PROGRAM OR CONCENTRATION NAME: Master of Science in Integrative Biology
DEPARTMENT: Department of Biology and Physics
PROPOSED EFFECTIVE DATE: Fall 2012

Check One or More of the Following and Complete the Appropriate Sections

√ New Program Proposal**
_____ Change in Program/Concentration/Degree Requirements
_____ New Concentration Proposal

**A new course proposal is required for each new course that is part of the new program

Submitted by:  Joseph M. Dirnberger  1 October 2010
Faculty Member  Date

___ Approved  ___ Not Approved
Department Curriculum Committee  Date

___ Approved  ___ Not Approved
Department Chair  Date

___ Approved  ___ Not Approved
College Curriculum Committee  Date

___ Approved  ___ Not Approved
College Dean  Date

___ Approved  ___ Not Approved
GPCC Chair  Date

___ Approved  ___ Not Approved
Dean, Graduate College  Date

___ Approved  ___ Not Approved
Vice President for Academic Affairs  Date

___ Approved  ___ Not Approved
President  Date
BACCALAUREATE AND MASTER’S DEGREES

NEW PROPOSAL FORM: ONE-STEP PROCESS
(Submit One Copy)

REVISED FORMAL PROPOSAL

Institution: Kennesaw State University

Institutional Contact: Dr. Ken Harmon, Provost and Vice President for Academic Affairs

Date: 15 October 2010

School/Division: College of Science and Mathematics

Department: Department of Biology and Physics

Departmental Contact: Joseph M. Dirnberger

Name of Proposed Program/Inscription: Master of Science in Integrative Biology

Degree: Master of Science

Major: Biology

CIP Code: 26.0101 (Biology/Biological Sciences, General)

Anticipated Starting Date: Fall 2012
Executive Summary

The Department of Biology and Physics is proposing a Master of Science program in Integrative Biology (Master’s of Integrative Biology or MIB). While Georgia already has several graduate-level degree programs in the biological sciences, KSU is proposing an Integrative Biology program to provide students a competitive advantage over traditional training and in anticipation of the future biological sciences. Integrative biology seeks to span across typical scales and disciplines within the current sciences to better answer some of the great scientific questions of our day. As biology becomes more and more integrative, new scientific societies have developed to foster this work and new journals focused on integrative biology continue to expand their publications and readership. In addition, most of the large external granting agencies (NSF, NIH, etc) recognize integrative biology as an approach that will yield significant breakthroughs, and have shifted monetary resources to support integrative projects.

Kennesaw State University’s (KSU) strategic plan calls for increased national recognition and enhanced student learning opportunities, and the College of Science and Mathematics’ (CSM) is specifically interested in providing an opportunity for faculty and students to succeed in scholarship roles. A graduate program in biology increases the scholarship potential for faculty and graduate students alike. In addition, the increased scholarship activity leads to greater recognition in the region and across the nation. This increased scholarship activity provides more opportunity for all students to engage in discovery learning through cultural changes in the institution, increased mentoring opportunities, and increased funding availability as extramural funding increases.

Graduates of KSU’s MIB program will also be able to contribute to Georgia’s economic goals. Our state has sought to increase its share of the growing biosciences economy, whether in the private sector or in government services. As these heavily technical businesses or government agencies seek to relocate to Georgia, they will need to be assured that there will be a technically viable workforce to operate here. Our graduates will be able to function not just as technicians, but also as effective facilitators and researchers. The integrative approach in their training will allow them to better anticipate changes in the marketplace, as well as to more successfully solve complex biological questions. These qualities will make our MIB graduates more competitive as Georgia ramps up within the biosciences sector.

The program involves 36 credit hours of graduate work. The students will be introduced to multiple levels of integration during their course work and as part of their thesis structure ensuring that students view problems through a wider lens. The department is asking for twelve teaching assistantships to give the graduate students valuable experience in teaching as well as provide a cost-effective release for faculty to shift their attention to developing graduate courses and supervising research. A graduate coordinator position is requested to administer the program. Most of the departmental tenure-track faculty are already research active, and the space for the program will be accommodated in the current buildings and the new lab wing scheduled to open in 2012. With the potential to support CSM, KSU and state strategic goals, and with the infrastructure already in place, this graduate program is strongly positioned to advance the department and the university into the next 10 years of learning excellence and beyond.
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1. Program Description and Objectives:

a. Objectives of the program

Expected Student Learning Objectives for Graduates:
Students who successfully graduate from our degree program will:

• Be able to integrate content, concepts, and data across biological scales, biological
disciplines, and/or academic disciplines to answer scientific questions that span
traditional boundaries and beyond.
• Be highly competitive for employment in the growing local, private-sector life-
sciences economy and enhance the attractiveness for businesses looking to
relocate to the Metro Atlanta area by offering a highly educated work force.
• Be highly competitive for employment in local and federal government positions
where scientific research is required.
• Be highly competitive for continued educational opportunities in research (Ph.D.)
or professional (e.g. M.D.) degree programs at advanced levels.
• Gather and analyze meaningful data to appropriately answer scientific questions
that will produce data appropriate for publication.
• Critically evaluate the primary scientific-literature, use that knowledge to generate
independent, novel hypotheses, and construct appropriate scientific experiments
to test those hypotheses.
• Gain a deeper conceptual understanding of the biological content necessary for
success as a biologist.
• Enhance undergraduate education by providing a scientific culture that stimulates
students early in their education, resulting in higher research participation among
Bachelor of Science (BS) students.

Expected Program Outcomes:
To assure that Kennesaw State University (KSU) meets the goals laid out in the 2007-
2012 strategic plan, this program will:

• Enhance the scholarship potential of faculty in the Department of Biology and
Physics, by increasing the national recognition of the program and KSU while
improving the departments ability to attract external funding through research and
educational grants and contracts.
• Increase the retention of new faculty in the Department by improving intellectual
engagement and professional opportunities, while offering discipline
advancement that is only available through continued academic scholarship.
• Create a degree program that can act as an organizing nucleus to expand interdisciplinary cooperation among departments within the College of Science and Mathematics (CSM) and across the campus.
• Enhance the regional and national recognition of the Department of Biology and Physics (DBP) and KSU by attracting research-active faculty.

b. Needs the program will meet
Master of Science (MS) graduates are uniquely positioned to enter the life-sciences private sector, government service, education, or doctoral or professional programs. Integrative biology is a scientific paradigm that assembles concepts and information from different disciplines (e.g. genetics, physiology, and behavior) and from different scales (e.g. molecules, cells, populations, ecosystems) to produce a more complete understanding of biological systems. An MS student who graduates with an Integrative Biology degree is more versatile than a conventionally-trained graduate because they can provide connectivity in interdisciplinary teams and adaptability to changing workplace needs in industry, research, and education. Recognition of the importance of this field is widespread and growing, but only a small number of integrative biology degree programs have been started, though at fairly prestigious universities (e.g. University of California-Berkeley, Yale University, University of Illinois at Urbana-Champaign, and University of Texas at Austin). A recent report from the National Research Council of the National Academies clearly stresses the need for an integrative approach in the biological sciences:

“The ways in which we think about and pursue research in biology are changing rapidly. In the past decade, powerful innovations—including recombinant DNA, instrumentation, and the digital revolution—have altered fundamentally the ways in which biology is done. Biologists are increasingly intrigued by the challenges of deciphering how components such as molecules, cells, or organisms interact to produce higher-order structures and properties. They are studying the ways in which molecules can affect cells, or ways in which cells can affect organ systems, or how individual organisms affect populations and ecosystems. At all levels of biological organization, the elucidation and understanding of integrated systems are moving to center stage.”

The state of Georgia is interested in expanding our industrial and research activity in the life sciences as a vital part of our continued economic growth. Initiatives to enhance this economic sector have included hosting the 2009 biotechnology industry-conference (BIO 2009) and investments in education from high schools (increased science course requirements, introduction of biotechnology courses, etc) to universities (expanded BS degrees in the sciences, increased graduate science degrees, expanded biotechnology-related doctoral programs, etc). While these initiatives continue to enhance our potential in life-sciences research, we have not kept pace with national leaders, including those in our region (North Carolina and Florida). Successful competition with our national peers

1 “BIO2010: Transforming Undergraduate Education for Future Research Biologists”
http://www.nap.edu/catalog/10497.html
will require a trained talent pool strong enough to attract, retain, and initiate enterprises. Demographic trends suggest that Georgia cannot continue to rely on immigration for a large fraction of its educated workforce.

In addition to the economic impacts of growth in the life-sciences private sector, there is an increasingly important need to address environmental degradation. Problems are most common where human populations require heavy interactions with the environment, and as the population of Georgia (especially the north-metro Atlanta corridor) expands over the coming years, environmental impacts will intensify (e.g. water quantity and quality, habitat destruction for game and non-game species, air quality, climate change, petrochemical spills). Solving these problems will require integrative approaches to address synergistic effects resulting from multiple levels. Biotechnological applications to address modern environmental concerns are promoted nationally, but solutions will also depend on innovations that span more traditional fields. As a result, employment opportunities for life scientists of all disciplines are expected to increase in the coming decade, and those scientists who can synthesize concepts from multiple disciplines into comprehensive solutions will be more competitive in the growing market. According to the US Bureau of Labor Statistics Occupational Outlook Handbook (2010-11 Edition) employment of biological scientists for all occupations is expected to “increase much faster than the average” (greater than 20%), and an integrative approach to biology will be needed (e.g. “understanding how certain genes function within an entire organism”)

Atlanta has a regional and national significance that attracts employers, and it is projected that many of the new employment opportunities in Georgia will be found in the metropolitan area. The state is currently home to many federal agencies, non-profit organizations, and industries that need life scientists who can help find comprehensive solutions to problems across disciplines. The southeast regional office of the U.S. Environmental Protection Agency, the Centers for Disease Control, the American Cancer Society, Georgia-Pacific, and Cryolife are just a few of the institutions in the area that need well-trained life scientists. Georgia Bio, a non-profit, membership-based organization that promotes the interests and growth of the life sciences industry, lists over 300 life science companies in Georgia (http://www.gabio.org/). Training students in integrative biology will help produce highly competitive candidates to meet current and future labor demands in all sectors of Georgia’s economy.

c. Brief explanation of how the program is to be delivered

Students in our Master of Science in Integrative Biology (MIB) program will be trained in the integrative paradigm through courses that incorporate scales and disciplines within and beyond biology, and by the structure of thesis committees where at least one of the three members is from outside the major professor’s subdiscipline. Such a foundation will develop ways of thinking that allow students to recognize and expand upon the integrative nature of modern biology, and it is expected that a student’s thesis research will be influenced and enhanced by this approach. KSU’s Biology and Physics Department currently contains collaborative research efforts that integrate subdisciplines and biological scale, and that will further provide students with excellent models for
studying integrative biology. These research groups include ecologic-genetic interactions, host-pathogen interactions, and protein-protein interactions during cell signaling. The integrative nature of the program will also stimulate other collaborative research with disciplines inside the department (physics) and outside the department (e.g. chemistry, geography, mathematics).

In addition to a thesis generated by original research, the degree will require 36 credit hours total: 11 credit hours Thesis Research, 12 credit hours of required graduate courses (including 2 Graduate Seminar experiences), and another 13 credit hours of graduate-level electives (maximum of two 6000 level courses can be applied toward the degree). Graduate-level courses (see Section 5 and Appendix A) are chosen based on their integrative nature across fields of study, and will be developed and offered over a 2-year schedule. These courses will provide a background in some of the major themes of integrative biology.

To ensure that students in this program receive a strong integrative experience, at least three credit hours will be required either from a discipline outside Biology / Biotechnology or from a subdiscipline that differs from a student’s major professor. Several existing courses within the department are integrative in nature and will be cross-listed for graduate credit. Additional integrative courses will be added as feasible, based on demand. Support has been obtained from the Departments of Chemistry and Biochemistry, Computer Science and Information Systems, and Math and Statistics for offering courses appropriate for the MIB program (Appendix E). Other options, such as allowing upper-level undergraduate courses from other disciplines, will be pursued as more graduate programs are developed on campus. To accomplish this teaching goal it will be necessary to offer 2-3 graduate courses and the graduate seminar each semester in order to accommodate student needs, with a class size of 10 students and a targeted number of 20 graduate students in the program.

Graduate student teaching assistantships will offset the undergraduate faculty teaching hours redirected for teaching graduate courses. Teaching assistants will be expected to teach 2-3 sections of an undergraduate lab in a given semester (6-9 contact hours in addition to 3 hours for lab preparation, 3 hours for grading, and 3 hours for office hours). Undergraduate contact hours covered by teaching assistants will compensate for the faculty contact hours devoted to teaching graduate courses and coordinating the graduate program. Twelve teaching assistantships funded by KSU (the remainder of graduate student support would be expected from externally supported grants) significantly reduces faculty teaching loads (72-108 contact hour reduction for the department), allowing for the additional effort toward scholarship needed to sustain a quality graduate program. Department funding of graduate assistantships for individual students will not exceed two years, and a maximum length of funding (regardless of source, department or investigator grant) will not exceed three years (under exceptional circumstances the graduate coordinator may consider a one year extension of funding by external sources beyond the three year maximum).

The MIB degree will require an original research thesis that will be presented in written
and oral form (i.e. a departmental seminar), and defended before the student’s thesis committee. To ensure an integrative experience in the development and interpretation of thesis research, it will be required that at least one of the three faculty members serving on a student’s thesis committee be from either:

- a subdiscipline that differs from his/her major professor’s (cell/molecular, organismal, ecological).
- outside the discipline of biology (e.g. physics, mathematics, chemistry, geography, etc.).

### d. Prioritization within the institution’s strategic plan

Kennesaw State University’s Vision:

“Kennesaw State University is among the best learning-centered comprehensive universities in the country and is expanding its programs of distinction to meet state and national needs. KSU provides excellent and accessible education, promotes research and scholarship, fosters community engagement, supports intellectual inquiry, and contributes to economic development. KSU alumni are well educated in the liberal arts, leaders in their chosen professions, and engaged citizens whose global awareness and lifelong learning make them visionary leaders for Georgia, the nation, and the world.”

