The Johns Hopkins University
Krieger School of Arts and Sciences
Proposal for Substantial Modification to an Existing Program

New Area of Concentration in Regenerative and Stem Cell Technologies within the Existing Master of Science in Biotechnology

A. Centrality to institutional mission statement and planning priorities

1. Program description and alignment with mission

The Johns Hopkins University Krieger School of Arts and Sciences proposes a new Area of Concentration in Regenerative and Stem Cell Technologies in the existing and previously endorsed Master of Science (MS) in Biotechnology (HEGIS code 0499-10, CIP code 26.1201).

The proposed area of concentration builds on the strength of the current MS in Biotechnology which was launched in 1993 and grounds students in Biochemistry, Molecular Biology and Cell Biology. Within the biotechnology industry there is an increasingly a need for highly skilled professionals in the area of regenerative technologies, who possess an in-depth understanding of stem cells, gene therapy, regenerative medicine and the laboratory skills necessary to advance this rapidly expanding field of research and clinical development. Graduates of this program will fill key positions in clinical, industry and research laboratories which are using cell therapies for treatment of diseases.

The mission of The Johns Hopkins University is to educate its students and cultivate their capacity for life-long learning, to foster independent and original research, and to bring the benefits of discovery to the world. In addition, the mission of the Krieger School of Arts and Sciences "is discovery—the creation of new knowledge through research and scholarship, and the education of our students, undergraduate and graduate alike, through immersion in this collaborative process." The proposed degree program aligns with both of these missions as discussed below.

2. Alignment with institutional strategic goals

As stated above, the mission of the Johns Hopkins University is to educate its students and cultivate their capacity for life-long learning and bring the benefits to the world. This new concentration within the existing MS in Biotechnology fulfills the role of educating students by offering a new program of study that is innovative. There are only a few programs across the country that specifically address the field of regenerative and stem cell technologies at the master's level, even as this field is expanding rapidly. Secondly, our students are primarily working full-time and thus are returning to school to pursue additional education. Finally, the promise of cell therapy, and stem cell technologies for curing disease and its benefits to humanity are significant. Graduates from this degree program will be important contributors to research, industry and clinical programs in cell therapy.

This degree program fulfills the KSAS mission through every course in the program. Throughout the degree program, students are immersed in the knowledge required to be successful practitioners in this field. Course work is collaborative, in that students work in group to solve problems, and create products. This is particularly important for our students as in addition to fulfilling the mission of KSAS, collaborative skills are critical for success in this field.

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

1. Program outline and requirements

A full course listing with course titles and descriptions is provided in Appendix A.

Admission requirements:

Students admitted to this degree program and concentration will have earned a bachelor's degree in the life sciences from an accredited four-year institution with a GPA of at least 3.0 on a 4.0 scale and completed:

- General Chemistry (2 semesters)
- Organic Chemistry (2 semesters)
- Biology (2 semesters)

Core courses

- 410.601 Biochemistry
- 410.602 Molecular Biology
- 410.603 Adv. Cell Biology I
- 410.604 Adv. Cell Biology II

Concentration courses

- 410.630 Gene Therapy
- 410.653 Regenerative Medicine: Bench to Bedside
- 410.753 Stem Cell Biology
- 410.6XX Stem Cell Culture Laboratory Methods*

*Note: this is the only new course to be developed for this concentration. All other courses are currently offered in the MS in Biotechnology program.

Electives
Students may choose any two electives from the MS in Biotechnology program with their advisor's permission

2. Educational objectives and student learning outcomes

Upon completion of the area of concentration, students will:

- Understand in depth of the fundamentals of Cell Biology including structure and function of biological membranes, transport mechanisms, cytoskeleton, signal transduction pathways, regulatory mechanisms and cancer
- Discuss principles of Biochemistry including thermodynamics and energetics, basic amino acid and protein structure, glycolysis, enzyme kinetics, cellular metabolism, lipids and carbohydrates, and apply laboratory methods to questions in Biochemistry
- Analyze and compare prokaryotic and eukaryotic replication mechanisms, transcription and translation and apply recombinant DNA technology methods to problems in molecular biology, discuss new technology and concepts in molecular biology
- Analyze, interpret, and present a scientific paper(s).

