



The University of Georgia

University Council
Athens, Georgia 30602

April 22, 2010

UNIVERSITY CURRICULUM COMMITTEE – 2009-2010

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Public Health – Dr. Phaedra S. Corso

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Veterinary Medicine - Dr. K. Paige Carmichael

Graduate School - Dr. Malcolm R. Adams

Undergraduate Student Representative – Cameron Secord

Graduate Student Representative – Lauren King

Dear Colleagues:

The attached proposal to offer a Master of Biomanufacturing and Bioprocessing (M.B.B.) will be an agenda item for the April 29, 2010, Full University Curriculum Committee meeting.

Sincerely,

David E. Shipley, Chair
University Curriculum Committee

cc: Professor Jere W. Morehead
Dr. Laura D. Jolly



The University of Georgia

Department of Microbiology
527 Biological Sciences Building
Athens, Georgia 30602-2605

Franklin College of Arts and Sciences

TEL 706-542-1434
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April 14, 2010

To Whom It May Concern:

RE: Institution: University of Georgia
School/College/Division/Institute: Arts and Sciences
Department: multiple, housed in the Microbiology Department
Name of Proposed Program: Master of Biomanufacturing and Bioprocessing (MBB)
Degree: Master of Biomanufacturing and Bioprocessing Major: Biomanufacturing
and Bioprocessing

The Microbiology Department of the College of Arts and Sciences will serve as the Academic Home for the new program: Master of Biomanufacturing and Bioprocessing, although faculty from many different colleges and departments are involved in the program. Dr. Joy Doran-Peterson in the Microbiology Department is Co-Director of the new program with Dr. Tim Davies in Biochemistry and Molecular Biology. Dr. Doran-Peterson will also be the new Graduate Coordinator and Faculty Program Manager for the new Degree.

The Microbiology Department supports this new program in principle and believes Dr. Doran-Peterson will perform well in her new capacity as described above. She is currently developing two courses, one a seminar course and the other a course in Industrial Microbiology, that will serve the new program. The new Master of Biomanufacturing and Bioprocessing furthers the mission of UGA and the Microbiology Department by allowing UGA to be responsive to the evolution of the state's educational and economic needs. The program also affords UGA the opportunity to have closer contact and interaction with public and private institutions throughout the state as well as with the citizens it serves. The Master of Biomanufacturing and Bioprocessing (MBB) will advance the model for introducing highly technical STEM methods to motivated science students by preparing them for immediate engagement in an industry that is short of leaders equipped with the necessary technical skills combined with experience in business and project management skills. As Department Head of Microbiology, this letter confirms our support of this vision and we are committed to helping develop the MBB as a landmark program at UGA.

Sincerely,

William B. Whitman, Ph.D.
Head, Microbiology Department

April 14, 2010

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I am supportive of the new program: Master of Biomanufacturing and Bioprocessing and acknowledge that I and/or my faculty have agreed to participate in the new program in the fashion described in the proposal.

William B. Whitman, Ph.D.
Head, Microbiology Department



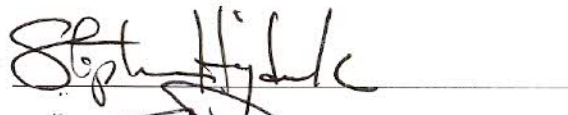
Joy Doran-Peterson, Ph.D.
Associate Professor, Microbiology



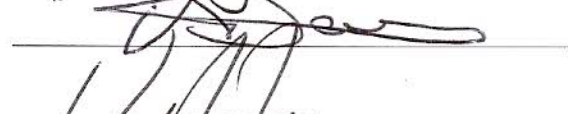
Allen C. Amason, Ph.D.
Head, Department of Management
Terry College of Business



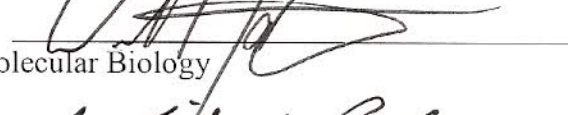
Stephen Hajduk, Ph.D.
Head, Biochemistry and Molecular Biology