To maintain this vision for KSU, the university has implemented a comprehensive strategic plan that outlines goals and benchmarks for improving key sectors of our institution.

The first goal of KSU’s strategic plan is ‘to enhance and expand academic programs and delivery.’ To accomplish this goal, the university is striving to: ‘Enhance the quality and quantity of technology available for teaching, research, and scholarship; develop interdisciplinary programs across academic units; and add degree programs that are strategically important to the local community, to Georgia, and to the nation at a graduate level.’ Our proposed MIB program is inherently interdisciplinary and will serve as a vital nucleus to expand collaborations across multiple units within the university setting. In addition, the integrative nature of the training our MIB students receive, as already noted, will position them to be highly competitive in all sectors of Georgia’s growing life-sciences sector while also making them highly competitive among graduate degree holders across the nation. Because the graduate degree program we are proposing is research intensive, faculty in the program will have increased scholarship and a higher potential for obtaining extramural funding from agencies like The National Science Foundation (NSF) and The National Institutes of Health (NIH). This funding will have the potential to directly impact the technology KSU has available for research and for teaching. Presently, there are no graduate programs in biology within the Department of Biology and Physics at KSU (all of the Peer and Aspirational Comparator Universities identified by KSU offer master degrees within the field of biology; see Appendix B).

KSU’s second strategic goal is ‘to improve retention, progression, and graduation rates while maintaining high quality.’ Science departments with strong cultures of research provide more engaging environments for undergraduate students. With regular science
seminars, increased teaching by research-active faculty, and close interactions between undergraduate and graduate students, these departments accentuate the excitement of science and immerse students in the thrill of discovery. This engagement alone can be vital to retaining students who might otherwise drift away from a science degree. In addition, a strong cadre of research-active and motivated graduate students can help those students who might be struggling while also offering increased undergraduate research potential where students can be immersed in the excitement of research. Finally, strong research programs have increased success in funding including better funding potential for undergraduate research. These funding opportunities include stand-alone REUs (Research Experiences for Undergraduates) from the National Science Foundation and numerous funding opportunities attached to traditional research grants. These opportunities have the potential to dramatically increase the number of undergraduates participating in research, which is a vital way of engaging students and keeping them excited about their science degrees. These features of strong research programs routinely lead to general improvements in retention and graduation rates of undergraduates in general. The enhanced potential to obtain grants like MARC (Minority Access to Research Careers) and MORE (Minority Opportunities in Research) also increase the research participation of underrepresented groups, improving retention and graduation of these at-risk students and addressing an important CSM goal ‘to maintain leadership in student and faculty diversity.’

KSU’s third strategic goal is ‘to expand campus resources and enhance campus infrastructure,’ including ‘Increasing funds brought to KSU through grants, contracts, and alumni giving by at least 10 percent per year.’ Graduate programs in the natural sciences have the potential to increase the scholarship of research-active faculty. Scientists must be successful in obtaining funding to support these increases in scholarly activity. The increased publication potential associated with graduate student research results in graduate faculty being more successful at obtaining extramural funding from the large, national funding sources (NSF, NIH, EPA, DOE, etc.) In addition to the direct increase in equipment available to KSU through these grants, generation of overhead will allow the university to invest in needed infrastructure and to expand resources across the campus.

2. Description of the program’s fit with the institutional mission and national trends.

Kennesaw State University’s Mission:

“Kennesaw State University is a comprehensive public university that serves primarily northwest Georgia and Atlanta. With nationally recognized liberal arts, professional, and continuing education programs, KSU offers exemplary disciplinary and interdisciplinary education at the baccalaureate, master’s specialist, and professional doctoral levels. KSU’s students prosper in a supportive environment with faculty, staff,
and administrators who are vitally engaged in student life. KSU's academic programs are collaborative and creative, emphasizing both the development and application of knowledge. The KSU community values and promotes integrity, global awareness, technological literacy, diversity, and lifelong learning.

In keeping with the University’s interdisciplinary mission, the Master’s of Integrative Biology Program will train graduate students to solve biological problems using knowledge from multiple fields. The choice of “Integrative Biology” also reflects the state of the sciences, which have gone through a period of training its students in specialization, but now require the ability of practitioners to work with others outside their discipline.

Biology operates on many hierarchical levels, from the set of reactions in a biochemical pathway through the effect that organisms have on global climate. To fully understand organisms from the micro to macro scales requires that the biologist be versed in several disciplines (physics, chemistry, mathematics, geology, climatology, biology) and the functional and organismal sub-disciplines within the field (microbiology, ecology, zoology, botany, behavioral biology, genetics, etc.). From the scientific revolution in the mid-16th century, the typical scientist was versed in many areas of science. The contributions made by such giants as da Vinci, Hooke, Newton, Lavoisier, Pasteur, Spallanzani and Darwin exceeded a single discipline. However by the late 19th century and into the 20th century, knowledge expanded at an exponential rate. No individual could master all disciplines, so reductionism and specialization began to replace the broader-based approach. A focus on a narrow area resulted in greater productivity and a modern approach. This trend is evidenced by the splitting of Biology Departments into sub-disciplines such as Departments of Microbiology, Botany, Zoology or Animal Sciences, Cell and Molecular or Biochemistry and Physiology. Although most undergraduate biology programs continue to maintain a more integrative approach by including physics, chemistry, mathematics and various sub-disciplines in biology, the graduate programs train in specialized areas. The problem with specialization is that biologists are finding it more difficult to talk to each other, unable to understand the information coming from other sub-fields and how it integrates into the various levels.

Because of the rapid accumulation of new knowledge and new techniques, the modern biologist cannot be the “Renaissance” person of old. Instead of one person mastering several fields, research can be redesigned such that several people bring their specialized areas and integrate it into a common focus. This move toward coherence is the objective of integrative biology and is important for 21st century biology. Evidence for the trend appears in the establishment of Departments and Programs of Integrative Biology, funding agencies that stress integrative science and new societies and journals that espouse integrative biology. In the United States, several universities have combined Departments representing various areas of biology into a single Department of Integrative Biology. The University of California at Berkley, University of Texas (Austin and other branches), University of Illinois, University of South Florida, Florida Atlantic University, Brigham Young University, Michigan State University and the University of
Massachusetts have recently reorganized to form undergraduate and/or graduate programs in Integrative Biology. Several universities in Canada, Europe and India have maintained or developed integrative programs. Many graduate institutions including those at medical schools have created integrative programs around a major research area such as cancer biology, evolution and development, physiology, neurobiology and infectious diseases.

The National Science Foundation, National Institutes of Health and National Cancer Institutes of Health have program areas that emphasize integrative aspects of research. For example, the NIH currently sponsors a program on integrative research into obesity, and another on infectious diseases. Because obesity is a complex problem with possible genetic, physiological and/or cultural/behavioral causes, to understand it requires investigation from the molecular to social scales. The same is true for infectious disease. When a new disease emerges in the population or an old disease reemerges, the Centers for Disease Control and Prevention assemble a team of microbiologists, physicians, nurses, anthropologists, ecologists, statisticians/epidemiologists, politicians and others. Through past experience it has become evident that infectious diseases require an integrative approach to understand why an epidemic has occurred and how to stop it.

Currently, the NSF has a Division of Integrative and Organismal Systems that supports integrative research on organisms and recognizes that “understanding these emergent, systems properties of organisms requires integrative, interdisciplinary approaches. The Division encourages proposals that include analyses across multiple levels of biological organization, from molecular through ecological, theoretical as well as advanced computational techniques, and interdisciplinary collaborations involving scientists from all areas of biology, behavioral science, physical science, mathematics, engineering, and computer science.” In addition, the NSF supports a variety of diverse, integrative projects such as Integrative Biology and Adaptation of Antarctic Marine Organisms, Quantitative Environmental and Integrative Biology, Integrative Biology and Neuroscience, and Integrative Graduate Education and Research Training in Computational Biology. An integrative approach is central in NSF’s “Investment Priorities” for research (bulleted text below taken from the National Science Foundation Investing in America’s Future: Strategic Plan FY 2006-2011):

- **Promote transformational, multidisciplinary research.** NSF will emphasize investigations that cross disciplinary boundaries and require a systems approach to address complex problems (e.g., the neural basis of behavior, natural hazards and grid technologies) at the frontiers of discovery.

- **Investigate the human and social dimensions of new knowledge and technology.** NSF will integrate research on ethics, safety considerations and virtual communities from the outset in new research and in the applications of emerging technologies.

- **Further U.S. economic competitiveness.** NSF has a major role in the ACI (President’s America’s Competitive Initiative). We will invest in basic research and in the tools of science to focus on fundamental discoveries that could have the potential to produce economically important technologies, processes, and techniques.
• **Foster research that improves our ability to live sustainably on Earth.** To strengthen our understanding of the links between human behavior and natural processes, research may range from investigations of deep oceans to urban centers and from basic energy science to climate science.

• **Advance fundamental research in computational science and engineering, and in fundamental, applied and interdisciplinary mathematics and statistics.** Beyond accelerating disciplinary progress, investments in these fields are needed to drive discovery in every science and engineering discipline and to power

In addition to the NSF’s funding goals for the future, current funding by the NSF reflects the need for integrative approaches. Using the general search word “biology” for the funding database at the NSF resulted in more than 50% of descriptions containing integration across some level (e.g. integration between cell biology, genetics, developmental biology, neuroscience, ecology and evolution; integration across mathematics and biology; interdisciplinary training requirements; metabolism, development and cellular biology integration). Furthermore, funding search results using the search terms “integrative” and “biology” and limiting the search to standard and continuing grants display 91 matching programs within NSF, including those directly targeted towards integration (e.g. within behavioral sciences; within the functional and regulatory systems cluster; integrative carbon cycle research cluster, biocomplexity in the environment cluster, frontiers in integrative biological research, among others). Excluding archived grants, grants for which our institution is not eligible, and those that clearly did not fit our existing or potential research, resulted in the following breakdown:

<table>
<thead>
<tr>
<th>Grant category</th>
<th>Number of grants</th>
<th>Total Budget</th>
<th>Award Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research infrastructure grants (for instrumentation or collaborative networks)</td>
<td>9</td>
<td>$571,500,000</td>
<td>$100,000 to 30,000,000</td>
</tr>
<tr>
<td>Research personnel grants (for promoting minorities and women in the graduate sciences, including faculty)</td>
<td>4</td>
<td>minimum of $43,000,000 (one grant did not specify a total budget)</td>
<td>$312,500 to 987,000</td>
</tr>
<tr>
<td>Research project grants</td>
<td>8</td>
<td>$107,000,000</td>
<td>$66,000 to 1,300,000</td>
</tr>
<tr>
<td>All grants</td>
<td>21</td>
<td>$721,500,000</td>
<td>$66,000 to 30,000,000</td>
</tr>
</tbody>
</table>

In the past decade, no fewer than five journals have been established for integrative biology. *Integrative Biology* is a journal that advertises itself as “a new journal of
quantitative biosciences from nano to macro”. Other science journals centered on integrative biology include *A Journal of Integrative Biology*, *Communicative and Integrative Biology*, *International Journal of Integrative Biology*, and *Journal of Integrative Plant Biology*. Scientific groups such as The Society for Integrative and Comparative Biology have formed to gather researchers in specialized areas into a connected group. Other established societies such as The American Physiological Society with its by-line of “Integrating the Life Sciences from Molecules to Organisms” offers themed programs such as *The Integrative Biology of Exercise*. There is also the International Society of Integrative Biology, established in 2007, which is “dedicated to the enhancement of biomedical and biological science for the improvement of health and quality of life in the community through education, cooperation and international collaborative research.”

The MIB program proposed here is designed to prepare students to address scientific questions that span traditional boundaries of scale within biology or across disciplines, and thus be able to integrate content across biological or academic disciplines. This master’s program directly fits KSU’s institutional mission of offering exemplary disciplinary and interdisciplinary education and supports KSU’s commitment to providing a challenging and facilitative collegiate environment, as well as fostering high-quality academic preparation and critical thinking. The MIB program will promote the university’s mission of preparing highly qualified graduates capable of providing the professional skills and leadership needed to leverage opportunities in life sciences and biotechnology.

3. **Description of how the program demonstrates demand and a justification of need in the discipline and geographic area.**

   The program proposed here would be the first in Georgia (the only similar programs are an undergraduate certificate offered by Georgia Tech and a specialized Biology M.S. Program with Interdisciplinary Emphasis in Bioinformatics at Georgia State) and will help KSU establish its niche within USG graduate programs in the biological sciences. Only eight institutions within the USG system presently offer graduate degrees in the biological sciences, and one in biotechnology; only three of Georgia’s private education institutions offer a graduate program in biology and/or biomedical science. There are no Georgia institutions north of metro Atlanta, public or private, that offer graduate degrees in the biological sciences or in biotechnology.

   Master of Science in Integrative Biology graduates would be attractive to a wide range of potential employers and collaborators. Their training would equip them to address a range of global problems in health and medicine, environmental issues, resource management and sustainability, as well as participate in new opportunities continuously
emerging from the national and international research community. Opportunities for MIB graduates are present in four primary areas: industry, government, education, and non-profit organizations. Some of these areas are integrative by their very nature and would benefit from more broadly educated MIB graduates. For example, areas in the biotechnology industry such as pharmaceutical/biomedical, food and agricultural biotech, and medical device manufacturing require people who can approach problems from different perspectives. Similarly, solving current environmental problems (e.g., biodiversity crisis, climate change, alternative energy) also requires people with advanced training in the biological sciences and broad conceptual knowledge in numerous disciplines. By acquiring an integrative perspective, graduates will have opportunities at the state, regional, and national levels.