Additional Outcomes for Concentration

- *Students who complete this concentration will be able to:*
  - Apply laboratory methods for stem cell cultivation and differentiation to biotechnology problems
  - Discuss major topics in gene therapy, cell therapy and tissue engineering
  - Describe the continuum from basic science to translational applications

3. General education requirements

Not applicable

4. Specialized accreditation/certification requirements

Not applicable

5. Contract with another institution or non-collegiate organization

Not applicable

C. Critical and compelling regional or statewide need as identified in the State Plan

1. Demand and need for program

A review of the Glass Door website on 3/24/2017 (glassdoor.com; which is a job search site) indicated that were 48 jobs available in stem cell technologies available in the state of Maryland. Nationwide, there were over 2,000 positions in stem cell technologies available. Because this is a new a growing area of biotechnology we expect the demand for trained individuals to increase over the next decade. In discussions with stem cell and bioprocessing industry professionals (J. Petrosky, J. Rowley, personal communications),

we learned that for every three jobs in this area, there is only one qualified individual. The leadership of Rooster Bio (Frederick, MD), reported that there is an increasing demand for professionals in this field, particularly in the state of Maryland (P. Baraniak, personal communication). Currently, there is no program in the state of Maryland that specifically addresses the workforce demands for highly skilled professionals at the master's degree level who are seeking industry, academic or government positions in Regenerative and Stem Cell Technologies.

The Bureau of Labor Statistics Occupational Outlook Handbook[1] for biological technicians reports that from 2014 – 2024 the growth in this job category will be 5% nationwide. Many of the new positions created for biological technicians will be in the state of Maryland. Specifically, Maryland will see a 25% increase in the number of positions that could be filled by our graduates.

Based on the data collected from search of job sites and the occupational outlook for the next decade, there will be sufficient newly created jobs to employ our graduates.

2. Alignment with the 2013 Maryland State Plan for Postsecondary Education

The proposed program is well aligned with *Maryland Ready,* the 2013–2017 Maryland State Plan for Postsecondary Education. The innovative MS in Biotechnology with a concentration in Regenerative and Stem Cell Technologies is intended to meet the growing need for skilled professionals in the growing area of cell therapy in the state, across the country, and around the globe. This is consistent with the Goal 1 of the State Plan, "Quality and Effectiveness," which asserts that Maryland will enhance its array of postsecondary education programs to more effectively fulfill the evolving educational needs of its students, the state, and the nation. Similarly, the proposed program is consistent with Goal 4, "Innovation," which articulates Maryland's aspiration to be "a national leader in the exploration, development, and implementation of creative and diverse education and training opportunities that will align with state goals, increase student engagement, and improve learning outcomes…" This new concentration will add a new dimension to the training opportunities available in the state as it is unique among biotechnology programs. Goal 5, "Economic Growth and Vitality," is centered on supporting a knowledge-based economy through increased education and training; this, too, is aligned with the goals of the proposed program.

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

1. Market Demand

As evidence for the current need and future potential of regenerative and stem cell sciences, several university/industry partnerships have formed over the last few years. For example, in 2012 a $20M University of Pennsylvania-Novartis partnership established the Center for Advanced Cellular Therapeutics to speed development of therapies. More recently, a joint investment of $28.1M between GE Healthcare & FedDev Ontario (Federal Economic Development Agency of Southern Ontario) was

established in 2016. Moreover, over 700 companies globally have a focus in regenerative science technologies, however, there is a continued shortage of trained scientists who can fill the expanding job opportunities within this field. (M. Thanhouser, personal communications, Johns Hopkins Technology Ventures).

The regenerative and stem cell science sector continues to show momentum year-after-year with over $5.3 billion raised in 2016 in support of industries participating in this emerging field. In addition, the clinical pipeline for regenerative technology is robust and continues to grow with over 800 clinical trials occurring in 2016 (Alliance for Regenerative Medicine). Sustained investor activity indicates a strong belief in the regenerative science growth potential over the next decade.

The Bureau of Labor Statistics Occupational Outlook Handbook for biological technicians reports that from 2014 – 2024 the growth in this job category will be 5% nationwide. Many of the new positions created for biological technicians will be in the state of Maryland. Specifically, Maryland will see a 25% increase in the number of positions that could be filled by our graduates.

Based on the data collected from search of job sites and the occupational outlook for the next decade, there will be sufficient newly created jobs to employ our graduates.

2. Educational and training needs in the region

As stated above, there are no programs in the state of Maryland that meet the growing demand for individuals with training within this area of concentration in Regenerative and Stem Cell Technologies. As the market demands continue, to grow, companies need to fill these positions with trained and qualified individuals.