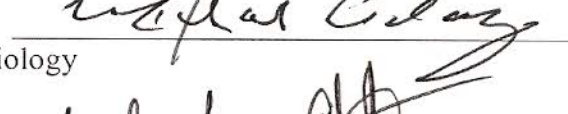
E. Timothy Davies, Ph.D.
Director, Bioexpress Fermentation Facility



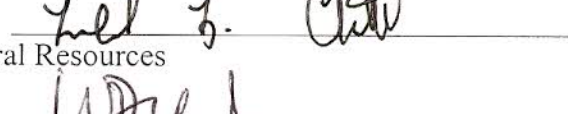
William Lanzilotta, Ph. D.
Associate Professor of Biochemistry and Molecular Biology



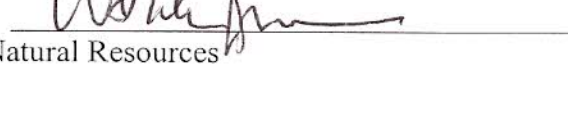
Michael J. Adang, Ph.D.
Professor of Biochemistry and Molecular Biology



Mike Clutter, Ph.D.
Dean, Warnell School of Forestry and Natural Resources



Dale Greene, Ph.D.
Professor, Warnell School of Forestry and Natural Resources



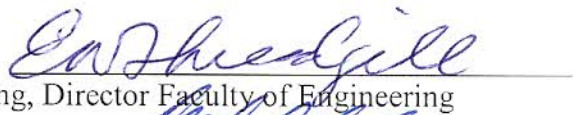
Paul Brooks, Ph.D.
Assistant Dean for Non-Traditional Education and Outreach at the College of Pharmacy



Anthony C. Capomacchia, Ph.D.
Associate Professor in Pharmaceutical and Biomedical Sciences



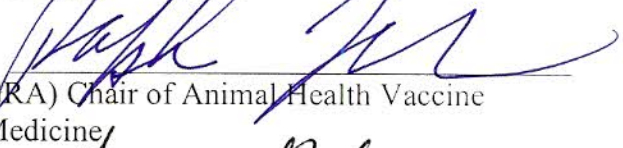
E. Dale Threadgill, Ph.D.
Head Biological and Agricultural Engineering, Director Faculty of Engineering



Mark Eiteman, Ph.D.
Professor, Biological and Agricultural Engineering



Ralph Tripp, Ph.D.
Professor and Georgia Research Alliance (GRA) Chair of Animal Health Vaccine Development in the College of Veterinary Medicine



Garnett Stokes, PhD.
Dean, College of Arts and Sciences



Maureen Grasso
Dean of the Graduate School



The University System of Georgia
FORMAT FOR NEW PROGRAM PROPOSAL
(Submit three copies)

Institution: University of Georgia
School/College/Division/Institute: Arts and Sciences
Department: multiple, housed in the Microbiology Department
Name of Proposed Program: Master of Biomanufacturing and Bioprocessing (MBB)
Degree: Master of Biomanufacturing and Bioprocessing
Major: Biomanufacturing and Bioprocessing

Program description and objectives

The Professional Science Master of Biomanufacturing and Bioprocessing specifically allows UGA to be responsive to the evolution of the state's educational and economic needs by partnering public and private institutions throughout the state with the citizens it serves. The Master of Biomanufacturing and Bioprocessing (MBB) will advance the model for introducing highly technical STEM methods to motivated science students by preparing them for immediate engagement in an industry that is short of leaders equipped with the necessary STEM skills combined with experience in business and project management skills. This program also contains a major assessment component coupled with industry internships and directed research for a truly unique educational experience unlike other programs throughout our region. The new Master of Biomanufacturing and Bioprocessing (MBB) will involve an exceptionally interdisciplinary group of UGA faculty from the Colleges of Arts and Sciences, Agricultural and Environmental Sciences, Veterinary Medicine, Pharmacy, the Warnell School of Forestry and Natural Resources, and the Graduate School. Key industry participants are also involved as advisory board members, internship providers, seminar speakers, and workshop instructors.