**State:** Georgia is poised to grow in the biological and biotechnology fields and is making an effort to raise its profile in these areas. An integrative master’s degree program will provide a different kind of graduate who is well prepared to take advantage of this growth, enriching the workforce available to existing companies and ultimately promoting Georgia’s ability to recruit companies from outside the state.

Georgia is home to more than 300 bioscience companies. These companies are supported through a large network of institutions and organizations, including the Georgia Research Alliance, Georgia Bio, Georgia Cancer Coalition, and the Georgia Intellectual Capital Partnership program. Specifically, Georgia Bio—the Life Sciences Partnership is a private, non-profit association representing the life sciences industry in Georgia. Its members include pharmaceutical, biotech and medical device companies, universities, research institutes, government groups and other business organizations involved in the development of products that improve healthcare, agriculture, industrial and bioenergy production and environmental management. Currently the bioscience industry has 18,000 employees. Including the public sector doubles the number to 33,000. From 2006-2007, the number of life sciences firms grew almost twice as fast as the number of firms in all industries. Life sciences firms rose by 6.3 percent compared to 3.4 percent for all industries. This recent growth in bioscience companies outpaced other industries in Georgia and is expected to continue to do so in the future.

The state government actively seeks to increase the number of individuals suitable for entry-level biotech jobs by supporting biotechnology programs in high schools (e.g., South Cobb biotechnology program) and at the two-year college level. Increasing this number will also require individuals with the graduate training to assume managerial, research and development roles. An integrative master’s degree program will provide the individuals with advanced degrees and a range of training needed to fulfill these upper-level roles.

**Region:** The expansion of the Life Sciences—as an academic discipline and a sector of the economy—and current demographic trends will increase KSU’s footprint in the region and our capacity to participate in state economic development. Regional
partnerships will provide job opportunities for graduates as well as opportunities in Georgia for activities with enterprises in neighboring states.

Georgia is competitive for attracting Life Sciences industries into the state. However, the availability of jobs and the pool of qualified applicants in Georgia lags behind those found in North Carolina and Florida. Florida has approximately twice the number of companies in this sector as Georgia, and is continuing to aggressively develop this area. North Carolina has also been proactive in fostering life sciences industries and both states have invested more heavily than Georgia. Part of this investment has come through development of university systems. North Carolina has five public University campuses with at least 18 doctoral programs, Duke is internationally recognized, and Wake Forest is rapidly developing. Florida has eight universities in the high to very high Carnegie classification scheme. Georgia only has five such campuses, including Clark Atlanta University (but not Medical College of Georgia). Kennesaw State University can help Georgia establish and grow its workforce of individuals trained in the Life Sciences.

Kennesaw State University is currently classified as a state university, in the same category as North Georgia College, Savannah State University and University of West Georgia, and is currently approaching expectations for more research-oriented institutions such as Georgia Southern University and Valdosta State University. However, in comparison to these other institutions, KSU’s location as a north metropolitan university can give its Master’s students resources unique to the local area. Kennesaw is in the “Innovation Crescent,” the area of 10 counties stretching from Athens to metro Atlanta where the biotechnology industry of Georgia is concentrated. Leading Life Sciences companies in the Crescent include CIBA Vision, UCB Inc, Merial Ltd, Abbott Laboratories, Kimberly-Clark Health Care, Immucor Inc., and CryoLife Inc. In particular, CryoLife Inc. specializes in biological devices and the processing and preservation of human cardiac and vascular homografts. It is less than four miles from the Kennesaw campus and has a strong history of taking Kennesaw students as interns and employees. Kennesaw is also within easy driving distance to Atlanta and less than 30 miles to the U.S. Centers for Disease Control and Prevention (CDC). A constant stream of students from the KSU Department of Biology and Physics take their internships at the CDC and many of those students continue on as full-time employees after graduation. Atlanta is also home to the headquarters of several nonprofit global health organizations including the American Cancer Society, the Carter Center (with its global health programs), and the Arthritis Foundation.

In comparison to graduate research universities such as Georgia Tech and Georgia State, which are located in downtown Atlanta, Kennesaw State is the only USG institution with the physical potential to absorb the tremendous growth of students expected to continue into the USG system. The 2003 analysis of system capacity by the Board of Regents projects a 57% expansion until 2020. Most of the projected population growth and

2 Innovation Crescent includes City of Atlanta, Athens-Clarke County, Barrow, Clayton, Cobb, DeKalb, Gwinnett, North Fulton, Jackson, Oconee, and Oglethorpe Counties. More information may be found at http://www.innovationcrescent.com/life.htm.
university cohort growth in Georgia will occur in Atlanta and the Atlanta area USG campuses. Kennesaw State University is the third largest university in Georgia and approximately the 60th largest in the United States (single campus comparison). We are projected to grow to 35-40,000 students over the next decade (SASAKI survey). It appears inevitable that KSU will become a very large regional institution; arguably, it has already reached this position. According to the 2009 data of the National Center for Education Statistics, only 19 university campuses in the United States have 30,000 students. It is likely that by 2020 KSU will be one of the twenty largest university campuses in the United States by enrollment. This continued expansion will bring increased opportunities for interaction with neighboring scientific centers such as the Research Triangle Park in North Carolina. Coupling graduate level research with Kennesaw’s growth into one of the largest universities in the South will bring immense profit to all—students, KSU, the University System, and the state of Georgia.

National: Interdisciplinary science discovery is recognized and funded by the NSF as necessary for the nation’s growth. Similarly, the need for advanced degrees in the biological sciences is expected to grow as the market for college-level educators increases (U.S. Dept. Labor).

As stated by the National Science Foundation in its 2006-2011 Strategic Plan and 2009 Budget Request to Congress, science discovery “increasingly requires the expertise of individuals with different perspectives—from different disciplines …working together to accommodate the extraordinary complexity of today’s science and engineering challenges”. The NSF lists interdisciplinary research among its investment priorities, in response to the President’s American Competitiveness Initiatives and its call for furthering the economic competitiveness of the US; “The NSF will emphasize investigations that cross disciplinary boundaries and require a systems approach to address complex problems.” The NSF also lists research in environmental sustainability among its priorities, greatly expanding a research-based environmental sector that will require individuals with the appropriate training over the next decades.

In education, the market for teaching positions in post-secondary institutions is also expected to grow 16% by the year 2016, much faster than all other occupations. This is due to the increased need for college-educated people and the workforce to instruct them. As stated in the employment outlook for individuals in the biological sciences (Department of Labor, 2006-2011 projections), “Opportunities for master’s degree holders are…. expected to be favorable because there will be considerable growth at community colleges, career education programs, and other institutions that employ them” and “Preference also may be given to those holding dual master’s degrees, especially at smaller institutions, because they can teach more subjects.” Holders of degrees in Integrative Biology may enjoy a similar advantage, being versed in more than one subject or sub-discipline.

An increased demand for broadly trained environmental scientists began with the Obama administration’s focus on renewable energy and sustainable development. The need for these professionals is highlighted by the BP Gulf oil spill, which is likely to result in
increased enforcement of environmental regulations or the creation of new ones. Both the
government (e.g. GA Department of Natural Resources) and private companies will need
to hire interdisciplinary ecologists and environmental scientists in order to comply with
regulations while still allowing economic recovery and growth. Further, the 2009 federal
ruling in the Water Rights litigation between Georgia, Florida, and Alabama (returning
Lake Lanier water release to that of the mid-1970’s) highlights a local need for
interdisciplinary ecologists/environmental scientists, as Metro Atlanta and the State of
Georgia respond to this challenge. According to the Bureau of Labor Statistics,
“employment of environmental scientists and specialists is expected to increase by 28%
between 2008 and 2018, much faster than the 10% average for all occupations. Job
growth should be strongest in private-sector consulting firms. Growth in employment will
be spurred largely by the increasing demands placed on the environment by population
growth and increasing awareness of the problems caused by environmental degradation.”

The demand for biotechnology and cell-molecular oriented questions will continue as
federal institutions like the NSF and the NIH continue in their mandate to promote
medicine, national health, and a deeper understanding of biological mechanisms.
Broadly, the biotechnology industry can be divided into sectors, the best known being the
pharmaceutical/biomedical area. Other important areas include agricultural biotech,
medical devices, diagnostics and medical supplies, contract laboratory services,
laboratory reagents and services, and areas related to the chemical industry. Emerging
areas include biofuels, development of novel catalysts, waste treatment, and mineral
processing. Many of these sectors are already represented in Georgia. Biologists are
required in many other industries, including the food industry, where production of wine,
cheese and other processed foods are ancient areas of biotechnology. Government at all
levels requires people with advanced biology training and broad conceptual knowledge.
The Bureau of Labor Statistics projects a 21% job growth in this industry for 2008-2018,
much higher than the average 10% of all other occupations. Letters of support from
industry and agencies are included in Appendix E.

4. Brief description of institutional
resources that will be used for the program

The MIB program will mainly be supported by current faculty and by the additional faculty
lines that will undoubtedly be requested to maintain the growth of the department given KSU’s
projected growth. All research-active faculty in the department are potentially eligible to teach
graduate courses and direct student thesis projects (participating faculty will be required to
meet standards for Graduate Faculty Status as determined the Graduate College). The
department already uses the “research-active faculty” model to reduce teaching hours and
research-active faculty status is determined by demonstrated scholarly output.

Twelve graduate assistantships are requested. Because teaching assistantships will cover
teaching hours required by the graduate program, there will be no additional teaching loads to
faculty as a result of the graduate program. A faculty coordinator position will be requested
beginning the first year of the program to supervise teaching assistants and to perform other administrative duties associated with the program.

No increases in library resources are requested. Strategies for acquisitions from general budget increases in the future will include journal subscriptions and books that are specifically in the field of integrative biology or critical in supporting current research in subdisciplines within biology. Funds for supplies and expenses in classes with laboratories will come from student lab fees as are currently implemented for all students participating in lab courses offered by the department.

A 64,000 ft² laboratory wing for the Department of Biology and Physics and Department of Chemistry is scheduled to be completed by Fall 2012. Existing laboratories and additional laboratories in the new science lab wing will be sufficient to accommodate graduate lab courses (~one per semester). No major capital expenses are envisioned for the graduate program itself, though additional funds are likely to be sought for renovations of the original lab building that will also support the proposed graduate program. One of the project objectives for the new wing is to build “competitive master’s degree programs in the sciences”. The planned lab wing includes space for graduate student cubicles, and the lab wing will help to relieve present space limitation on research space in faculty research labs.

No significant changes in institutional resource needs are anticipated between program start-up and the time when the program undergoes its first comprehensive program review.

5. Curriculum

a. Courses

The following graduate-level courses are chosen based on their integrative nature across fields of study, and will be developed and offered over a 2-year schedule:

- Advanced Evolutionary Analysis – BIOL 6413 - 3 credits
- Professional Aspects in Biology* - BIOL 7100 - 3 credits
- Integrative Biology* - BIOL 7200 - 3 credits
- Research Methods across Biology* – BIOL 7300 - 4 credits
- Ecological Physiology – BIOL 7333 - 4 credits
- Multidisciplinary Approaches to Ecological Questions – BIOL 7400 - 3 credits
- Molecular and Microbial Approaches to Pathogenesis - BIOL 7478 - 3 credits
- Current Topics in Integrative Biology Seminar* - BIOL 7500 - 1 credit
- Cell Signaling – BIOL 7634 - 3 credits
- Computational Biology – BIOL 7638 - 3 credits
- Research for Master’s Thesis* – BIOL 7990 – 1 to 9 credits

*required courses
The following courses are considered to be integrative in nature and will be cross-listed (with additional requirements for graduate credit):

- **Comparative Vertebrate Anatomy** – BIOL 4350/ BIOL 6350 (4 credit hours)
- **Cell and Molecular Biology** – BIOL 4410/ BIOL 6410 (3 credit hours)
- **Plant Physiology** – BIOL 4420/Biol 6420 (4 credit hours)
- **Plant Ecology** – BIOL 4422/ BIOL 6422 (4 credit hours)
- **Medical microbiology** – BIOL 4460/ BIOL 6460 (4 credit hours)
- **Virology** – BIOL 4475/ BIOL 6475 (3 credit hours)
- **Bioethics*** – BIOL 4486/ BIOL 6486 (3 credit hours)
- **Special Topics in Biology*** - BIOL 4490/ BIOL 6490 (1-4 credit hours) – topics recently taught under this course number are considered integrative and include Bioinformatics, Conservation Genetics, Restoration Ecology, and Cancer Biology
- **Molecular Genetics** BTEC 4100/6100 (3 credit hours)
- **Diagnostic Microbiology**– BTEC 4800/6800 (3 credit hours)

* presently cross-listed as a graduate level course

The following graduate courses outside of the department are considered to be appropriate electives for Integrative Biology:

- **Design and Analysis of Human Studies** (epidemiology) - STAT 8125
- **Advanced Topics in Biochemistry** - CHEM 6510 (3 credit hours)
- **Introduction to Bio-Informatics** - CS 8550 (3 credit hours)
- Any other graduate level course that is deemed appropriate by the student’s thesis committee. The Department of Chemistry is presently developing a Master’s degree with an emphasis in biological chemistry.
Course offering schedule:

<table>
<thead>
<tr>
<th>Fall</th>
<th>Spring</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Methods across Biology*</td>
<td>Integrative Biology*</td>
<td>Research Methods across Biology *</td>
<td>Integrative Biology*</td>
</tr>
<tr>
<td>Professional Aspects in Biology*</td>
<td>Ecological Physiology</td>
<td>Professional Aspects in Biology*</td>
<td>Microbial and Molecular Pathogenesis</td>
</tr>
<tr>
<td>Computational Biology</td>
<td>Cell Signaling</td>
<td>Multidisciplinary Approaches to Ecological Questions</td>
<td>Advanced Evolutionary Analysis</td>
</tr>
<tr>
<td>Graduate Seminar*</td>
<td>Graduate Seminar*</td>
<td>Graduate Seminar*</td>
<td>Graduate Seminar*</td>
</tr>
<tr>
<td>Research for Master’s Thesis</td>
<td>Research for Master’s Thesis</td>
<td>Research for Master’s Thesis</td>
<td>Research for Master’s Thesis</td>
</tr>
</tbody>
</table>

