course at the graduate or advanced undergraduate level in a different discipline (chosen from a list of appropriate courses, see below) and (B) one out-of-field graduate seminar course (1 credit or more) from a third discipline.

COMBINE Core Courses (8 credits)		
Course	Title	Credits
PHYS798N	Interdisciplinary Communication for Data-Driven Science	3
PHYS798T	Network Science Literature Survey	1
PHYS798U	Network Biology Research-in-Progress	1
CMSC828O	Advanced Topics in Information Processing; Computational and Mathematical Analysis of Biological Networks across Scales	3

COMBINE Discipline-Bridging Coursework (2 courses, 4 credits minimum) Must be approved by the program director.		
Course	Title	Credits
Computational Discipline		
BIOL667	Mathematical Biology	4

CBMG688P	Special Topics in Cell Biology and Molecular Genetics: Programming for Biology	3
CMSC882T	Advanced Topics in Information Processing: Vision, Planning and Control in Aerial Robotics	3
NACS641	Introduction to Neurosciences	4
NACS643	Computational Neuroscience	4
Life Sciences Discipline		
BIOL704/ BIPH704/ BSCI404	Cell Biology from a Biophysical Perspective	3
BSCI442	Plant Physiology	4
BSCI453	Cellular Neurophysiology	3
CBMG688P	Special Topics in Cell Biology and Molecular Genetics: Programming for Biology	3
CBMG688Y	Special Topics in Cell Biology and Molecular Genetics: Bioinformatics and Genomics	3
NACS641	Introduction to Neurosciences	4
NACS643	Computational Neuroscience	4
PLSC411	Plant Genetics	4
Mathematics/Physics Discipline		
AMSC660	Scientific Computing	3
BIOM601	Biostatistics I	4
ENEE620	Random Processes in Communications and Control	3
MATH420	Mathematical Modeling	3
PHYS615	Nonlinear Dynamics of Extended Systems	3

See Appendix A for course descriptions.
Please note: The courses that have suffixes with their course numbers (e.g., PHYS798N) are temporary course numbers used for special topics courses. These courses will go through UMD's course approval process and in most cases will be assigned a new number when officially approved.

General Education. Not applicable as this is a graduate program.

Accreditation or Certification Requirements. There are no specialized accreditation or certification requirements for this program.

Other Institutions or Organizations. The department will not contract with another institution or non-collegiate organization for this program.

Student Support. Only students enrolled in UMD doctoral programs will be able to participate in this certificate program. Students will have an understanding of the UMD learning management system, academic support services, financial aid resources, and cost and payment policies from their existing programs. Otherwise, the Graduate Catalog will provide information about curricular requirements.

Individual course syllabi will specify any technical competency or equipment requirements. The program staff will also advise prospective and enrolled students of the program requirements.

Marketing and Admissions Information. COMBINE is only available to students enrolled in a doctoral program in the life sciences, physical and mathematical sciences, or computational sciences. Marketing and admissions information will be available in the Graduate Catalog and available through the program advising office.

H. Adequacy of Articulation

As a graduate program, articulation is not applicable.

I. Adequacy of Faculty Resources

Program faculty. Faculty who will teach the core courses (8 credits) for the program will have knowledge of the following areas: network science, network biology, network research, and scientific communication. Discipline-bridging elective coursework (2 courses, minimum of 4 credits) are already offered by the university.

See faculty biographies in Appendix B for those currently expected to teach in the program.

Faculty training. The Teaching and Learning Transformation Center at the University of Maryland inspires and supports effective, engaging, efficient, and equitable teaching innovations among the university's instructors and assistants. This team provides faculty with training, resources, professional development activities, and individualized consultation to transform their classrooms and careers.

For the learning management system, faculty teaching in this program will have access to teacher development opportunities available across campus, including those offered as part of the Teaching and Learning Transformation Center. For online elements of the coursework, instructors will work with the learning design specialists on campus to incorporate best practices when teaching in the online environment.

J. Adequacy of Library Resources

The University Libraries staff have reviewed the proposal and have determined that the Libraries are able to meet, with its current resources, the curricular and research needs of the program.

K. Adequacy of Physical Facilities, Infrastructure, and Instructional Resources

The physical facilities and infrastructure needs for COMBINE are minimal as faculty and students will use laboratories, equipment, and office space that is already provided by their home departments. Otherwise, classroom space needed for the program core requirements are already available through the sponsoring departments.

The program is not a distance-education program. For ancillary online components of any COMBINE coursework, UMD maintains an Enterprise Learning Management System (ELMS). ELMS is a Web-based platform for sharing course content, tracking assignments and grades, and enabling virtual collaboration and interaction.