The MBB is industry-led from the start, with respected companies combining forces with an experienced faculty to develop curricula and non-traditional learning experiences to prepare students for a challenging but highly rewarding workplace. Companies that will potentially hire graduates will be involved alongside those that produce biomanufacturing tools to guide faculty and to train, set challenges for, and provide internships to students. The faculty, UGA administration and numerous companies fully support this vision and are committed to developing the MBB as a landmark program at UGA.

UGA's two-year Master of Biomanufacturing and Bioprocessing degree program educates and trains technically savvy professionals by incorporating rigorous scientific training, an understanding of business principles, a focused research experience, case studies involving teamwork and real-world problem solving, an industrial internship, and professional communication opportunities.

Year 1: Students participate in a common educational experience during the first semester and are immediately engaged in an identity-building/branding experience in a new course developed specifically for this program. Additional first semester courses taken by all students include: bioethics, biostatistics, business strategy, and a course in biotechnology or gene technology. In the second semester, students will participate in another newly developed course in microbial

strain development and industrial applications of microbiology. Additional courses specific to one of three focus areas and one of two business tracks will comprise the remainder of the second semester. During the summer students will learn how STEM research creates knowledge through participation in a graduate level research experience reflecting industrial interests.

Year 2: Students will continue scientifically rigorous courses and focused business instruction. Two innovative new core courses have to be completed by all students, 1) Biomanufacturing Process Development and 2) Optimization and Fermentation Engineering. These courses will use specifically designed interactive cyber-enabled learning modules prior to hands-on training with industry-relevant fermentation equipment and control systems. After completing these courses, teams will work together on industry-defined problems in a capstone experience, prior to embarking on industry internships. Internships will consist of a minimum of 400 hours (10 weeks at 40h/week). Most, if not all, internships will be paid by the industrial partners.

Business Tracks: Students will choose one of two business tracks. The **large company track** will include courses designed to facilitate working within large organizations, as a product champion or project leader. Emphasis will be on understanding enterprise level issues, such as market dynamics, strategy, and performance, as well as task specific issues like supply chain, scheduling, and product promotion. The **small firm track** will include courses designed to facilitate new venture creation and management and working as or with entrepreneurs. Emphasis is placed on understanding new venture financing, challenges specific to entrepreneurs, and basics of cost and cash flow management.

Focus areas: Students will choose one of three focus areas: biofuels/biochemicals, industrial/environmental, and pharmaceutical. A sample program outline with course descriptions follows. A typical student undertaking our two year MBB will satisfy 38 credits with a summer research experience in year 1, and summer internship in year 2.

Research: There are numerous opportunities for students to develop lab-based research skills. In addition to laboratory training students will complete a summer research project and a 400 hour industrial internship.

Start-up costs: for the program will be enhanced by receipt of a Professional Science Masters' Program grant from the National Science Foundation to which we have applied. The total project period grant is for \$699,997. Most of the funding is for graduate student stipends and tuition reimbursement. A small amount of funding is requested for program management and evaluations. Some funding will be provided for students via company paid internships and from individual research laboratories seeking to hire second year students on specific projects. The Bioexpress Fermentation Facility will supply an additional internship. Many of the courses proposed in this degree program already exist in other programs and we will make use of relevant courses by integrating our new students into these established courses. Costs for faculty, minimal supplies, and related expenses are approximately \$300,000 per year and will be covered primarily through reallocation of other resources.

Justification and need for the program

1. Indicate the societal need for graduates prepared by this program. Describe the process used to reach these conclusions, the basis for estimating this need, and those factors that were considered in documenting the program need.