*required courses

Sample program of study that would be followed by a representative student:

<table>
<thead>
<tr>
<th>Fall</th>
<th>Spring</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Methods across Biology *</td>
<td>Integrative Biology*</td>
<td>Multidisciplinary Approaches to Ecological Questions</td>
<td>Microbial and Molecular Pathogenesis</td>
</tr>
<tr>
<td>4 credits</td>
<td>3 credits</td>
<td>3 credits</td>
<td>3 credits</td>
</tr>
<tr>
<td>Professional Aspects in Biology*</td>
<td>Ecological Physiology</td>
<td>Any 6000-level course</td>
<td>Graduate Seminar*</td>
</tr>
<tr>
<td>3 credits</td>
<td>4 credits</td>
<td>3 credits</td>
<td>1 credit</td>
</tr>
<tr>
<td>Graduate Seminar*</td>
<td></td>
<td>Graduate Seminar*</td>
<td></td>
</tr>
<tr>
<td>1 credit</td>
<td></td>
<td>Graduate Seminar*</td>
<td></td>
</tr>
<tr>
<td>Research for Master’s Thesis</td>
<td>Research for Master’s Thesis</td>
<td>Research for Master’s Thesis</td>
<td>Research for Master’s Thesis</td>
</tr>
<tr>
<td>1 credit</td>
<td>2 credits</td>
<td>3 credits</td>
<td>5 credits</td>
</tr>
<tr>
<td>9 credits</td>
<td>9 credits</td>
<td>9 credits</td>
<td>9 credits</td>
</tr>
</tbody>
</table>

*required courses
In addition to a thesis generated by original research, the degree will require 36 credit hours total: 11 credit hours Thesis Research, 12 credit hours of required graduate courses (including 2 Graduate Seminar experiences), and another 13 credit hours of graduate-level electives (maximum of two 6000 level courses can be applied toward the degree). Maximum credit applicable toward degree for Research for Master’s Thesis hours is eleven.

b. **Course descriptions and prerequisites**
See Appendix A

c. **Documentation that all courses meet institutional requirements.**
See Appendix F

d. **Accrediting agencies**
Not Applicable

e. **National standards**
There are no specialized or professional accreditation standards for Biology graduate programs. As described in sections 1-3 (above), this program addresses national needs as described by the National Science Foundation and is designed to be competitive with the best programs at comparable state institutions.

f. **Internships or field experiences**
Not applicable.

g. **Adequacy of core offerings to support the new program**
The master’s program in Integrative Biology will offer three introductory courses on a yearly basis, the graduate seminar each semester, and the five other graduate courses developed for the program and offered every other year (see Course Offering Schedule in Section 5). All designated undergraduate courses that will be cross-listed as graduate courses (Section 5) are presently offered on a regular basis.

6. **Admissions criteria**
Students will be selected on a competitive basis. Meeting minimum requirements does not guarantee admission. The applicant must meet the following criteria to be considered for acceptance:
- Completed requirements for the bachelor degree in a college accredited by the proper regional accrediting associations. Adequately prepared applicants will typically have completed at least 5 college-level biology courses (including introductory biology courses, ecology, genetics and evolution), 9 hours of
mathematics, 16 hours of chemistry (including organic chemistry), and 8 hours of physics (or geological science).

- A score of at least 1000 (combined math and verbal) on the Graduate Record Examination (GRE)
- A grade point average of at least 3.0 (on a 4.0 scale)
- Two letters of recommendation from persons familiar with the applicant's potential to complete successful graduate work.

International students that may have matriculated from oversea institutions that employ different methods of evaluation from those of U.S. institutions in terms of GPA and accreditations must meet the requirements set forth by the university. If the applicant’s first language is not English, then they must score a minimum of 80 on the TOEFL test. All students with international transcripts must have their transcripts evaluated by a National Association of Credential Evaluation Services accredited evaluation agency. Applicants must also have an F1 student visa and appropriate documents (including sponsor letter and bank letter showing at least $26,000).

7. Availability of assistantships

Twelve teaching assistantships will be available each year. Depending on availability of funding from other sources (e.g. external grants to mentoring faculty) some students may not need teaching assistantship in either year of their program, allowing more students to hold TA positions over both the first and second year in their program. However, it is possible that teaching assistantships will not be available for some students in the second year of their program. Students in the second year of their program, in collaboration with their major professors, will be encouraged to seek other sources of funding for support. The salaries for the twelve teaching assistantships are justified by differences in the costs of teaching between faculty and teaching assistants (see Section 14 and Appendix C).

8. Student learning outcomes

Goal 1: Students who successfully complete a Master of Science in Integrative Biology at KSU will gain a deep understanding of Integrative Biology

Objective 1: MIB students will be able to communicate and explain content and concepts across the biological sciences, displaying a broad mastery of the field.

Objective 2: MIB students will be able to integrate content, concepts, and data across scales within biology and/or across academic disciplines outside of biology.

Assessment Method: Each student will be expected to complete a written comprehensive examination for graduation that will include embedded questions in addition to committee questions. These embedded questions will be categorized by biological subdiscipline and selected to ensure that there is broad coverage of the biological sciences as well as a capacity for cross-disciplinary integration. As a thesis-focused graduate degree, the assessment for Objective 2 will include the quality of students’ formal theses as well as the oral thesis defenses.
Assessment Process: The student’s advisory committee will be responsible for selecting questions from the embedded, categorized pool. The Biology and Physics Graduate Advisory Committee and the Biology and Physics Course Curriculum Committee will build the questions, develop scoring rubrics, and determine appropriate success benchmarks. The student’s advisory committee will be responsible for scoring each of the embedded questions and reporting the results to the Graduate Degree Coordinator who will collect performance data and monitor the progress of students, revising the degree program to ensure success on this assessment.

**Goal 2:** Students who successfully complete a Master of Science in Integrative at KSU will be highly proficient doing scientific research.

**Objective 1:** MIB students will be able to critically evaluate the scientific literature.

**Objective 2:** MIB students will be able to generate novel hypotheses.

**Objective 3:** MIB students will be able to construct the appropriate experiments to test a hypothesis.

**Objective 4:** MIB students will be able to gather and analyze data to answer scientific questions.

**Objective 5:** MIB students will be able to publish results in a scientific journal.

**Assessment Method:** As a thesis-focused graduate degree, the assessment for these objectives will be the quality of students’ formal theses as well as the oral thesis defenses. Students will also submit any presentations from professional conferences as additional evidence of having attained these objectives.

**Assessment Process:** A research portfolio of each student will be maintained by the Graduate Degree Coordinator and necessary modifications to the degree program will be made in consultation with The Biology and Physics Graduate Advisory Committee and the Biology and Physics Course Curriculum Committee.

**Goal 3:** Students who successfully complete a Master of Science in Integrative Biology at KSU will be competitive in the intellectual marketplace post-graduation.

**Objective 1:** Graduating students will successfully obtain positions with employers or other academic institutions that further their career goals.

**Objective 2:** Private sector and/or academic supervisors who accept our students will be satisfied with the level of preparation offered by our degree program.

**Assessment Method:** These objectives will be tracked using a combination of graduate exit surveys, alumni tracking, and supervisor surveys. These will be designed to ensure we can follow graduating students for a minimum of 6 years and determine their career paths during that time. In addition, supervisor surveys will present a slate of questions that evaluate multiple aspects of our degree program.

**Assessment Process:** The Graduate Degree Coordinator, in consultation with the Biology and Physics Graduate Advisory Committee, will build the surveys the first year to ensure broad, useful coverage of the degree program. The Graduate Degree Coordinator along with the student’s major advisor will be responsible for ensuring completion of the exit survey and tracking the student post-graduation. The Graduate Degree Coordinator, in consultation with the Biology and Physics
Graduate Advisory Committee will initiate changes to the degree program to deal with any deficiencies.

**Goal 4:** The Master of Science in Integrative Biology will enhance the scholarship potential and national recognition of KSU’s department of Biology and Physics.

*Objective 1:* The MIB program will increase the publication record of the department.

*Objective 2:* The MIB program will increase the presentation record of the department.

*Objective 3:* The MIB program will increase the external funding obtained by the department.

*Objective 4:* The MIB program will increase the ability of the department to retain new faculty.

**Assessment Methods:** The direct measures of productivity in these areas are already collected by the departmental staff. In addition to these measures, a graduate faculty survey will be conducted every 3 years to assess departmental conditions for continuing to improve scholarship and national recognition.

**Assessment Process:** Faculty in the MIB program will ensure that appropriate data is forwarded to the departmental staff who will collect the data for dissemination. The Graduate Degree Coordinator, in consultation with the Biology and Physics Graduate Advisory Committee, will build the intra-departmental survey, administer it, and process the data. Any necessary changes will be pursued with appropriate university administration and faculty colleagues.

**Goal 5:** The Master of Science in Integrative Biology will expand the interdisciplinary cooperation among KSU departments.

*Objective 1:* The MIB program will stimulate an increase in the faculty research collaborations among KSU departments.

*Objective 2:* The MIB program will stimulate an increase in the graduate-level course offerings by related degree programs.

**Assessment Method:** As part of the graduate faculty survey, data will be collected on potential collaborations with interested faculty outside the department. In addition, publications, presentations, and external funding in collaboration with faculty from outside the department will be tracked to measure the success of the program.

**Assessment Process:** Faculty in the MIB program will ensure that appropriate data is forwarded to the departmental staff who will collect the data for dissemination. The Graduate Degree Coordinator, in consultation with the Biology and Physics Graduate Advisory Committee, will build the intra-departmental survey, administer it, and process the data. Any necessary changes will be pursued with appropriate university administration and faculty colleagues.
9. Administration of the program:

a. Indicate where the program will be housed within the academic units of the institution.
   Department of Biology and Physics within the College of Science and Mathematics

b. Describe the administration of the program inclusive of coordination and responsibility.
   The Coordinator of the Master of Science in Integrative Biology Program will be included in a departmental team that plans and evaluates the progress of graduate students. Also, solving critical problems that may arise within the program will be a part of the Coordinators duties. The Coordinator will be the resource person who enables faculty to focus on their roles as mentors. The main responsibilities of this position will be to develop and implement strategies, procedures, and indexes that support the promotion, admission, advising, assistantships, enrollment and forecasting of the Master of Science in Integrative Biology program. The Coordinator will report directly to the Department Chair. The Coordinator will work very closely with the admissions officer and degree auditor to ensure that standard procedures are followed. The Coordinator will be the liaison person for both student and faculty. The coordinator is expected to:
   • Manage staff and student workers in relation to the program
   • Be involved in strategic planning for program growth, positioning, and marketing
   • Engage directly with current and prospective students as needed
• Act as primary author of policies and procedures pertaining to the program
• Serve as a liaison between program and key partners including the Faculty, Staff, Other Departments, Registrar, Alumni Relations and community partners.

The graduate coordinator position will be a Ph.D. faculty line with reduced teaching load and scholarship expectations providing "reassigned time" for the administrative duties associated with the graduate program.

10. Waiver to Degree-Credit Hour
Not applicable; the proposed degree will require 36 credit hours total.

11. Accreditation
Because KSU already offers undergraduate programs in Biology and Biotechnology as well as master’s level programs in Biology and Physics (MAT programs), the development of a master’s degree in Biology & Physic would not require additional SACS accreditation approval. SACS only needs to be notified of the new program once it has been approved by the BOR.

12. Projected enrollment

<table>
<thead>
<tr>
<th>Year</th>
<th>Implementation year</th>
<th>2nd year</th>
<th>3rd year</th>
<th>4th year</th>
</tr>
</thead>
<tbody>
<tr>
<td>New students admitted</td>
<td>6</td>
<td>6</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Continuing students</td>
<td>0</td>
<td>6</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Total enrollment</td>
<td>6</td>
<td>12</td>
<td>16</td>
<td>20</td>
</tr>
<tr>
<td>Graduating students</td>
<td>0</td>
<td>6</td>
<td>6</td>
<td>10</td>
</tr>
</tbody>
</table>

Enrollments will not be cohort-based.