3. Prospective graduates –

One other program in the State of Maryland has a Master in biotechnology degree with CIP 26.1201. Below is a table of graduates for 2009 – 2014 from both programs. Since the JHU program is offered nationwide, approximately 33% of the graduates actually reside in the state of Maryland.

Graduates from CIP 261201 programs in Maryland

School	2010	2011	2012	2013	2014
UMUC	45	65	86	122	121
Johns Hopkins	155	195	232	182	192

We expect to graduate 10 students in years 2 and 3 of the program, 15 students in year 4 and 20 students in year 5. To reiterate, we expect that more than half of the students in this program will come from outside the state of Maryland.

E. Reasonableness of program duplication

1. Similar programs

While there are several other MS in Biotechnology programs within the state of Maryland (UMUC and UMBC (MS in Professional Studies, Biotechnology)), these programs do not report a concentration in Regenerative and Stem Cell Technologies. Within the Translational Research area of the MS in Cellular and Molecular Biomedical Science (CMBS-MS) at the University of Maryland School of Medicine there is a Stem Cell Research track. However, there is little overlap between the program we are proposing and the CMBS-MS degree, Stem Cell Research Track and thus not a competing program. To our knowledge there are no other similar programs in the state of Maryland.

2. Program justification

With the development of new technologies for the cultivation of stem cells and new methods for gene modification such as CRISPR and lentivirus vectors, there is a need for highly trained professionals who can contribute to research and support the clinical development of life saving therapies. The National Cell Manufacturing Consortium in their Roadmap to 2025 reports that "*Over the past few decades, cell-based medical technologies have helped treat many patients with cancer, blood disorders, vision disorders, and other ailments. In 2012 alone, these products treated more than 160,000 patients. Though this relatively new industry has been growing significantly—with annual U.S. revenue above $1 billion—its potential is still far being fully realized.*"[1] To meet the potential of this new field, the National Cell Manufacturing Consortium Roadmap is calling for the development of new graduate programs by 2019 to satisfy projected growth in the industry. There are currently few training programs to fulfill the demand for these professionals in Maryland and across the country. This program will complement our existing MS in Biotechnology concentrations by adding a new dimension to our program as we address the changing demands of the biotechnology workforce. We expect that this new program will attract students who need to enhance their skill set as well as students new to the biotechnology industry. Our marketing analysis indicates there is significant need in the state and nationwide (see section C.1)

F. Relevance to Historically Black Institutions (HBIs)

1. Potential impact on implementation or maintenance of high-demand programs at HBIs

2. Potential impact on the uniqueness and institutional identities and missions of HBIs

By definition, an appropriate student for the MS in Biotechnology concentration in Regenerative and Stem Cell Technologies would apply after attending and completing a baccalaureate degree at any undergraduate institution, including any of Maryland's Historically Black Institutions. The proposed program would not directly affect the implementation, maintenance, uniqueness, identity or mission of these institutions.

G. Evidence of the Principles of Good Practice

See Appendix B for the evidence that this program complies with the Principles of Good Practice noted above.

H. Adequacy of faculty resources

See Appendix C for a representative list of full-time and part-time faculty who will teach in the proposed program. The use of part-time adjunct faculty is both intentional and important. Our program is committed to marrying theory and practice, and this is particularly important in a master's program designed for current and aspiring professionals and practitioners in Regenerative and Stem Cell Technologies. All of our faculty have at least the equivalent of a master's degree, over 90% have a Ph.D. or other terminal degree in their field. Most of the faculty for this proposed program have already been teaching for the MS in Biotechnology program for some time.

I. Adequacy of library resources

Students will full and complete access to the Milton S. Eisenhower Library on the Homewood campus, which is ranked as one of the nation's foremost facilities for research and scholarship. Its collection of more than three million bound volumes, several million microfilms, and more than 13,000 journal subscriptions has been assembled to support the academic efforts of the University. The interlibrary loan department makes the research collection of the nation available to faculty and students. The library also provides easy access to a wide selection of electronic information resources, including the library's online catalog, and numerous electronic abstracting and indexing tools. Many of the databases are accessible remotely. Librarians help students electronically and the library maintains an extensive web site to take visitors through all of its services and materials. To this are added more than 10,000 audiovisual titles available for on-site consultation.