L. Adequacy of Financial Resources

Tables 1 and 2 contain the details of resources and expenditures. Grant funding provides most of the resources for the first few years of the program. When the grant expires, tuition revenue will be sufficient to cover the cost of offering the program.

M. Adequacy of Program Evaluation

Formal program review is carried out according to the University of Maryland's policy for Periodic Review of Academic Units, which includes a review of the academic programs offered by, and the research and administration of, the academic unit (http://www.president.umd.edu/policies/2014-i-600a.html). Program Review is also monitored following the guidelines of the campus-wide cycle of Learning Outcomes Assessment (https://www.irpa.umd.edu/Assessment/LOA.html). Faculty within the department are reviewed according to the University's Policy on Periodic Evaluation of Faculty Performance (http://www.president.umd.edu/policies/2014-ii-120a.html). Since 2005, the University has used an online course evaluation instrument that standardizes course evaluations across campus. The course evaluation has standard, university-wide questions and also allows for supplemental, specialized questions from the academic unit offering the course.

N. Consistency with Minority Student Achievement goals

COMBINE supports UMD's continuous efforts and strong record of educating minorities at all levels, therefore the recruitment process will focus on diversity in addition to engaging and retaining a group of outstanding students. Expanding the pool of talented students interested in pursuing research in the areas related to the COMBINE certificate program will be achieved by leveraging UMD's participation-broadening initiatives. By working closely and replicating successful models at UMD such as the Applied Mathematics program, which is dedicated to recruiting and retaining both women and minority students, the program will be well-positioned to recruit students from underrepresented groups. An example of an effective practice for recruitment will be having faculty individually reach out to prospective applicants from underrepresented groups.

COMBINE will also engage with the two established, NSF-funded UMD programs for broadening participation: the Louis Stokes Alliances for Minority Participation (LSAMP), Bridge to the Doctorate (BD) Fellowship, and the ADVANCE program for increasing participation and advancement of women in academia. By connecting with the BD Fellowship program, which partially supports minority students during their Ph.D. tenure, the proposed program will be well-positioned to recruit and support talented minority students.

Interactions with UMD's ADVANCE program, such as a featured presentation by the ADVANCE program, at our Career Development Workshop, will help our community better understand and overcome the challenges that women face in the university setting.

O. Relationship to Low Productivity Programs Identified by the Commission

N/A

P. Adequacy of Distance Education Programs

N/A

Appendix A. Course Descriptions

Core Courses

PHYS 798N: Interdisciplinary Communication for Data-Driven Science (3 credits)

Students will work on a semester-long individual research project under the direction of a faculty mentor, and they will concurrently use this project to develop and refine their science communication skills. Class sessions will address interdisciplinary science communication with some discussion of data exploration, analysis, and visualization. The motivating idea behind this course is to fill a major gap in graduate science education by helping students develop and hone the skills necessary for communicating data-driven, interdisciplinary research. The course has a significant focus on developing skills for communication to diverse audiences. Students will learn to communicate with individuals in the same field, with individuals in another specified field to which their research is applicable, and with a general science audience.

PHYS798T: Network Biology Literature Survey (1 credit)

For this course, students will work in pairs to present and lead discussion of data-driven interdisciplinary research articles dealing with biological networks. Some sessions will feature invited faculty or postdocs that will give research talks and career perspectives/advice. Students will practice communication of scientific results and concepts to individuals in their own field and with individuals in other field to which the students' research is applicable.

PHYS798U: Network Biology Research-in-Progress (1 credit)

For this course, students will each deliver an oral research-in-progress presentation. Students will practice communication of scientific results and concepts to a general scientific audience (as opposed to an audience of their own immediate field). Presentations will be followed by instructor and peer feedback. Peer reviewing will also be implemented online. Some sessions will feature invited faculty or postdocs that will give research talks and career perspectives/advice.

CMSC828O: Advanced Topics in Information Processing; Computational and Mathematical Analysis of Biological Networks across Scales (3 credits)

At the end of this course, students will be able to describe, implement and analyze algorithms that solve fundamental problems in biological network analysis: descriptive summaries of network structure and properties, probabilistic and dynamical network models, statistical models for networked data and network visualization. They will also be able to apply these methods to data in networks from biological applications: molecular, neuronal and ecological networks by completing a semester-long project.

Discipline-Bridging Courses:

AMSC660: Scientific Computing (3 credits)

Monte Carlo simulation, numerical linear algebra, nonlinear systems and continuation method, optimization, ordinary differential equations. Fundamental techniques in scientific computation with an introduction to the theory and software of each topic.