13. Faculty

a. Inventory of faculty directly involved with the administration of the program

<table>
<thead>
<tr>
<th>Faculty Name</th>
<th>Rank</th>
<th>Highest Degree</th>
<th>Degrees Earned</th>
<th>Academic Discipline</th>
<th>Current Workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Premila Achar</td>
<td>Associate Professor of Biotechnology</td>
<td>Ph.D</td>
<td>BS, MS, M Phil. Ph.D.</td>
<td>Fungal/microbial interactions</td>
<td>9,9</td>
</tr>
<tr>
<td>Name</td>
<td>Title</td>
<td>Degree</td>
<td>Major Areas of Research</td>
<td>Office Room</td>
<td></td>
</tr>
<tr>
<td>-----------------------</td>
<td>--------------------------------------------</td>
<td>--------</td>
<td>-----------------------------------------------------------------------------------------</td>
<td>-------------</td>
<td></td>
</tr>
<tr>
<td>Eric Albrecht</td>
<td>Assistant Professor of Biology</td>
<td>Ph.D.</td>
<td>Cellular Toxicology</td>
<td>7,9</td>
<td></td>
</tr>
<tr>
<td>Estella Chen</td>
<td>Assistant Professor of Biology</td>
<td>Ph.D.</td>
<td>Cancer Genetics</td>
<td>10,10</td>
<td></td>
</tr>
<tr>
<td>Marcus Davis</td>
<td>Assistant Professor of Biology</td>
<td>Ph.D.</td>
<td>Evolutionary Developmental Biology</td>
<td>9.9</td>
<td></td>
</tr>
<tr>
<td>Joseph Dirnberger</td>
<td>Professor of Biology</td>
<td>Ph.D.</td>
<td>Aquatic ecology, invertebrate zoology</td>
<td>15,13</td>
<td></td>
</tr>
<tr>
<td>William Ensign</td>
<td>Professor of Biology</td>
<td>Ph.D.</td>
<td>Aquatic ecology, Environmental monitoring</td>
<td>10,12</td>
<td></td>
</tr>
<tr>
<td>Sigurdur Greipsson</td>
<td>Associate Professor of Biology</td>
<td>Ph.D.</td>
<td>Bioremediation</td>
<td>12,9</td>
<td></td>
</tr>
<tr>
<td>Melanie Griffin</td>
<td>Assistant Professor of Biology</td>
<td>Ph.D.</td>
<td>Bacterial gene regulation</td>
<td>9,9</td>
<td></td>
</tr>
<tr>
<td>Xueya Hauge</td>
<td>Associate Professor of Biology</td>
<td>Ph.D.</td>
<td>Molecular and Human Genetics</td>
<td>13,9</td>
<td></td>
</tr>
<tr>
<td>Jerald D. Hendrix</td>
<td>Interim Chair &amp; Professor of Biology</td>
<td>Ph.D.</td>
<td>Bacterial Physiology and Taxonomy</td>
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<td>Paula Jackson</td>
<td>Associate Professor of Biology</td>
<td>Ph.D.</td>
<td>Plant physiology and ecology</td>
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<td>Nikolaos Kidonakis</td>
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<td>Ph.D.</td>
<td>Theoretical particle physics</td>
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<td>Matthew Laposata</td>
<td>Professor of Environmental Science</td>
<td>Ph.D.</td>
<td>Urban ecology, environmental science</td>
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<td>Theodore N. LaRosa</td>
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<td>Jean Lu</td>
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<td>Ph.D.</td>
<td>Microbial ecology and genetics</td>
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<td>Ron Matson</td>
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<td>Brent McDaniel</td>
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<td>Large-scale atmospheric dynamics</td>
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<td>Thomas McElroy</td>
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<td>Conservation Genetics, molecular ecology</td>
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<td>Donald McGarey</td>
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<td>Ph.D., BS, MS, Ph.D.</td>
<td>Applied and Environmental Microbiology, and Diagnostic Microbiology</td>
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<td>Troy Mutchler</td>
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<td>R.C. Paul</td>
<td>Director of Sustainability &amp; Professor of Biology</td>
<td>Ph.D., B.S., Ph.D.</td>
<td>Environmental Sustainability</td>
<td>Administration/teaching</td>
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<td>Scott Reese</td>
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<td>Comparative physiology</td>
<td>12, 9</td>
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<td>John Salerno</td>
<td>Professor of Biotechnology and Neel Distinguished Chair</td>
<td>Ph.D., BS, Ph.D.</td>
<td>Molecular modeling, cell signaling</td>
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<td>Heather Sutton</td>
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<td>Plant toxicology, Aquatic ecology</td>
<td>9,7</td>
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<td>Matthew Unwin</td>
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<td>Plant systematic, Economic botany</td>
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<td>Dale Lynn Vogelien</td>
<td>Professor of Biology</td>
<td>Ph.D., BS, MS, Ph.D.</td>
<td>Plant physiology, Environmental stress</td>
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<td>Jared Taglialatela</td>
<td>Assistant Professor of Biology</td>
<td>Ph.D., BA, Ph.D.</td>
<td>Primate behavior, neurobiology</td>
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<td>Martin Hudson</td>
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<tr>
<td>Jeremy Gulley</td>
<td>Assistant Professor of Physics</td>
<td>Ph.D., BS, Ph.D.</td>
<td>Computational Optics</td>
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Any of the above faculty that successfully applies for graduate faculty status will be eligible to serve as chair of a student’s thesis committee (major professor). The expertise and experience of KSU faculty are ideally suited for implementing a program in integrative biology (Appendix D). The integrative nature of this program builds upon the existing collaborative research efforts (research nuclei) within the department that involve interactions among faculty working at different levels of biological organization and within the different subdisciplines of the biological sciences (see Section 1c and Appendix D). Furthermore, the proposed Master of Science in Integrative Biology will encourage even more collaborative efforts not only among faculty within the department but with faculty in other disciplines (e.g., chemistry and mathematics) as well. Publication rate and external funding success are comparable to departments at other USG institutions that offer master’s degree programs (faculty in the Department of Biology and Physics have publish over 110 papers in refereed journals, and received $778,172 in external funding for research in biology over the last five years), and several KSU faculty have experience supervising graduate students (see Appendix D).

**Explanation of how workload will be impacted by the new program:**
Because scientific research is a labor intensive (field and lab work typically require hours of repetitious, hands-on data collection), benefits of having graduate students to assist in research is expected to largely offset hours required for thesis supervision.

The nature of laboratory class setting in college science teaching is especially well suited for the graduate student teaching, allowing graduate teaching assistantships to effectively relieve faculty teaching loads. Graduate student teaching assistants will cover partial teaching load reductions, allowing faculty contact hours to be redirected for teaching of graduate courses and for the Faculty Graduate Coordinator. For the graduate program to have no negative effect on current teaching loads, several assistantships (TAs) are required. An ideal number of 12 teaching assistantships, funded by the university each year (with the remainder of graduate student support coming from extramural funding), where TAs are expected to teach a minimum of 2 sections of labs in a given semester, results in a minimum of 72 contact hour reduction in the faculty teaching load for the department. Fifteen contact hours would be required to cover the new graduate courses leaving 57 contact hours of extra teaching time. This would allow 10-11 graduate faculty to have a reduced 9 contact hour teaching load without impacting the undergraduate degree program or increasing the teaching load of non-graduate faculty.

**Expected responsibilities in the program:**
All faculty listed above will potentially supervise thesis research of graduate students as major professors (faculty must obtain Graduate Faculty Status to be eligible) and serve on thesis committees of other students. A subset of this group (3-4 faculty per semester) will be enlisted to teach graduate courses.
b. New faculty needed to begin the program

Two new faculty will be requested to further support the graduate program. One of these new faculty hire will be requested at Year 1 of the program to support administration of the graduate program (see Section 9b). Faculty new hires will have sufficient experience to obtain Graduate Faculty Status, initiate a successful research program, be competitive in seeking funding, and mentor graduate students. Several new FTE positions have also been requested by the department, and are needed based on demand created by the rapid growth of the undergraduate biology program. The hiring strategy for areas of specialization is based in part on potential contributions such faculty will make to an integrative biology graduate program. Positions include a ecological modeler and a cell biologist for FY11 (searches in progress), and a population geneticist for FY12 (requested). Previously requested positions are not included in the following budget because these positions are needed to support the rapidly growing undergraduate program and will be needed regardless of whether the graduate program is approved or not.

14. Fiscal, Facilities, Enrollment Impact, and Estimated Budget

The most significant aspect of the proposed program is the graduate assistantship stipends. Graduate students are critical in the transition of the department toward a self-sustaining research program capable of competing for external funding, hence toward national recognition. Graduate students provide laboratory and field research skills and labor beyond what the principle researcher can provide alone. Among the pool of individuals who can fill this role (e.g. post-docs, lab technicians) graduate students are the most cost-efficient. In addition to the traditional role graduate students play in sustaining a research-based graduate program, they also receive educational training through their role teaching. Because laboratory sections used in college science teaching are particularly well suited for the use of graduate students as teachers, the 12 proposed teaching assistantships become a highly cost-effective way to free up faculty time, thereby enhancing the research potential within the college. The funds required for teaching assistants are 62% of the amount required for an assistant professor to teach the same number of contact hours (Appendix C). The expense of twelve teaching assistantships at $12,000 covering 72 contact hours per semester is over $200,000 per year less than would be required if future faculty positions are used to alleviate the rapid and continued growth in biology majors. Only 15 additional faculty contact hours per semester are needed to cover graduate level courses, allowing redirection of faculty workloads for research and grants writing. Furthermore, a portion of the 15 contact hours for teaching graduate courses will be covered by faculty hired specifically for the program (see below), and the cost
of these new hires can be subsidized by the savings generated by using graduate assistants to teach lower division laboratory sections. When revenues generated by the program are considered, the graduate program will come to save the university about $60,000 per year as the need to hire faculty for the undergraduate program is alleviated by teaching assistants (Appendix C). These savings should be reallocated back into expanding teaching assistant stipends.

The reassignment of faculty workloads from teaching to research will increase the potential for success in external funding, which will in turn provide funds for graduate research assistantships to support students in their second year of study. Despite the absence of a graduate program, the Department of Biology and Physics has obtained $778,172 in external funding for research over the last five years. In the same time period the number of funding requests (proposals written) has increased dramatically. The percentage of full time faculty involved in research has also increased, from 4% in 1997, out of 27 full time faculty members, to 41% in 2008 out of 40 full time faculty, and the percentage of research faculty is expected to continue to increase with new hires. As of November (2009), the dollar amount of pending funding for research-based biology proposals in this department was $5,451,581. Considering the past success and dramatic increase in research-based proposals submitted, it is certainly reasonable to expect an increase in external funding for the department. Not only is a graduate program likely to enhance funding success in general, but specifically the Master of Science in Integrative Biology program will be able to take advantage of funding programs that explicitly emphasize interdisciplinary and integrative approaches. Funding for integrative approaches is expected to increase as the NIH and NSF have indicated that these approaches are necessary for new solutions in biology (see Section 2).

The College of Science and Mathematics will reallocate $20,000 per year and the College of Graduate Studies $8,000 per year for the twelve teaching assistantships (totaling $144,000 per year). New funds that will be requested through the institution for teaching assistantships are the remainder, $44,000 the first year, and $116,000 each subsequent year. Graduate assistant stipends must reflect trends at peer and aspirational institutions to attract and retain quality students who contribute positively to achieving KSU’s strategic goal of promoting research and scholarship and enhancing external funding. Stipends of $12,000 per student for 9 months approach the range of stipend awards at comparable institutions (Appendix C).

The faculty position in the first year of the program is required primarily for administration of the graduate program (see Section 9b for duties). The faculty hired in the second year will mainly support teaching and research in the graduate program, reducing the impact associated with shifting some teaching assignment from the undergraduate to the graduate program.
Supplies and expenses for the teaching of graduate instructional labs will be generated from the student lab fees that are presently implemented for all laboratory courses within the department.

Student demand for this program is expected to be high given KSU’s strategic location within rapidly growing areas of greater Atlanta and northwest Georgia, and the university’s continued and projected increases in enrollment. In a Fall 2010 survey of KSU Biology majors, 150 of 226 students returning surveys responded “very likely” or “likely” when asked how likely they would be “to attend a Master’s program at KSU”. Of 226 students, 155 indicated that they would “very likely” or “likely” consider a program specifically in integrative biology at KSU. In addition, 89% of respondents indicated that they would be more likely “to consider pursuing a graduate degree if there was a Master’s program here at KSU”. The proposed program will admit an average of 10 students per year, so competition for admission is likely to be significant. Demand for the program is also expected to be driven by the “much faster than average job growth” for biological scientists (US Bureau of Labor Statistics Occupational Outlook Handbook 2010-11 Edition).
### I. ENROLLMENT PROJECTIONS

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<th></th>
<th>First Year FY 13</th>
<th>Second Year FY 14</th>
<th>Third Year FY 15</th>
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<th>Fifth Year FY 17</th>
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### II. EXPENDITURES

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<td><strong>Personnel – reassigned or existing positions</strong></td>
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<td>Faculty</td>
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<td>Part-time Faculty</td>
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<td>Graduate Assistants</td>
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<td>Support Staff</td>
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<td>Fringe Benefits</td>
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<td>Other Personnel Costs</td>
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### EXPENDITURES (Continued)

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<th>Part-time Faculty</th>
<th>Graduate Assistants</th>
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**Total New Personnel Costs**: $156,500 $303,900 $303,900 $303,900 $303,900 $303,900

**Start-up Costs (one-time expenses)**

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<tbody>
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**Total One-time Costs**: $10,000 $10,000 $10,000 $10,000 $10,000 $10,000

**Operating Costs (recurring costs – base budget)**

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<th>$1120</th>
<th>$1400</th>
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<td>Equipment</td>
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<tr>
<td>Library/learning resources</td>
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<tr>
<td>Other</td>
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**Total Recurring Costs**: $420 $840 $1120 $1400 $1400 $1400

**GRAND TOTAL COSTS**: $166,920 $314,740 $315,020 $315,300 $315,300 $305,300

---

### III. REVENUE SOURCES

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<th>Source of Funds</th>
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<th>One-time funds</th>
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<td>Reallocation of existing funds</td>
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<tr>
<td>New student workload</td>
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<tr>
<td>New Tuition</td>
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<td>Other grants</td>
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<td>Student fees</td>
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<td>Other</td>
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<td>New state allocation</td>
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</table>

**GRAND TOTAL REVENUES**: $35,416 $42,832 $60,712 $78,592 $78,592 $78,592
Facilities Information for New Academic Programs

Proposed Location for the Program: Science complex on KSU campus

Floor area required for the program (gross and net square feet): 2757 net sq. ft

Type of spaces required:

- Number of classrooms 3-4 per semester - ~925 sq ft.
- Number of labs 1 per semester - ~1200 sq ft.
- Number of offices 20 desks in designated space in new lab wing ~516 sq ft
- Other spaces 1 administrative faculty office ~120 sq ft.

* new lab addition is designed to accommodate the proposed graduate program

Place an “X” beside the appropriate selection:

_____X____ Existing facility will be used as is (area square footage):

_______ Existing facility will require modification (area square footage):

- Projected renovation cost:
- Estimated relocation cost:
- Total funding required:
- Source of Funding:

_______ Construction of new facilities will be required (area square footage):

- Estimated construction cost:
- Estimated total project cost:
- Proposed source of funding:

List any infrastructure impacts that the program will have (i.e., parking, power, HVAC, etc.) and indicated estimated cost and source of funding.