J. Adequacy of physical facilities, infrastructure and instructional equipment

The courses in this program will offered both online and onsite. Onsite courses are offered at the Montgomery County Campus and the Homewood campus which have adequate classroom facilities including real time access to the internet, LCD projectors, etc. The

Biotechnology program has a dedicated state of the art Biosafety level 2 laboratory for the required Stem Cell Techniques course. This lab has bioreactors and biosafety cabinets as well all equipment necessary for this course. The program will have no discernible impact on the use of existing facilities and equipment beyond the standard requirements already in place; primarily, faculty office space in an existing university facility

K. Adequacy of financial resources with documentation

See Appendix D for detailed financial information.

L. Adequacy of provisions for evaluation of program

JHU-AAP has an online student course evaluation process that is completed at the midterm of each semester and after the offering of each course. This process will be applied to the proposed program. This evaluation also includes student reviews of the faculty for each course offered. Besides course grades, learning outcomes will be assessed through significant writing assignments, including the drafting of regulatory documents. Students will be surveyed for their satisfaction with courses and instructors at the end of each completed semester as well as at the completion of the program. Evaluations will provide valuable feedback on how well students believe their expectations are being met. The course evaluation process also allows student input on faculty, and all full-time MS in Biotechnology faculty are evaluated annually by program chairs or directors.

M. Consistency with the State's minority student achievement goals

Any student meeting the admissions requirements can apply to the MS in Biotechnology concentration in Regenerative and Stem Cell Technologies. The program will work to help all accepted students improve their workplace competitiveness and reach their professional goals, an aim consistent with the State's minority student achievement goals.

N. Relationship to low productivity programs identified by the Commission:

Not applicable

Appendix A
Course Descriptions

410.601 - Biochemistry
This course explores the roles of essential biological molecules focusing on protein chemistry, while covering lipids and carbohydrates. It provides a systematic and methodical application of general and organic chemistry principles. Students examine the structure of proteins, their function, their binding to other molecules and the methodologies for the purification and characterization of proteins. Enzymes and their kinetics and mechanisms are covered in detail. Metabolic pathways are examined from thermodynamic and regulatory perspectives. This course provides the linkage between the inanimate world of chemistry and the living world of biology.

410.602 - Molecular Biology
This course provides a comprehensive overview of the key concepts in molecular biology. Topics to be covered include nucleic acid structure and function, DNA replication, transcription, translation, chromosome structure and remodeling and regulation of gene expression in prokaryotes and eukaryotes. Extended topics to be covered include methods in recombinant DNA technology, microarrays, and microRNA. Prerequisite: 410.601 Biochemistry

410.603 - Advanced Cell Biology I
This course covers cell organization and subcellular structure. Students examine the evolution of the cell, chromosome and plasma membrane structures and behaviors, mechanics of cell division, sites of macromolecular synthesis and processing, transport across cell membranes, cell dynamics, organelle biogenesis, and cell specialization. Students also are introduced to the experimental techniques used in cell biology to study cell growth, manipulation, and evaluation.

410.604 - Advanced Cell Biology II
This course is a continuation of 410.603 (Advanced Cell Biology I) and further explores cell organization and subcellular structure. Students examine cell-to-cell signaling that involves hormones and receptors, signal transduction pathways, second messenger molecules, cell adhesion, extracellular matrix, cell cycle, programmed cell death, methylation of DNA and modification of chromatic structure, and mechanisms of the cell. The involvement of abnormalities in signal transduction pathways to oncogenesis and other disease states will be stressed. Prerequisites: 410.601 Biochemistry; 410.602 Molecular Biology; 410.603 Advanced Cell Biology I

Concentration Courses

410.630 - Gene Therapy
Students are introduced to gene transfer, its technical evolution, and its testing through clinical studies. Gene therapy holds promise for both genetic diseases and acquired diseases such as cancer and AIDS. The health, safety, and ethical issues surrounding gene therapy are discussed, together with the review and oversight systems established to regulate this therapy. Students also consider how industry is developing these techniques, both in new start-up companies as well as in established biotechnology and pharmaceutical companies. An overview of proprietary and

patent issues in gene therapy is part of the course. Prerequisites: 410.601 Biochemistry; 410.602 Molecular Biology; 410.603 Advanced Cell Biology I