The biomanufacturing and bioprocessing industry is diverse, encompassing the massive production scales of the liquid biofuels industry at one end, to the high quality, highly regulated biopharmaceutical industry at the other. In between there are commercial sectors such as the biochemical industry, agriculture, environmental technology, biodefense, biomaterials, household goods and even leisure that use biotechnology products. Each market sector has its own needs and drivers, but a common resonating aspect is that to get a product to market, a biological entity must be grown and products harvested from it, in a word “biomanufacturing”. Products include biomass (e.g. foodstuffs or probiotics), metabolic products (e.g. fuels and biochemicals such as ethanol and lactic acid, or pharmaceutical products such as antibiotics), or cell components (e.g. pDNA for vaccines, therapeutic antibodies, or industrial enzymes). Biomanufacturing is the common operation that links the different market sectors in the biotechnology industry. Historically, the US has not had a large fermentation industry and has therefore not developed sufficient training programs in this area. With the emergence of the biofuel and biopharma sectors and maturation of other biomanufacturing industries, the dearth of scientists, engineers and technicians to run these plants is evident. While many biotechnology programs touch on biomanufacturing and bioprocessing, the UGA MBB will be unique in its focus on the full biomanufacturing and bioprocessing experience with hands on training and exposure to industrial grade equipment. This program will be the first biotech SMP in Georgia, and the first with a truly biomanufacturing focus in the Eastern US. The industrial focus will separate the program from many others which have a more biomedical slant.

Biomanufacturing training is not easy to execute. The subject is interdisciplinary. Students need a thorough understanding of microbiology, genetics, biochemistry and engineering in addition to understanding industrial methods, supply chains, finances, company operation, management, regulatory and environmental issues, and of industrial drivers and markets.

2. Indicate the student demand for the program in the region served by the institution. What evidence exists of this demand?

Biomanufacturing equipment is complex and expensive, and it is usually impractical to provide hands on access to students. This lack of traditional training at universities has led to a situation where many of the most skilled operators and leaders were educated by on-the-job training from industrial mentors. However, rapid growth of the industry in the past decade, and the expected future growth dictate that one-on-one mentor-pupil relationships will not be sufficient to meet industry needs. Universities and other training institutions need to act now to ensure that this manpower market is properly resourced. Many of the principles involved in this program application have former students now employed in this industry and calls are fielded on a weekly (sometimes daily) basis from companies looking to hire recent graduates with training such as that described in the proposed program. Several recent studies document the need for the training that is proposed in this program including (see Appendix A for details):

- Shaping Infinity: The Georgia Life Sciences Industry Report (2009), Beata D. Kochut and Jeffrey M. Humphries. Prepared by the Selig Center for Economic Growth (UGA) for Georgia BIO and BioGeorgia.
- The Bioscience Industry in Georgia's Innovation Crescent: Employment, growth and economic Impact (2008); Tommie L. Shepherd and Archie Flanders. Prepared for the Fanning Institute, UGA by the Center for Agribusiness and Economic Development, UGA.
- Energy and Environmental Workforce Educational Needs: Supply and Demand in Georgia (2008). Prepared for the University System of Georgia Board of Regents by the Georgia Tech Enterprise Innovation Institute.

3. Give any additional reasons that make the program desirable (for example, exceptional qualifications of the faculty, special facilities, etc.)

The University of Georgia is uniquely equipped to fill the need for a well trained biomanufacturing workforce primarily due to the special facilities available through the **University of Georgia Bioexpression & Fermentation Facility** (BFF; www.bff.uga.edu). The BFF is a state-of-the-art biomanufacturing facility founded in 1967 and reorganized in 2001. The BFF offers services in strain development, fermentation process development and scale up to 800L; downstream processing and protein purification process development and scale up to multi-gram product quantities; fill-finish services and full analytical support. In 2009 a BSL3 containment mammalian cell culture and protein purification suite was commissioned. In 2008/2009 the BFF's fermentation pilot plant was updated using a \$1m Georgia Research Alliance (GRA) grant. More than \$500,000 of additional money has been used for equipment upgrades since 2001 and a further \$3m of GRA money was used to equip the BSL3 cell culture suite. The facility is now suitable as a training center, and the MBB could be the first program to benefit from the \$1m pilot plant renovation, including access to state of the art process control systems furnished by MBB partner DCI-Biolaffite. This company is also a technology provider to Merial, another MBB partner. Further global facility control systems are provided by Siemens and Innovative Controls. Both companies will be involved with the MBB program and are also installing systems into MBB partner company Terrapin Breweries and Dupont-Danisco's biofuel facility in Tennessee. The State's commitment and investment in systems for research and training that match those in modern commercial facilities allows students unparalleled access to equipment and facilities and will in turn provide industry with well-trained work-ready graduates.