Infrastructure impacts are minimal because maximum enrolment for the proposed program (20) is very low relative to that of the Biology undergraduate program (>1200)

Other comments:

Note: A system office Facilities Project Manager (through the Office of Facilities) may contact you with further questions separate from the review of the new academic program.
Appendix A: Course Descriptions

The following graduate-level courses are chosen based on their integrative nature across fields of study, and will be developed and offered over a 2-year schedule:

- **BIOL 7100. Professional Aspects in Biology** - 3 credits. This course develops specific skills and experiences expected of a professional scientist. Students will learn to present scientific data in a seminar format, practice grant writing, and conduct scientific literature reviews. This course also provides an introduction to the principles of the ethical conduct of research as relevant to human subjects and other organisms, scientific integrity and the appropriate use of regulations. Students must finish the teaching module (offered in the week prior to beginning of Fall semester) before assuming teaching assistant duties. *Pre-requisites: Student must be enrolled in Master of Science in Integrative Biology Program.*

- **BIOL 7200. Integrative Biology** - 3 credits. This course explores how modern biologists use knowledge from other disciplines to answer novel questions. Explicit applications of physics, chemistry, and math in biological problem solving will give the students a solid foundation for exploring the living world. That foundation will then expand upon as the students learn to integrate across scales within biology. From biological molecules through organismal biology and up to ecosystem interactions, students will learn how to formulate and explore the complex scientific questions that dominate modern biology. Finally, these integrative techniques will be used to explore scientific applications with outside fields (e.g. economics and policy making). *Pre-requisites: Student must be enrolled in Master of Science in Integrative Biology Program.*

- **BIOL 7300. Research Methods across Biology** - 4 credits. Biological disciplines are diverse and require various and specialized techniques that have become essential to the process of scientific inquiry. This course introduces graduate students to diverse research methods and literature as used in disciplines such as ecology, cell biology, genetics, physiology, zoology, botany and microbiology. Activities in the course may include, but are not limited to, lectures on research strategy and tactics, experimental design and technology, and use of statistical methods. Use of various research methods both in the laboratory and field will be supported through review of the scientific literature, and demonstration. Research Methods is a modular course taught by a faculty team with varying specialties. Each student selects a concentration that will include research methods in closely related disciplines, but also include research modules that assure all students are exposed to concepts and methods from a broad range of biological science. *Pre-requisites: Student must be enrolled in Master of Science in Integrative Biology Program.*

- **BIOL 7638. Computational Biology** - 3 credits. Computational Biology introduces mathematical techniques used in molecular, cellular, organismal, and population biology. Methods appropriate to modeling and analysis of data from a variety of organizational levels are studied. The course includes some material from molecular bioinformatics and statistics, but is focused on modeling, simulation and network analysis. Introductory modules introduce representation of biochemical and genetics systems at the molecular level, and move to cellular feedback systems in metabolism and related concepts from higher organizational levels such as biomechanical modeling and predator-prey analysis. *Pre-requisites: “C” or better grade in BIOL 3300 Genetics, MATH 2202 Calculus II, or permission of the graduate program coordinator.*

- **BIOL 7333. Ecological Physiology** - 4 credits. This course explores the physiological mechanisms used by plants and animals to address common environmental stresses. It presents the functional mechanisms that underlie organismal interactions with their environment providing causal explanations for distributions across ecosystems. Lab experiments integrate physiology and ecology across plant and animal systems. *Pre-requisites: “C” or better grade in BIOL 3370 Ecology, or
 permission of the graduate program coordinator.

- **BIOL 7478. Molecular and Microbial Approaches to Pathogenesis** - 3 credits. This course focuses on host-pathogen interactions with emphasis on the molecular mechanisms of pathogenesis. Special emphasis is placed on the various strategies used by microorganisms for attachment, invasion and evasion of host defenses to cause diseases. Recent developments in molecular biology, microbiology, and host cell biology are also discussed. *Pre-requisites: “C” or better grade in BIOL 3340 Microbiology, or permission of the graduate program coordinator.*

- **BIOL 7634. Cell Signaling** - 3 credits. This course introduces students to a selection of signal transduction pathways and explores their function in regulation of cellular processes, development, adaptation and sensory response. General topics include receptor-ligand complexes, signal generators, signal cascades and signal networks. Specific topics include guanylate and adenylate cyclases, G-protein linked receptors, kinases and phosphatases, hormone receptors, nitric oxide pathways, and applications in feedback regulation, development and pharmacology. *Pre-requisites: “C” or better grade in BIOL 3300 Genetics, CHEM 3500 Biochemistry, or permission of the graduate program coordinator.*

- **BIOL 7400. Multidisciplinary Approaches to Ecological Questions** - 3 credits. The course examines theoretical and applied topics in ecology across temporal and spatial scales and from diverse perspectives within and beyond the traditional boundaries of biology. In particular, contemporary debates in ecological theory, such as the nature of community assembly, the metabolic theory of ecology, and niche conservatism, will be explored along with implications of the theories for ecological problem-solving. For example, students will critically evaluate competing theories on succession and consider the implications of each for restoration ecology and conservation biology. Quantitative methods for developing and analyzing ecological models will be emphasized along with integrative approaches, such as stable isotope analysis, spatial analysis using geographic information systems, and mathematical models, for testing predictions of ecological theory. Upon completion of the course, students will be able to address ecological hypotheses at various scales using multiple lines of evidence, critically evaluate current ecological research, and discuss recent advances in the field. *Prerequisite: “C” or better grade in STAT 3125 Biostatistics, BIOL 3370, Ecology, BIOL 3380 Evolution, or permission of the graduate program coordinator.*

- **BIOL 6413. Advanced Evolutionary Analysis** - 3 credits. Advanced concepts in evolutionary theory and mechanism. Topics include the derivations of the foundational principles of population and quantitative genetics, selection, speciation, mutation, sexual and kin selection, and life history evolution. Genome evolution, the evolution of development, and phylogenetic reconstruction and its application will be covered. Application of these evolutionary principles across ecology, medicine, and molecular biology are discussed. *Prerequisite: “C” or better grade in BIOL 3380 Evolutionary Biology, MATH 1190 Calculus I, or permission of the graduate program coordinator.*

- **BIOL 7500. Current Topics in Integrative Biology Seminar** - 1 credit; maximum credit applicable toward degree, four hours. Students will be assigned selected related topics that are of current interest and integrative in nature. Each student will read and critically analyze the appropriate literature and deliver a seminar, and will be expected to participate in thoughtful discussion during seminar presentations. *Pre-requisites: Student must be enrolled in Master of Science in Integrative Biology Program.*

- **BIOL 7990. Research for Master’s Thesis** – Variable credit hours, 1-9 hours; maximum credit applicable toward degree, nine hours; repeatable for maximum 27 hours credit. Research and thesis writing while enrolled for a master's degree under the direction of faculty members. *Pre-requisites: Student must be enrolled in Master of Science in Integrative Biology Program.*
The following undergraduate-level courses are chosen based on their integrative nature across fields of study, and will be cross-listed for graduate credit (maximum of two cross-listed courses can be applied toward the degree):

- **BIOL 6350. Comparative Vertebrate Anatomy. 3-3-4.** A survey of representative vertebrates and related chordates emphasizing phylogeny and anatomical adaptations. Evolutionary trends are examined in the context of large-scale environmental changes that have occurred over geological time. Lab component will have students dissecting selected vertebrates organisms and experimentally determining the physical forces acting on the evolution of vertebrates. *Prerequisite: C or better grade in BIOL 2107, 2108.*

- **BIOL 6410. Cell and Molecular Biology. 3-0-3.** Cellular function and genetic principles from an experimental point of view. Emphasis on functional interactions among cellular substructures, regulation of cellular biosynthetic activity, molecular genetics, and evaluation of experimental data. *Prerequisite: C or better grade in BIOL 3300, CHEM 3361.*

- **BIOL 6420. Plant Physiology. 3-3-4.** Plant physiology is the study of plant function. Emphasis will be placed on photosynthesis, secondary metabolism, transport of water and solutes, plant defense against pathogens and herbivores, mineral nutrition, and environmental and hormonal control of growth and development. Each process will be examined at the biochemical, cellular and organismal level so as to provide a more complete understanding of the process. Laboratory studies will expose students to both current and classical approaches used to study plant physiology. *Prerequisite: C or better grade in BIOL 2107, 2108, CHEM 3361.*

- **BIOL 6422. Plant Ecology – 3-3-4.** Students will learn aspects of physiological responses of plants to their environment, methods to determine plant population growth and plant distribution patterns, as well as interactions among plants and other organisms. They will use science as a process and learn to argue scientific points of view persuasively. Students will also learn to use both classical and modern technologies to address questions in plant ecology. *Prerequisite: “C” or better grade in BIOL 2107 and BIOL 2108.*

- **BIOL 6460. Medical Microbiology. 3-3-4.** This course will explore the disease process of, the immune response to, and the prevention and treatment of the medically important Monera, Viruses, Fungi and some microscopic Protista with emphasis on emerging infections, including a laboratory experience that focuses on enhancing laboratory and investigative skills. *Prerequisite: C or better grade in BIOL 3340.*

- **BIOL 6475. Virology. 3-0-3.** This course will explore current concepts associated with the field of virology. The structure and genetic composition of viruses as well as strategies for replication and expression of viral genetic material will be explored. Mechanisms of viral pathogenesis will be presented. In addition, current methods for viral diagnostics, prevention of viral infection and treatment of infected individuals will be presented within the context of viruses of historical significance as well as newly emergent viruses of current medical concern. Novel infectious agents such as satellites, viroids and prions will also be discussed. *Prerequisite: C or better grade in BIOL 3300; BIOL 3340 recommended.*

- **BIOL 6486. Bioethics. 3-0-3.** This course will enable the student to think more critically about some of the difficult moral problems which arise in the practice of science and from our contemporary understanding of living systems and biotechnology. Readings and discussion will focus on issues of personal decision making and public policy regarding both biomedical and environmental issues.
Prerequisite: C or better grade in BIOL 3300, plus a minimum of 9 additional hours of 3000-4000 level Biology/Biotechnology/Biochemistry or consent of instructor.

- **BIOL 6490. Special Topics in Biology. 1-4.** Selected special or current topics of interest to faculty and students. *Prerequisite: Varies as to topic.*

- **BTEC 6100. Molecular Genetics. 2-3-3.** This course covers molecular genetics theory and practice, including gene structure and function, genetic engineering, and bioinformatics. Areas of emphasis will include DNA structure, replication, and manipulation, and gene expression. Biotechnology laboratory exercises will include creating recombinant DNA, gene mapping, DNA sequencing, DNA sequence analysis, and polymerase chain reaction applications. *Prerequisite: Grade of “C” or better in BIOL 3300.*

- **BTEC 6800. Diagnostics Microbiology. 2-3-3.** The application of microscopy, antibody-based techniques and molecular probes for the detection and identification of infectious agents. *Prerequisite: Grade of “C” or better in BIOL 3340 and BTEC 3301.*

The following graduate courses outside of the department are considered to be appropriate electives for Integrative Biology:

- **CHEM 6510. Advanced Topics in Biochemistry. 3-0-3.** Topics relating to the chemistry of metabolic processes in living organisms. *Prerequisite: Grade of C or better in CHEM 3501.*

- **CS 8550. Introduction to Bio-Informatics. 3-0-3.** Students will understand the theoretical data manipulation strategies fundamental to bioinformatics, and will examine the successful application domains and techniques. Students will apply their knowledge through programming and database exercises. *Prerequisite: Permission of the Program Director.*

- **STAT 8125. Design and Analysis of Human Studies. 3-0-3.** This course will serve as an introduction to epidemiologic methods used to investigate disease outbreaks and the effectiveness of public health interventions. At the end of the course, students will be able to design, analyze, and report the results of an epidemiologic investigation and will be able to interpret literature related to analysis of studies of disease causality and treatment. *Prerequisite: STAT 7020, STAT 8210*
Appendix B: KSU's Peer and Aspirational Comparator Universities

The following were identified by KSU (27 October 2008) Peer and Aspirational Comparator Universities and are institutions that offer Master’s Degrees in Biology:

<table>
<thead>
<tr>
<th>Peer Institutions</th>
<th>Aspirational Comparators</th>
</tr>
</thead>
<tbody>
<tr>
<td>California State Univ., Sacramento</td>
<td>George Mason Univ.</td>
</tr>
<tr>
<td>California State Univ., Fresno</td>
<td>Indiana Univ.-Purdue Univ.-Indianapolis</td>
</tr>
<tr>
<td>Illinois State Univ.</td>
<td>Univ. of Wisconsin - Milwaukee</td>
</tr>
<tr>
<td>Oakland University, Detroit</td>
<td>Univ. of Texas, Arlington</td>
</tr>
<tr>
<td>Western Kentucky Univ.</td>
<td>Kent State Univ., Main Campus</td>
</tr>
<tr>
<td>San Francisco State Univ.</td>
<td>Univ. of North Carolina, Greensboro</td>
</tr>
<tr>
<td>Missouri State Univ., Springfield</td>
<td>Univ. of California, Riverside</td>
</tr>
<tr>
<td>Middle Tennessee State Univ., Nashville</td>
<td>Univ. of Missouri, St. Louis</td>
</tr>
<tr>
<td>Cleveland State Univ.</td>
<td>Florida Atlantic Univ. - Boca Raton*</td>
</tr>
<tr>
<td>Towson Univ.</td>
<td>Univ. of North Texas</td>
</tr>
<tr>
<td>Univ. of North Carolina, Charlotte</td>
<td>Univ. of Memphis</td>
</tr>
<tr>
<td>Eastern Michigan Univ.</td>
<td>Univ. of Central Florida</td>
</tr>
<tr>
<td>Portland State Univ.</td>
<td></td>
</tr>
<tr>
<td>Univ. of North Florida</td>
<td></td>
</tr>
<tr>
<td>Cal State Univ., Fullerton</td>
<td></td>
</tr>
<tr>
<td>Univ. of Texas, San Antonio</td>
<td></td>
</tr>
</tbody>
</table>

* offers Master’s in Integrative Biology
Appendix C: Justification of Graduate Assistant Stipends

The proposed stipend for graduate assistants ($12,000 for the two semester academic year) and tuition waiver consider both recent evidence on the role of stipends in attracting quality graduate students and recent stipend amounts and benefits at comparator institutions.