410.653 - Regenerative Medicine: from Bench to Bedside
Regenerative Medicine is a multidisciplinary field developing next-generation therapies that aim to augment, repair, replace or regenerate tissues and organs. This field can be broadly defined by three overlapping technology domains: cell therapy, gene therapy and tissue engineering. In this course, we will explore these regenerative medicines from bench to bedside. We will discuss relevant biological, engineering, clinical, legal, regulatory and ethical principles and perspectives to understand the emerging field of regenerative medicine. Specific topics include induced pluripotent stem cells, bioartificial organs, cell-based immunotherapy, and gene editing techniques such as a CRISPR/Cas-9. In addition to gaining a scientific foundation, students will become familiar with the current state of the industry and the process of bringing these regenerative medicine products to market, including market trends and opportunities, process development and manufacturing, and commercialization challenges and successes. Readings will be drawn primarily from scientific journals. Prerequisites: 410.601 Biochemistry; 410.602 Molecular Biology; 410.603 Advanced Cell Biology I.

410.753 - Stem Cell Biology
This course will involve discussion and debate on current topics concerning stem cell biology and the use of stem cells in biotechnology and therapeutics. Topics will include review and discussion of developmental and cell biology, stem cell characteristics, stem cell preparation and therapeutic uses, tissue engineering, global regulatory and ethical issues, and commercialization of stem cell therapy. Current peer-reviewed literature and guest experts in the field will provide up to date information for discussion. Prerequisites: 410.601 Biochemistry, 410.602 Molecular Biology; 410.603 Advanced Cell Biology I; 410.604 Advanced Cell Biology II.

410.XXX Stem Cell Culture Laboratory Methods
This laboratory course introduces students to the cultivation and differentiation of stem cells. Students are introduced to cell cultivation methods, for three types of stem cells and the basics of tissue engineering. Students will scale-up cells into mini-bioreactors for large scale use. The class will include industry wide practices in cGMP. Prerequisites: 410.601 Biochemistry; 410.602 Molecular Biology; 410.603 Advanced Cell Biology I; 410.652 Cell Culture Techniques

Appendix B
Evidence of Compliance with the Principles of Good Practice
(as outlined in COMAR 13B02.03.22C)

(a) Curriculum and instruction

(i) A distance education program shall be established and overseen by qualified faculty.

The Center for Biotechnology Education (CBE) has been a pioneer in the field of distance education offering its first online course in 2000. All of our faculty have terminal degrees and have significant teaching experience online. Four of the master's degrees with CBE are fully online, including the M.S. in Bioinformatics which was the second master's degree at JHU to be offered fully online. Our faculty have been developing, teaching, and overseeing distance education courses for 15 years

(ii) A program's curriculum shall be coherent, cohesive, and comparable in academic rigor to programs offered in traditional instructional formats.

Every course in this program was first taught onsite and then developed for online delivery and thus the curriculum is coherent and cohesive and is comparable in academic rigor. The online course development process is overseen by the Instructional Resource Center an academic support unit consisting of instructional technologists, trainers, and instructional designers. The process incorporates the Quality Matters™ research-based set of eight standards for quality online course design to ensure the academic rigor of the online course is comparable or better to onsite delivery.

(iii) A program shall result in learning outcomes appropriate to the rigor and breadth of the program.

Students who complete the MS in Biotechnology program will:

- Have an in depth understanding of the fundamentals of Cell Biology including structure and function of biological membranes, transport mechanisms, cytoskeleton, signal transduction pathways, regulatory mechanisms and cancer
- Understand the principles of Biochemistry including thermodynamics and energetics, basic amino acid and protein structure, glycolysis, enzyme kinetics, cellular metabolism, lipids and carbohydrates, and apply laboratory methods to questions in Biochemistry
- Analyze and compare prokaryotic and eukaryotic replication mechanisms, transcription and translation and apply recombinant DNA technology methods to problems in molecular biology, discuss new technology and concepts in molecular biology
- Analyze, interpret, and present a scientific paper(s).

Students who complete this concentration will be able to:

- Apply laboratory methods for stem cell cultivation and differentiation to biotechnology problems
- Discuss major topics in gene therapy, cell therapy and tissue engineering
- Describe the continuum from basic science to translational applications

(iv) A program shall provide for appropriate real-time or delayed interaction between faculty and students.

Our Learning Management System, Blackboard and other tools such as adobe connect, allow for both real-time and delayed interactions. This program will follow the same model for course delivery as our other fully online degree programs.

(v) Faculty members in appropriate disciplines in collaboration with other institutional personnel shall participate in the design of courses offered through a distance education program.

Our faculty members in collaboration with Instructional Resource Center's (IRC) staff of instructional designers and technology staff will develop all new courses for the program. Our IRC has helped over 100 faculty members develop their courses for online delivery.