Another major plus for housing the new MBB program at UGA include the interdisciplinary collaborations and learning opportunities provided by the faculty involved in the new major. Several are members of the Faculty of Engineering (FoE), a pan-university group of faculty that have engineering backgrounds, but that are based in a variety of schools and departments. The FoE is a ground breaking university paradigm bringing together university faculty and private sector partners in a virtual department structure to foster collaborations. Several members of the group are members of the Biofuels, Bioenergy and Biomaterials initiative (B3i) formerly chaired by Co-PI and MBB co-director Joy Doran Peterson. B3i has more than 90 members interested in sustainable industry, many of whom interact with companies that hire employees with biomanufacturing expertise. This bioenergy initiative is now run primarily through the Office of

the Vice President for Research and will remain a valuable resource for the proposed program. In addition, UGA is part of one of three DOE-funded bioenergy research centers. The Bioenergy Science Center (BESC) is an interdisciplinary group involving academia, industry and government labs and which may be used as a resource for MBB students. Another resource available to the MBB program are the faculty involved in the Biomedical and Health Sciences Institute (BHSI) which was formed in 2001 specifically to foster interdisciplinary research and instruction and which currently boasts 170 members from 9 schools and 38 departments. The BHSI faculty includes those with interests in drug design, manufacturing and deployment and MBB students may have a direct impact on these scientists and their industrial collaborators.

4. Include reports of advisory committees and consultants, if available.

Please see Appendices for referenced reports. For doctoral programs, the institution should involve at least three authorities in the field (outside of the institution) as consultants, and should include their reports as a part of the proposal. Not a doctoral program.

5. List all public and private institutions in the state offering similar programs. There are no similar programs in the state at either public or private institutions. Also, for doctoral programs, list at least five institutions in other southeastern states that are offering similar programs. If no such programs exist, so indicate. No such programs exist.

Procedures used to develop the program

Describe the process by which the institution developed the proposed program.

Georgia based companies indicate a growing need for biotechnologists and specifically pinpointed team leader/middle management positions typically filled by master's level graduates as areas of intense need. Graduates with a combination of technical and scientific skills and a good grounding in business and project management skills are highly sought. This finding was echoed by our industry partners and other companies interviewed during the development of the proposed curriculum. In North East Georgia, growth in training opportunities at technical colleges has resulted in better availability of technicians, but the state universities need to be better equipped to train team leaders and managers. It is the intent of this group to make UGA a center for training these scientists, an effort that will in turn staff existing companies in the state and encourage new companies to locate in the region. This plan will be complementary to numerous efforts already underway in the Northeast Georgia Innovation Crescent and will potentially attract students involved in the Biotechnology Major program at UGA.

As indicated in the previous section, three major documents were used to help provide background information for development of our specific MBB program. Please see Appendix A for these documents. In addition we surveyed companies likely to be interested in hiring new technically trained employees via phone calls, face-to-face meetings, and questionnaires. These surveys indicated a need for a scientifically, technically trained workforce with additional competencies in business practices, specifically strategic planning and finance. Our program descriptions were met with enthusiasm and support and a number of companies will participate as seminar presenters, workshop presenters, and/or industry partners for internships or service on our advisory boards. We will develop external advisory boards to help guide our activities, help develop the curriculum further, and to provide mentorship to students enrolled in our program.

The curriculum presented in this request resulted as a team effort with industry and academic partners. We have built in an evaluation tool that will also help us to fine tune the program.