Based on a Workshop Report, Support of Graduate Students and Postdoctoral Researchers in the Sciences and Engineering: Impact of Related Policies & Practices (sponsored by the National Science Foundation, the National Institutes of Health, and the Council of Graduate Schools (http://www.nsf.gov/pubs/2005/nsf0504/nsf0504.pdf) stipends influence graduate student choice negatively if they do not provide at least a minimum standard of living:

- "A number of concerns about the current state of affairs were voiced during the session, as were a few suggestions and possible courses of action. Two of the most prominent points among the panelists were the need for support packages that provide at least basic subsistence and the need for health care coverage." p. 4
- "The effect of stipend policy can be asymmetric. Most felt that while slightly higher stipends may not necessarily attract students, poor stipend policies could certainly drive many away. Stipend policy must account for no less than, and preferably better than, a minimum level of subsistence, of which health care is a mandatory aspect, particularly as graduate and postdoctoral appointments become longer." p. 4
- "Stipends can only have a negative, not positive effect on career decisions. No one felt another couple of thousand dollars in grad school stipends would have influenced their career decisions so long as a minimum standard of living could be maintained. So, while too little money would drive them away, a little more would not attract them.” p. 10
- “[T]he costs of spending money for stipend payments in order to increase the supply of quality researchers are minute compared to other government expenditures, yet the benefits are potentially enormous for the economic and research agenda.” p. 13
- "While it is not clear how attractive stipends make graduate/postdoc science careers, it is clear that inadequate support can be a barrier.” p. 14
- "The economists at the meeting said that paying higher stipends induces better-qualified students into STEM fields.” p. 15

A stipend of $12,000 will defray 72% of the estimated cost of attending KSU (based on amounts for room, board, books, supplies, transportation, and personal needs listed in the 2009-10 catalog), with students responsible for covering the remaining 28% of costs. While it is recognized that stipends should not be equated with salaries paid for fulltime employment, it is important that stipends meet basic living needs (the 2009 U.S. Census Bureau threshold is $9,822 corrected for cost of living of 12% below national average for the Kennesaw area). The net living wage of a $12,000 stipend at KSU considering student fees required for enrollment is $10,704. Because the proposed master’s program is research based, graduate students with
teaching assistantships will necessarily spend significant time, outside of that dedicated to teaching responsibilities, conducting thesis research. As a result, students will essentially have no time to pursue additional employment. Therefore, the proposed stipend meets minimal criteria recommended by NSF and should not be a prohibitive barrier to student interested in the Master of Science in Integrative Biology program at KSU.

A stipend of $12,000 also approaches a level that is competitive with published data from other institutions. In a survey of more than 100 colleges and universities, “Stipends for Graduate Assistants, 2008-9” (http://chronicle.com/stats/stipends/), The Chronicle of Higher Education reported that the average of all teaching stipends in Biology was $16,368. Because it is not reasonable to expect stipends at KSU to be comparable to those at the largest research institutions (e.g. UGA’s is $21,000), the following table lists stipends for those institutions in the study that were also indentified in 2008 by a university committee at KSU as “Peer Institutions” of KSU or “Aspirational Comparators” (see Appendix B).

<table>
<thead>
<tr>
<th>Institution</th>
<th>9 mo. stipend</th>
<th>Amount of tuition and fees that are not remitted*</th>
<th>Net Living Wage (not considering health care)</th>
<th>Percent health care covered</th>
<th>Hours of work per week</th>
</tr>
</thead>
<tbody>
<tr>
<td>KSU - Proposed</td>
<td>$12,000</td>
<td>$1,296</td>
<td>$10,704</td>
<td>0%</td>
<td>20</td>
</tr>
<tr>
<td>Peer Institutions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UNC Charlotte</td>
<td>$13,146</td>
<td>$2,415</td>
<td>$10,731</td>
<td>100%</td>
<td>20</td>
</tr>
<tr>
<td>Portland State Univ.</td>
<td>$13,743</td>
<td>$242</td>
<td>$13,501</td>
<td>0%</td>
<td>12</td>
</tr>
<tr>
<td>Aspirational Comparators</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UNC Greensboro</td>
<td>$14,000</td>
<td>$701</td>
<td>$13,299</td>
<td>100%</td>
<td>20</td>
</tr>
<tr>
<td>Univ. Missouri, St. Louis</td>
<td>$15,808</td>
<td>$629</td>
<td>$15,179</td>
<td>75%</td>
<td>20</td>
</tr>
<tr>
<td>University of Central Florida</td>
<td>$11,643</td>
<td>$1,320</td>
<td>$10,323</td>
<td>0%</td>
<td>20</td>
</tr>
</tbody>
</table>

• for students serving as graduate assistants

Data on graduate student stipends are also collected by the National Survey of First Year Graduate Stipends (under the supervision of Binghamton University). The survey is designed to be “a valuable resource to the graduate community, helping institutions determine and set competitive stipend levels”. The average graduate student stipend for 2007 - 2008 in the biological sciences for a broad range of institutions (n=18) is $13,072 (less $109 for tuition), and $10,735 (less $392 for tuition) for the 3 aspirational and 1 peer institutions identified by KSU and included in the survey (stipends from individual institutions cannot be accessed from the survey report; http://gradschool.binghamton.edu/StipendSurvey/). Both surveys indicate that graduate student stipends vary dramatically with discipline, with biology tending toward the upper end of this range.
Despite the additional costs represented by graduate student stipends, it is important to recognize that a stipend of $12,000 is extremely cost effective based on the following comparison of contact hour cost:

<p>| | |</p>
<table>
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<tbody>
<tr>
<td>Asst. Professor Salary:</td>
<td>$55,000.00</td>
</tr>
<tr>
<td>+Benefits:</td>
<td>$71,500.00</td>
</tr>
<tr>
<td>Teaching Salary*:</td>
<td>$42,900.00</td>
</tr>
<tr>
<td><strong>Cost/Contact hour of faculty:</strong></td>
<td><strong>$2,383.33</strong></td>
</tr>
<tr>
<td>TA Stipend:</td>
<td>$12,000.00</td>
</tr>
<tr>
<td>-fees:</td>
<td>$10,834.00</td>
</tr>
<tr>
<td><strong>Cost/Contact hour of TA’s:</strong></td>
<td><strong>$902.83</strong></td>
</tr>
<tr>
<td><strong>% cost savings:</strong></td>
<td><strong>-62.1%</strong></td>
</tr>
</tbody>
</table>

For 12 assistantships X 4 labs/assistantship X 3 contact hours/lab = 144 contact hours/yr**

<p>| | |</p>
<table>
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</thead>
<tbody>
<tr>
<td>Faculty cost:</td>
<td>$343,200.00</td>
</tr>
<tr>
<td>TA cost:</td>
<td>$130,008.00</td>
</tr>
<tr>
<td><strong>Difference between Faculty and TA:</strong></td>
<td><strong>$213,192.00</strong></td>
</tr>
<tr>
<td>Cost per year to teach graduate courses</td>
<td>$72,900.00</td>
</tr>
<tr>
<td><strong>Difference between Faculty and TA factoring in cost to teach graduate courses:</strong></td>
<td><strong>$140,292.00</strong></td>
</tr>
<tr>
<td>Salary and fringes of two graduate faculty</td>
<td>$159,900</td>
</tr>
<tr>
<td><strong>Revenue generated by program</strong>*</td>
<td><strong>$78,592</strong></td>
</tr>
<tr>
<td><strong>Net savings per year as TA’s alleviate need to hire future faculty</strong></td>
<td><strong>$58,984</strong></td>
</tr>
</tbody>
</table>

*KSU Workload Model: Teaching-Research Balance Track of 3-3 course load (60% Teaching, 30% Research, 10% Service)

**Calculation is based on the minimum proposed number of contact hours (4 lab sections per year). Maximum proposed number of contact hour (6 lab sections per year) increases difference between faculty and TA salaries by nearly another $100K.

*** Calculations based on revenues and assistantship costs by Year 4 of the program.
Appendix D: Faculty Competence in Integrative Biology

Publications and Graduate Students since 1990 of those faculty currently participating in the three integrative research nuclei: Ecologic-Genetic interactions, Microbiology Host-pathogen Interactions, and Cell Signaling Protein Interactions (List is based on rank and year of appointment)

Ecology and Population Genetics

Bill Ensign (Professor in Biology):


Paula C. Jackson (Associate Professor in Biology):


**Sigurdur Greipsson (Associate Professor in Biology):**


and rhizobia as revealed by REP-PCR genomic fingerprinting.” *Invasive Plant Science and Management* (In press).


Thomas Mc Elroy (Associate Professor in Biology):

McElroy, TC; Trexler, JC; Kandl, KL. 2009. Temporal dynamics of population genetic structure reveal colonization dynamics of eastern mosquitofish in a dynamic aquatic landscape. Submitted to the Journal of Heredity. Accepted with revisions. Revisions are in progress.


Presley, ML; McElroy, TC; Diehl, WJ. 1996. Soil moisture and temperature interact to affect growth, survivorship, fecundity, and fitness in the earthworm Eisenia fetida. Comparative Biochemistry and Physiology 114A: 319-326.

Troy Mutchler (Assistant Professor in Biology):


Scott Reese (Associate Professor in Biology):


Stewart ER, Reese SA, Ultsch GR. 2004. The physiology of hibernation in Canadian leopard frogs (Rana pipiens) and bullfrogs (R. catesbeiana). Physiological and Biochemical Zoology 77:65-73.


Reese SA, Jackson DC, Ultsch GR. 2002. The physiology of overwintering in a turtle that occupies multiple habitats, the common snapping turtle (Chelydra serpentina). Physiological and Biochemical Zoology 75(5): 432-438.


Microbiology: Host-pathogen Interactions

Donald Mc Garey (Associate Professor in Biology):


Premila N Achar (Associate Professor in Biotechnology):


*undergraduate students; ** maiden

Jean Lu (Assistant Professor in Biology):


**Melanie C. Griffin (Assistant Professor in Biology):**


**Cell Signaling: protein interactions**

**John Salerno (Professor of Biotechnology):**


Xia Hauge (Associate Professor in Biology):


**Estella Chen (Assistant Professor in Biology):**


Eric Albrecht (Assistant Professor in Biology):


Marcus C. Davis (Assistant Professor in Biology):


New Faculty – Behavior and Neurobiology

Jared Taglialatela (Assistant Professor in Biology):


**Master’s students supervised by faculty:**

**Salerno JC (all supervision done at Rensselaer University)**

Susan E. Kelly (1982). Thermodynamics of Substrate Binding and Reduction of Adrenal Mitochondrial Cytochrome P450SCC


**Achar PN (all supervision done at University of Durban Westville):**


**Greipsson S (supervision at different universities):**

Verlin Ryan Perry (2009). Effects of chemical-assisted (benomyl and EDTA) phytoextraction of lead-contaminated soils by ryegrass (*Lolium perenne*). Georgia State University (supervisor).


Patricia Kinney (2006). Role of *Rhizobia* Bacteria and Arbuscular Mycorrhizal Fungi in Invasion of a Non-native Legume (Kudzu) in the Southeastern U.S. Troy University (supervisor).

Sandy Gibson MS (2005). Assessment of native plants of South-Alabama in phytoremediation of soils contaminated with heavy metals. Troy University (supervisor).


Emily Wong (1997). Comparison of Lupinus polyphyllus and Lupinus nootkatensis in heavy metal contaminated soil from Iceland. Saint Mary’s University, Halifax, Nova Scotia, Canada (co-advisor).


**Estella Chen (Kennesaw State University, Master of Science in Applied Statistics)**

P. Stafford (2010). The Pattern of Natural Selection in Somatic Cancer Mutations of Human mtDNA.

**Doctoral students supervised by faculty:**

**Salerno JC (all supervision done at Rensselaer University):**


Xu Yan (1987) collaborative project on succinate cytochrome c reductase (with T.E. King) at SUNY (1987) most of the work was done in my laboratory (co-supervisor).

Jeff Kramer (1987) thesis was collaborative project with Dan Pope on Desulfovibrio Electron Transfer all published work done in my laboratory (co-supervisor).


Jim McGill - Identification and Location of Cytochrome b6f and bc1 Complex Electron Carriers complete except for thesis defense.


Denise Kay (2004). Function of novel thioredoxin-like genes in cyanobacteria (co-supervisor with Jackie Collier after she moved to Stony Brook).

Ruma Banerjee, who did her thesis work in Professor James Coward’s enzymology lab in the Rensselaer Chemistry Department (co-supervisor).

**Achar PN (all supervision at University of Durban Westville):**


**Jackson P (CICY: Centro de Investigación Científica de Yucatán, México):**


**Postdoctoral students supervised by faculty:**

**Salerno JC (all supervision done at Rensselaer University):**


Dr. Marcy Osgood (1988-1990). Quionol cytochrome c reductase mechanism.


**Short Term Post docs:**


Ying Tong Gao (2005). NOS activation and mechanism.


**Achar PN (all supervision at University of Durban Westville):**


**Visiting Scientists hosted by Faculty:**

**Davis MC (at Kennesaw State University):**


**Salerno JC (at Rensselaer University):**


**Achar PN (at University of Durban Westville):**


Appendix E: Letters of Support

Letters have been requested and will be added to the proposal
Jerald D. Hendrix, Ph.D.
Interim Chair, Department of Biology and Physics
Professor of Biology
Kennesaw State University
1000 Chastain Road
Kennesaw, Georgia 30144-5591

Dear Dr. Hendrix:

Thank you for your letter regarding the development of an innovative degree program in the biological sciences at Kennesaw State University.