(b) Role and mission

(i) A distance education program shall be consistent with the institution's mission.

Refer to See section A.1 in the main body of the proposal.

(ii) Review and approval processes shall ensure the appropriateness of the technology being used to meet a program's objectives.

All the courses in the program are designed with the support of an instructional designer and multimedia specialists. The instructional designer and multimedia specialists serve as instructional technologist consultants to assist in identifying and recommending the most effective learning technologies for accomplishing the course learning objectives. The course instructor and instructional designer identify all the learning components of the course, and how the course will be facilitated to achieve the most optimal learning outcome for the students. This is an iterative process that goes through several levels of review prior to the course actually being developed. Once the courses launch, the design team continually monitors the courses, and consults with the instructors to make adjustments to the course, if needed. All new online courses participate in a mid-term and end-of-term course evaluation process. The mid-term feedback is used to determine if any mid-point term corrections are needed. And the end-of-term is used to assess whether further course refinements are needed prior to the next time the course is offered.

(c) Faculty support

(i) An institution shall provide for training for faculty who teach with the use of technology in a distance education format, including training in the learning management system and the pedagogy of distance education.

Faculty in this online program are supported by the Instructional Resource Center (IRC) of Advanced Academic Programs, as well as the program director, assistant director and program coordinators. The IRC provides oversight for all online course developments, including faculty training and development. The IRC has a formal, structured faculty development approach for preparing faculty to develop and teach an online course. All faculty are required to complete three Blackboard training sessions and a course in the use of Adobe Connect. These trainings provide an overview of online learning pedagogy and introduce the faculty to some of the technologies they'll be using to develop their online courses. Faculty may also sign up for one-on-one training sessions with staff of the IRC.

The IRC together with the Center for Biotechnology Education provide pedagogical training. Biotechnology offers a monthly pedagogical virtual seminar (Brown Bag series) and day long pedagogical training for two – three times a year that is offered onsite and virtually.

(ii) Principles of best practice for teaching in a distance education format shall be developed and maintained by the faculty.

The Instructional Resource Center offers training on how to be an effective online instructor based on best practices from research and other related sources. All new online instructors are required to participate in this training prior to teaching their first online course.

(iii) An institution shall provide faculty support services specifically related to teaching through a distance education format.

The Instructional Resource Center provides a wide range of faculty support services for faculty engaged in online instruction. Faculty have access to multimedia specialists, instructional designers, technical trainers, and a 24/7 technical help desk to provide the necessary support required to effectively deliver distance education programs. In addition, the IRC offers faculty development training opportunities in online pedagogy and new instructional technologies throughout the year specifically designed for online instructors. The IRC provides a wide range of support services for faculty engaged in online instruction. Faculty have access to multimedia specialists, instructional designers, technical trainers, and a 24/7 technical help desk to provide the necessary support required to effectively deliver distance education programs.

(d) An institution shall ensure that appropriate learning resources are available to students including appropriate and adequate library services and resources.

The students will have online access to the Milton S. Eisenhower Library on the Homewood campus, which is ranked as one of the nation's foremost facilities for research and scholarship. Its collection of more than three million bound volumes, several million microfilms, and more than 13,000 journal subscriptions has been assembled to support the academic efforts of the University. The interlibrary loan department makes the research collection of the nation available to faculty and students. The library also provides easy access to a wide selection of electronic information resources, including the library's online catalog, and numerous electronic abstracting and indexing tools. Many of the databases are accessible remotely. Librarians help students electronically and the library maintains an extensive web site to take visitors through all of its services and materials.

(e) Students and student services

(i) A distance education program shall provide students with 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.

Students enrolled in all of our programs regardless of location are assigned an advisor to help them with information about curriculum, etc., the advisor is available by phone, email or skype so that the student's location is irrelevant. All students have access to the catalog and website which provides information about services. In addition, student services are available for all students regardless of location

(ii) Enrolled students shall have reasonable and adequate access to the range of student services to support their distance education activities.

JHU online students have access to the following academic support services:

Academic advising. Students are assigned an advisor when accepted. Students work individually with the advisor to develop a course of study that meets the requirements of the program and the career goals of the student. The advisor regularly contacts the students to check on progress and answer questions. Courses that deviate from the program plan and have not been approved by an adviser may not count toward degree requirements. A degree audit tool is provided so students verify their selections match degree requirements.