BIOL667: Mathematical Biology (4 credits)
Mathematical methods of analyzing deterministic and stochastic biological processes from a variety of areas (including population and evolutionary biology, neurobiology, physiology, and morphogenesis). Qualitative aspects of dynamical systems which are usually given as difference or differential equations. The computer program Mathematica will be used to obtain the numerical solutions of these equations.

BIOL704: Cell Biology from a Biophysical Perspective (3 credits)
Also offered as: BSCI404 and BIPH704
An approach to cell biology by focusing on mechanisms and unifying paradigms. It will not assume a great deal of factual biological knowledge, but will expect a background that prepares students to think quantitatively and mechanistically.

BIOM601: Biostatistics I (4 credits)
Estimation and hypothesis testing, t tests, one and two way analysis of variance, regression, analysis of frequency data. Lecture will emphasize uses and limitations of these methods in biology, while the laboratory will emphasize the use of statistical analysis software for the analysis of biological data.

BSCI442: Plant Physiology (4 credits)
A survey of plant physiology and development and responses and adaptation to the environment.

BSCI453: Cellular Neurophysiology (3 credits)
The cellular and molecular basis of nervous system function.

CBMG688P: Special Topics in Cell Biology and Molecular Genetics; Programming for Biology (2 Credits)
Students should gain an ability to implement standard bioinformatics tools and manipulate large data files in a unix environment. Although true programming is beyond the scope of this course, students should achieve an ability to understand, use and edit programs in awk, Python and R.

CBMG688Y: Special Topics in Cell Biology and Molecular Genetics; Bioinformatics and Genomics (2 Credits)
Provides an overview of some major topics and research areas bioinformatics and genomics, and includes material from basic foundations through advanced concepts. The course consists of readings, lectures, discussions, collaborative learning activities, writing assignments, and exams.

CMSC882T: Advanced Topics in Information Processing; Vision, Planning and Control in Aerial Robotics (3 credits)
This is a comprehensive course on aerial robotics, with a focus on quadcopters and their related hardware and software implementations. The course will cover both the theoretical and practical aspects of quadcopters, with special focus on perception, planning and control algorithms involved in the same.

ENEE620: Random Processes in Communications and Control (3 credits)

Introduction to random processes: characterization, classification, representation; Gaussian and other examples. Linear operations on random processes, stationary processes: covariance function and spectral density. Linear least square waveform estimating Wiener-Kolmogroff filtering, Kalman-Bucy recursive filtering: function space characterization, non-linear operations on random processes.

MATH420: Mathematical Modeling (3 credits)
The course will develop skills in data-driven mathematical modeling through individual and group projects. Emphasis will be placed on both analytical and computational methods, and on effective oral and written presentation of results.

NACS641: Introduction to Neurosciences (4 credits)
Detailed examination of neurophysiology and sensorimotor systems.

NACS643: Computational Neuroscience (4 credits)
Provides a mathematical foundation in computational neuroscience.

PHYS615: Nonlinear Dynamics of Extended Systems (3 credits)
Theory and applications of nonlinear dynamics of extended systems including nonlinear waves, pattern formation, turbulence, self-organized criticality and networks. Additional topics to be selected by instructor from areas of current research.

PLSC411: Plant Genetics (4 credits)
An introduction to genetic principles and technologies in plants, centered on linking phenotype to genotype. Topics include Mendelian inheritance of single and complex traits, epigenetics, population genetics and plant breeding. Examples on creating and mapping genetic mutations in both model plants and non-model crops are discussed. Current genetic and genomic approaches are highlighted, such as genome engineering and reprogramming, TILLING, and genome-wide association mapping.

Appendix B. Faculty

Faculty members who teach COMBINE'S core courses are listed below.

Name	Degree	Title, Field	Status	Courses
Corrada Bravo, Hector	Ph.D.	Associate Professor, Computer Science	Full-Time	CMSC828O
Girvan, Michelle	Ph.D.	Professor, Physics	Full-Time	PHYS615, PHYS798N, PHYS798T, PHYS798U
Serrano, Daniel	Ph.D.	Faculty Specialist, Institute for Research in Electronics and Applied Physics	Full-Time	PHYS798N, PHYS798T, PHYS798U

Courses that count as discipline-bridging courses have been offered by UMD as part of existing academic programs. Faculty for these courses are listed below.