The Centers for Disease Control and Prevention (CDC) serves as the national focus for developing and applying disease prevention and control, environmental health, and health promotion and health education activities designed to improve the health of the people of the United States.

CDC certainly supports the need for interdisciplinary academic programs. Accredited programs that prepare students for interdisciplinary and integrated scientific research and program development will be an asset to the local and regional labor market. It is likely that other federal agencies besides CDC will have need for future employees with rigorous training in the life sciences and research.

Sincerely,

Thomas R. Frieden, M.D., M.P.H.
Director, CDC, and
Administrator, Agency for Toxic Substances and Disease Registry

This letter is intended for the exclusive use of the recipient named above. It contains information that is protected, privileged, or confidential, and should not be disseminated, distributed, or copied to persons not authorized to receive such information.
November 10, 2010

Jerald Hendrix, Chair
Dept. of Biology and Physics
Kennesaw State University
1000 Chastain Road
Kennesaw, GA 30144

Dear Jerald:

I read with interest that the Biology and Physics Department at Kennesaw State University is developing a new graduate program in Integrative Biology. As you know, over the past several years, Skidaway Institute of Oceanography has had connections with your faculty and students. We have worked with them individually, and have developed joint summer courses in biological oceanography for advanced undergraduate students. These interactions have gone well, and there is considerable interest in my faculty in continuing and expanding our collaborations. The graduate program under development appears to provide an excellent mechanism for doing so.

As I understand, you are developing a Master of Sciences program that will be traditional in the sense that it will be heavily focused on original research and will be thesis generating, but will embrace the interdisciplinary focus of modern sciences. At Skidaway Institute, our oceanographic focus is inherently interdisciplinary, therefore, should your department be interested, we have a joint opportunity to provide both educational and research training experiences for your students. It would be possible for students interested in marine topics to work with a Skidaway Institute faculty member in a variety of different research areas. We currently provide similar opportunities to graduate students at Savannah State University, and both institutions have found these interactions to be beneficial. In addition, as your faculty members build their research programs, I would be happy to encourage and facilitate collaborations between KSU and SkIO faculty members. Finally, Skidaway Institute may provide a potential home to graduates from your program, as opportunities for further study leading to a PhD are available, as are some opportunities for professional employment on our technical staff.
I fully support your efforts, and look forward to hearing more about your program as your plans mature. If I can be of any assistance to you, please feel free to contact me.

Sincerely,

[Signature]

James G. Sanders
Director and Professor
Ph: 912-598-2400
Email: jim.sanders@skio.usg.edu

cc: Daniel S. Papp, President
Jerald D. Hendrix, Ph.D.
Interim Chair, Department of Biology and Physics
Kennesaw State University
1000 Chastain Road
MD 1202, SC-Bldg 12, Room 308
Kennesaw, Georgia 30144-5591

Dear Dr. Hendrix:

Thank you for your October 6, 2010, letter concerning Kennesaw State University’s proposed Master of Science in Integrative Biology degree program (program) and your request for feedback from the U.S. Environmental Protection Agency (EPA) Region 4, on the proposed program.

EPA Region 4 currently has ninety-two Life Scientists on its staff. Since we do have a need for broadly trained biologists, we feel that an interdisciplinary program approach, as described in your letter, could possibly be a beneficial resource for our employment needs. However, we would encourage including courses in geology, ecology, hydrology, and other wide ranging courses. In addition to these types of courses, introducing field experience as a part of the curriculum would be something that we would seek in potential job candidates.

The overview you provided demonstrates a program that could possibly provide a good candidate pool of quality Life Scientists. In order to determine if students graduating from the proposed program would be a valued resource to us, more information is needed on how the program will emphasize linkages within and beyond biology, as well as on how the students will acquire these technical skills. However, based on the information provided, we would definitely be interested in considering graduates of the proposed Master’s program for employment.

We appreciate the opportunity to provide feedback on Kennesaw State University’s proposed Master of Science in Integrative Biology degree program and hope you find this information helpful. If EPA may be of further assistance, please contact Bill Cosgrove, Chief of the Ecological Assessment Branch, Science and Ecosystem Support Division, at 706-355-8616.

Sincerely,

[Signature]

Gwendolyn Keyes Fleming
Regional Administrator
October 27, 2010

Dr. Jerald Hendrix, Chairman  
Kennesaw State University  
Department of Biology and Physics  
1000 Chastain Rd.  
MB1202  
Kennesaw, GA 30144

Dear Dr. Hendrix,

This letter is to support the proposed Master’s of Science in Integrative Biology program being developed by the Department of Biology and Physics at Kennesaw State University. The Genetics Department at CSI Laboratories currently employs over 30 biologists. The flow cytometry and immunohistochemistry lab also employ several biologists. All three laboratories work closely together in order to provide the best diagnostic/prognostic information to our clients and their patients.

With our rapid growth over the past four years (24 to begin and 146 employees now), we are constantly recruiting new employees. The pool of trained technologists is quite small, so we find ourselves having to hire new undergraduates and train them. Students having completed this Master’s program will have several things in their favor; in my opinion the most important one will be the maturity that they will have after completing the class work, serving as a teaching assistant, and performing and documenting a research project. In addition, the ethics and scientific integrity being taught in this program will provide a better understanding of all the laws, regulations, and rules that a reference laboratory must abide by. Microbiology classes will provide basic, but necessary, techniques that are required in any laboratory working with infectious agents and body fluids. Also, working in our genetics laboratory requires many hours of hands-on training by a seasoned technologist. As a teaching assistant, the students will learn how to answer questions, teach many different types of individuals and learn to identify the important points and ignore the minutia. This will aid them while learning on the job and result in them being better trainers in the future.

While we do not perform typical research projects in our laboratory, research methods and statistical analysis is something we use daily to improve our procedures and to solve problems. Writing a thesis allows the students to understand all the background information needed to plan a project, the documentation required for the research data,
the possibly of unexpected findings and how to interpret these unexpected findings. The committee members also allow for the student to see how one project can have different priorities to the different members and to learn to see things from other perspectives.

As a cancer diagnostic lab, we must be integrative in our approach to identifying the disease at a chromosomal level and how it relates on the gene level, which will affect the transcription level, as well as the protein level. We must be aware of the biochemical pathways that are interrupted based on the laboratory results and how this will affect the patient’s outcome and how the patient may need to be treated based on the abnormalities we identify in our lab. We also incorporate results from other testing to provide as much diagnostic and prognostic information to our clients for the best possible patient care.

I am very excited about this Master’s program and feel it will provide my laboratory with many well-trained candidates. We have several Kennesaw graduates as employees already and I see this Master’s program as a possibility of long term continuation of our relationship.

Sincerely,

Theresa C. Brown, PhD, FACMG
Director, Genetics
CSI Laboratories
11525 Park Woods Circle
Alpharetta, GA 30005
678-205-4346
Jerald D. Hendrix, Ph.D.
Interim Chair, Department of Biology and Physics
Kennesaw State University
1000 Chastain Road
MD 1202, SC, Building 12, Room 308
Kennesaw, GA 30144-5591

Dear Dr. Hendrix:

With regard to your letter of October 6, 2010, the following is our response to your questions concerning the benefits of the proposed degree program in the biological sciences.

The Cobb County-Marietta Water Authority is a regional wholesale drinking water provider serving approximately 800,000 people through our 12 customers. We own and operate two water treatment plants, a water transmission system, a dam and reservoir, and a drinking water laboratory.

Our current, full workforce is just over 100 employees with ten laboratory employees. Of these ten, three hold undergraduate biology degrees. One is completing an undergraduate science degree from KSU and one holds an advanced science degree.

Broadly trained biologists would benefit our staff and provide value to our customers. A biologist with additional knowledge of drinking water and the processes for treating drinking water could assist us in meeting the challenges associated with treating natural waters used for providing safe drinking water. We would also benefit from additional support in laboratory procedures and research methods that contribute to laboratory certification and credibility.

Competitive job candidates should show evidence of productive problem solving skills, collaborative work ethic, flexibility and the ability to coordinate/communicate effectively. This candidate should be willing to go beyond the "status quo" and provide the Water Authority with innovative ideas and strategies that project an interest in quality, accountability and diversity.

The proposed program addresses skills that the Water Authority would find valuable. From the description given, students would be able to look beyond what is typical for the biologist, and customize their learning to meet the demands of the current environment. We need minds that not only understand the current phenomenon concerning drinking water, conservation and preservation, but also understand what is necessary to sustain future water supplies and address future water quality issues. This program should help students follow and forecast the impact of our water sources.
The success of our organization would be enhanced by acquiring graduates of this proposed program. It would be even more valuable to support current Water Authority employees in seeking acceptance and participation in the proposed program. Bringing our day to day concerns to the program is one way to get applicable education to address our current needs. It is also a practical approach to causing education to move forward in addressing ever changing workforce requirements.

A person with a degree in Integrative Biology, and with the requisite skills and knowledge for the position, would likely be on the short list to hire.

We are excited to hear of this potential educational program right here in our community and wish you well. Please contact me if you have any questions or would like to discuss this further.

Yours truly,

Robert L. Kenyon
Director of Operations
January 17, 2010

Dr. Jerald Hendrix  
Interim Chair, Department of Biology and Physics  
1000 Chastain Road, #1202  
Kennesaw, GA 30144

Dear Jerald:

I am writing in support of your department’s proposed Master of Science in Integrative Biology (MSIB). Our faculty are excited about the interdisciplinary positioning of your degree program because of the potential opportunities to collaborate between our departments. The Department of Mathematics & Statistics includes mathematicians who conduct research in biomathematics, as well as statisticians, an epidemiologist and, by next fall, two biostatisticians (searches underway). For example, mathematician Liancheng Wang’s research involves the modeling of biological contexts, such as the growth of of HIV infection in T cells. Epidemiologist Louise Lawson’s has recently published on the correlation between pectus excavatum (a common congenital deformity of the anterior wall of the chest) and pulmonary function in children.

Our department currently has a Master of Science in Applied Statistics (MSAS), and several of those courses would be relevant for MSIB students. Some MSIB students might be ready for the Design of Human Studies course in the MSAS program, if their interest is in human studies. Others might find useful our traditional Design of Experiments course. Some other courses, like Longitudinal Data Analysis may also be useful to MSIB students, depending on their research interests and background in statistics and SAS.

We anticipate opportunities for our graduate students to participate in research collaborations with the MSIB students. MSAS are required to complete applied projects that may provide additional opportunities for collaboration with MSIB students.

Our department currently hosts a weekly Mathematics Talk (for an audience that includes undergraduates) and a weekly Applied Mathematics Seminar (for faculty and advanced undergraduate students). We’ve already scheduled speakers that might appeal to MSIB students and will probably plan more if the MSIB was approved. Relevant seminar topics this past semester include “Mathematical Modeling on Algal Blooms in Presence of Nutrient and Toxic
January 21, 2011

Substances" by Dr. Samares Pal, University of Kalyani, West Bengal, India and "A Size-Structured Model for Bacterial Growth in a Chemostat" by KSU’s Dr. Sean Ellermeier.

Our departments already share a number of undergraduate students who major in Biology and minor in Statistics. A program such as the MSIB would be particularly appealing to that group.

Faculty in our departments already have overlapping research interests and some history of collaboration. The approval of an MSIB would provide a number of opportunities for the two departments to collaborate and capitalize on our strengths to provide distinctive educational and research opportunities for our students. You have our full support in launching the Master of Science in Integrative Biology.

Sincerely,

[Signature]

Lynn Stallings, Ph.D.
Chair, Department of Mathematics & Statistics
January 28, 2011

Dr. Jerald Hendrix, Interim Chair  
Department of Biology and Physics  
Kennesaw State University

Re: Proposal submitted for the Master of Science Degree in Integrative Biology (MIB)

Dear Dr. Hendrix,

The Department of Biology and Physics is submitting a new degree program proposal for an M.S. Degree in Integrative Biology and I am very happy to write a letter of support for that proposal.

The M.S. degree program in Integrative Biology is a truly interdisciplinary degree program that will allow the students to work with multiple faculty members to develop a wider skill set and knowledge base than would be typically found in a traditional program. As science becomes more interdisciplinary in nature, it becomes increasingly important for students to develop the ability to work effectively in teams on a complex research problem. The proposed program will foster that skill in its students.

The multidisciplinary coursework, including courses from disciplines outside those traditionally thought of as biology, will also give the students a broader context in which to develop their theories and understanding of their research projects. As part of our own M.S. degree program development in the Chemical Sciences, we are looking toward the course offerings proposed as part of the MIB program to augment courses taught as the core course offerings in our program, to complement the more chemistry-related course content the students will receive. Likewise, we hope that you will consider incorporating courses from our program into possible upper-level electives for your MIB program. In addition, the possible collaborations between our faculty members who have more biologically-relevant projects on committees or as co-mentors even for graduate students would be very welcome.

Further, the increase in scholarly output and extramural funding that accompanies such a program will require an increased research infrastructure at the university, which will help all the science departments. The increased focus on graduate research, and the more active research community that accompanies that growth, including more seminars and generally more awareness among the students and faculty of research going on in the discipline will, I believe, increase the number of science majors at KSU, and lead to a more “science-aware” community among our students.

There may well be students who see an M.S. degree in integrative biology, coupled with a B.S. degree in chemistry, as excellent preparation for entrance into a doctoral program or professional (medical, veterinary, dental, law) schools, and we hope there would be a path developed to facilitate that type of transition for students who wish to pursue such a course of study.
I strongly support the development of the MIB degree program, and hope that it leads to even more productive collaboration between our departments.

Sincerely,

Mark B. Mitchell, Ph.D.
Professor and Chair
Appendix F: Documentation that courses meet institutional requirements