Library services. Students have online access to the Milton S. Eisenhower Library on the Homewood campus, ranked as one of the nation's foremost facilities for research and scholarship. The interlibrary loan department allows students access to resources at any other university in the nation. The library also provides easy access to a wide selection of electronic information resources, including the library's

online catalog, and numerous electronic abstracting and indexing tools. Many of the databases are accessible remotely. Librarians are available to assist students remotely and the library maintains an extensive web site to take visitors through all its services and materials.

Services for students with disabilities. The Johns Hopkins University is committed to making all academic programs, support services, and facilities accessible to qualified individuals. Students with disabilities who require reasonable accommodations can contact out student services director.

Johns Hopkins Student Assistance Program. The Johns Hopkins Student Assistance Program (JHSAP) is a professional counseling service that can assist students with managing problems of daily living. Stress, personal problems, family conflict, and life challenges can affect the academic progress of students. JHSAP focuses on problem solving through short-term counseling. Accessing the service is a simple matter of a phone call to arrange an appointment with a counselor. Online students may call a phone number for consultation and will be directed to the appropriate resource or office. JHSAP services are completely confidential. The program operates under State and Federal confidentiality legislation and is HIPAA compliant.

Transcript access. Official transcripts will be mailed upon written request of the student at no charge.

Student ID JCard. The JCard serves as the student's University identification card. This card is mailed to the home address of every registered student. The JCard acts as the university library card, which enables students to check out books from the Homewood Eisenhower Library or at any of the campus center libraries, and provides access to many computer laboratories.

(iii) Accepted students shall have the background, knowledge, and technical skills needed to undertake a distance education program.

All accepted online students must meet the admissions requirements of graduate students in Advanced Academic Programs and the specific requirements of the proposed program. New online students are required to complete the "New Online Student Orientation" course prior to beginning their first online course. This course covers a broad range of topics on how to be a successful online student such as: Blackboard basics, online student learning expectations, how to access the library, how to conduct online research, and how to participate in online discussions.

(iv) Advertising, recruiting, and admissions materials shall clearly and accurately represent the program and the services available.

All relevant program information is keep up-to-date on the JHU-AAP Web site at advanced.jhu.edu

(f) Commitment to support

(i) Policies for faculty evaluation shall include appropriate consideration of teaching and scholarly activities related to distance education programs.

Faculty teaching online courses are strongly encouraged to participate in minimally one to two professional development opportunities annually to improve their online teaching skills. An institution shall demonstrate a commitment to ongoing support, both financial and technical, and to continuation of a program for a period sufficient to enable students to complete a degree or certificate. Advanced Academic Programs has a commitment to online teaching as demonstrated by the resources of its Instructional Resource Center that provide course development, instructional, and technical support to new and current faculty. See also Appendix D for detailed financial information regarding the proposed program.

(iii) An institution shall demonstrate a commitment to ongoing support, both financial and technical, and to continuation of a program for a period sufficient to enable students to complete a degree or certificate.

Advanced Academic Programs has a commitment to online teaching as demonstrated by the resources of its Instructional Resource Center that provide course development, instructional, and technical support to new and current faculty.

(g) Evaluation and assessment

(i) An institution shall evaluate a distance education program's educational effectiveness, including assessments of student learning outcomes, student retention, student and faculty satisfaction, and cost-effectiveness.

Please see section L of the main body of the proposal.

(ii) An institution shall demonstrate an evidence-based approach to best online teaching practices.

JHU-AAP has an online student course evaluation process that is completed at the midterm of each semester and after the offering of each course. This process will be applied to the proposed program. This evaluation also includes student reviews of the faculty for each course offered. Besides course grades, learning outcomes will be assessed through significant writing assignments, and exams Students will be surveyed for their satisfaction with courses and instructors at the end of each completed semester as well as at the completion of the program. Evaluations will provide valuable feedback on how well students believe their expectations are being met. The course evaluation process also allows student input on faculty, and all full-time MS in Biotechnology faculty are evaluated annually by program chairs or directors.

(iii) An institution shall provide for assessment and documentation of student achievement of learning outcomes in a distance education program.

As part of the online course design process in JHU-AAP, course assessments are required to be aligned with stated course learning outcomes. The proposed program will incorporate authentic learning assessments that demonstrate student's application of learned skills.