Name	Degree	Title, Field	Status	Courses
Babadi, Behtash	Ph.D.	Assistant Professor, Electrical Engineering	Full-Time	ENEE620
Butts, Daniel	Ph.D.	Associate Professor, Biology	Full-Time	BSCI453, NACS643
El-Sayed, Najib	Ph.D.	Professor, Cell Biology & Molecular Genetics	Full-Time	CBMG688P, CBMG688Y
Feijo, Jose	Ph.D.	Professor, Cell Biology & Molecular Genetics	Full-Time	BSCI442
Girvan, Michelle	Ph.D.	Professor, Physics	Full-Time	PHYS615
Herberholz, Jens	Ph.D.	Associate Professor, Psychology	Full-Time	NACS641
Imbert-Gerard, Lise-Marie	Ph.D.	Assistant Professor, Mathematics	Full-Time	AMSC660
Levermore, Charles	Ph.D.	Professor, Mathematics	Full-Time	MATH420
Ma, Li	Ph.D.	Professor, Animal & Avian Sciences	Full-Time	BIOM601
Mount, Stephen	Ph.D.	Associate Professor, Cell Biology & Molecular Genetics	Full-Time	CBMG688P
Qi, Yiping	Ph.D.	Assistant Professor, Plant Science & Landscape Architecture	Full-Time	PLSC411
Simon, Jonathan	Ph.D.	Professor, Electrical Engineering	Full-Time	BIOL667
Sukharev, Sergei	Ph.D.	Professor, Biology	Full-Time	BIOL704/BSCI404/BIPH704

Table 1: Resources

Resources Categories	Year 1	Year 2	Year 3	Year 4	Year 5
1.Reallocated Funds	$0	$0	$0	$0	$0
2. Tuition/Fee Revenue (c+g below)	$902,720	$920,774	$939,190	$957,974	$977,133
a. #FT Students	0	0	0	0	0
b. Annual Tuition/Fee Rate	$17,208	$17,724	$18,256	$18,804	$19,368
c. Annual FT Revenue (a x b)	$0	$0	$0	$0	$0
d. # PT Students	40	40	40	40	40
e. Credit Hour Rate	$728	$743	$757	$773	$788
f. Annual Credit Hours	31	31	31	31	31
g. Total Part Time Revenue (d x e x f)	$902,720	$920,774	$939,190	$957,974	$977,133
3. Grants, Contracts, & Other External Sources	$0	$0	$0	$0	$0
4. Other Sources	$0	$0	$0	$0	$0
TOTAL (Add 1 - 4)	**$902,720**	**$920,774**	**$939,190**	**$957,974**	**$977,133**

Student enrollments are a mix of full-time and part-time, but for ease of computation, enrollments are identified as part time and tuition revenue is computed on a per credit-hour basis.

Table 2: Estimated expenditures

Expenditure Categories	Year 1	Year 2	Year 3	Year 4	Year 5
1. Faculty (b+c below)	$339,150	$349,325	$359,804	$370,598	$381,716
a. #FTE	3.0	3.0	3.0	3.0	3.0
b. Total Salary	$255,000	$262,650	$270,530	$278,645	$287,005
c. Total Benefits	$84,150	$86,675	$89,275	$91,953	$94,712
2. Admin. Staff (b+c below)	$133,000	$136,990	$141,100	$145,333	$149,693
a. #FTE	1.0	1.0	1.0	1.0	1.0
b. Total Salary	$100,000	$103,000	$106,090	$109,273	$112,551
c. Total Benefits	$33,000	$33,990	$35,010	$36,060	$37,142
3. Total Support Staff (b+c below)	$89,110	$91,783	$94,537	$97,373	$100,294
a. #FTE	1.0	1.0	1.0	1.0	1.0
b. Total Salary	$67,000	$69,010	$71,080	$73,213	$75,409
c. Total Benefits	$22,110	$22,773	$23,456	$24,160	$24,885
4. Graduate Assistants (b+c)	$148,832	$153,297	$157,896	$162,633	$167,512
a. #FTE	4.0	4.0	4.0	4.0	4.0
b. Stipend	$80,000	$82,400	$84,872	$87,418	$90,041
c. Tuition Remission	$68,832	$70,897	$73,024	$75,215	$77,471
5. Equipment	$10,000	$10,300	$10,000	$10,000	$10,000
6. Library	$0	$0	$0	$0	$0
7. New or Renovated Space	$0	$0	$0	$0	$0
8. Other Expenses: Operational Expenses	$152,408	$155,116	$157,878	$160,696	$163,570
TOTAL (Add 1 - 8)	**$872,500**	**$896,811**	**$921,215**	**$946,633**	**$972,785**

The Program director, who also teaches in the program, is included as Administrative Staff. Support staff includes a program coordinator. Equipment includes periodic turnover of computing equipment used in the instructional laboratories. Other expenses include marketing, materials and supplies, and centrally provided administrative expenses computed at 15% of tuition revenue.