Appendix C
Faculty

- Patrick Cummings, ScD., Sr. Lecturer, Director MS in Biotechnology, Center for Biotechnology Education (full-time)
    - electives, Stem Cell Culture Laboratory Methods
- Kristina Obom, PhD, Sr. Lecturer, Director, MS in Individualized Genomics and Health, Center Director, Center for Biotechnology Education (Full-time)
    - Electives, Stem Cell Culture Laboratory Methods
- Meredith Safford, PhD, Sr. Lecturer, Coordinator, Biotechnology, Center for Biotechnology Education (full-time)
    - Adv. Cell Biology II
- Beatrice Kondo, PhD, Sr. Lecturer, Coordinator, Biotechnology, Center for Biotechnology Education (full-time)
    - Adv. Cell Biology I
- Karen Wells, PhD, Sr. Lecturer, Center for Biotechnology Education (full-time)
    - Biochemistry
- Thomas Koval, PhD Sr. Lecturer, Center for Biotechnology Education (full-time) Adv. Cell Biology I and Adv. Cell Biology II
- Sherry Ogg, PhD, Sr. Lecturer, Center for Biotechnology Education (full-time)
    - Molecular Biology
- Olivia Spicer, PhD, Lecturer, Coordinator Biotechnology (full-time)
    - Stem Cell Culture Laboratory Methods, Biochemistry
- Lisa Selbie, PhD, adjunct lecturer (part-time)
    - Stem Cell Biology
- Mary Beth Wilson, PhD adjunct lecturer (part-time)
    - Regenerative Medicine: Bench to Bedside
- Erin Morrey, PhD, adjunct lecturer (part-time)
    - Gene Therapy

Appendix D
Finance Information

TABLE 1: 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)	209,800	440,580	809,566	1,335,783	2,040,106
a. Number of F/T Students	0	0	0	0	0
b. Annual Tuition/Fee Rate	0	0	0	0	0
c. Total F/T Revenue (a x b)	0	0	0	0	0
d. Number of P/T Students	10	20	35	55	80
e. Credit Hour Rate	1,049	1,101	1,157	1,214	1,275
f. Annual Credit Hour Rate	20	20	20	20	20
g. Total P/T Revenue (d x e x f)	209,800	440,580	809,566	1,335,783	2,040,106
3. Grants, Contracts & Other External Sources	0	0	0	0	0
4. Other Sources	0	0	0	0	0
TOTAL (Add 1 – 4)	**209,800**	**440,580**	**809,566**	**1,335,783**	**2,040,106**

Resources narrative

1. Reallocated Funds. No funds will be reallocated from existing campus resources.
2. Tuition/Fee Revenue. Tuition revenue is the product of the incremental number of P/T students, the credit hour rate, and the total annual credit hours.
3. Grants and Contracts. There are no grants or contracts that will provide resources for this program.
4. Other Sources. There are no other sources that will provide resources for this program.

TABLE 2: EXPENDITURES:					
Expenditure Categories	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
1. Faculty (b + c below)	44,042	70,805	188,252	226,116	278,215
a. # Sections offered	5	10	15	20	27
b. Total Salary	40,780	65,560	159,340	193,950	421,727
c. Total Benefits	3,262	5,245	28,912	32,166	36,488
2. Admin. Staff (b + c below)	0	0	0	0	0
a. # FTE	0	0	0	0	0
b. Total Salary	0	0	0	0	0
c. Total Benefits	0	0	0	0	0
3. Support Staff (b + c below)	0	0	0	0	0
a. # FTE	0	0	0	0	0
b. Total Salary	0	0	0	0	0
c. Total Benefits	0	0	0	0	0
4. Equipment	10,000	0	15,000	0	0
5. Library	0	0	0	0	0
6. New or Renovated Space	0	0	0	0	0
7. Other Expenses	0	0	0	0	0
TOTAL (Add 1 – 7)	**54,042**	**70,804**	**203,252**	**226,115**	**278,214**

Expenses narrative

1. Faculty Salaries and Benefits. Current adjunct salary is $5,000 per course. Costs will consist of that salary (plus possible minor annual increases) for each of the courses offered plus online course development fees.
2. Administrative Staff. It is not anticipated that the program will need a dedicated support staff member as JHU-AAP has staff to perform duties that may arise.
3. Support Staff. It is not anticipated that the program will need a dedicated support staff member as JHU-AAP has staff to perform duties that may arise.
4. Equipment. Students will have access to existing resources.
5. Library. Students will have access to existing resources.
6. New or Renovated Space. Not applicable.
7. Other Expenses. Not applicable.