Further we were assisted in the development of our program by selecting three programs that appeared to have components that would help us to create the type of graduate that would be desired by industries in our area. Those three programs are highlighted in a separate section of this proposal and are as follows:

Keck Graduate Institute of Applied Life Sciences Master of Bioscience with Bioprocessing Focus, www.kgi.edu/x1598.xml <http://www.kgi.edu/Prospective-Students/Admissions.html>
Dr. Matthew S. Croughan, Matthew.Croughan@kgi.edu (909) 607-8838

Illinois Professional Science Master's in Bioenergy, University of Illinois at Urbana-Champaign
<http://psm.illinois.edu/prospectivestudents/programs/bioenergy.htm> , Dr. Hans Blaschek,
blaschek@illinois.edu (217) 333-8224

North Carolina State University Master's of Microbial Biotechnology,
<http://www.microbiology.ncsu.edu/graduate/MMB/opinions.html>
Dr. Paul Hamilton, Department of Microbiology, MMBprogram@ncsu.edu, (919) 513-7206

Curriculum

List the entire course of study required and recommended to complete the degree program. Give a sample program of study that might be followed by a representative student. Indicate ways in which the proposed program is consistent with national standards.

- 1. Clearly differentiate which courses are existing and which are newly developed courses.*
- 2. Append course description for all courses (existing and new courses).*
- 3. When describing required or elective courses, list all course prerequisites.*
- 4. Indicate whether courses in a proposed masters program are cross-listed as undergraduate courses and, if so, what safeguards are employed to ensure that courses taken as undergraduates are not repeated or that requirements are significantly different for graduate students and undergraduates enrolled in the same course.*
- 5. Provide documentation that all courses in the proposed curriculum have met all institutional requirements for approval.*
- 6. Append any materials available from national accrediting agencies or professional organization as they relate to curriculum standards for the proposed program.*
- 7. When internships or field experiences are required as part of the program, provide information documenting internship availability as well as how students will be assigned and supervised.*
- 8. Indicate ways in which the proposed program is consistent with national standards.*
- 9. List student outcomes associated with this program.*

Curriculum

I. Year 1 (25 credits)

A. First Semester: 13 credits (cr) common to both business tracks and all focus areas.

- **Biomanufacturing Seminar (new course):** (1 cr) Course will engage students in team building dynamics, presentations and public speaking, introduce them to project

management, and provide networking opportunities. Student teams will prepare presentations that capture biomanufacturing events (e.g., development of a breakthrough vaccine or drug, or new technology for biochemical generation). Students will be introduced to resources including the UGA Biobusiness Incubator, GeorgiaBIO, the Terry College of Business's Entrepreneurship Program, and company partners. The remainder of the course will be devoted to invited speakers from industry and academia. Likely speakers would be from companies offering internships including Novozymes, Merial, C2Biofuels and Lonza Biotec. All presentations will be open. However, meetings with speakers will be available for MBB students. Instructor: Doran Peterson and guest speakers.

- **Ethical Issues in Research: PHRM 7230. Regulatory Affairs Graduate Education Program. College of Pharmacy.** (3 cr) Provides an introduction to bioethical principles used to make decisions when confronted with ethical issues involving research, fraud, scientific misconduct, and conflicts of interest. Students develop a framework for decision making to predict and solve ethical dilemmas within the pharmaceutical, biotechnology and medical device fields. NSF and NIH guidelines and hypothetical case study format will be used to analyze and apply these principles to industry. Instructor: Paul Brooks
 - 1. **Biotechnology BCMB (BTEC, ENTO) 6200. College of Agriculture and Environmental Science.** (3 cr) Applied aspects of biochemistry and molecular biology, with emphasis on use of recombinant DNA and protein engineering. **OR Introduction to Gene Technology PBIO (CRSS) (BIOL) 6500.** (3 cr) Methods and applications of gene technology and related concepts in molecular biology including structure/synthesis of macromolecules; cDNA/genomic cloning, polymerase chain reaction; molecular markers and mapping; gene isolation strategies; and host-vector systems. Instructors: Adang, Eiteman, Lanzilotta.
 - 2. **Strategic Management EMBA 7550E. Terry College of Business.** (3 cr) Traditional corporate strategy combined with principles of organizational change to produce an overview of strategic management as a process for adapting the firm to its changing environment. Topics include practical issues related to mental frameworks, human behavior, environmental and competitor analysis, and change implementation. Instructor: Allen Amason
 - 3. **Biostatistical Applications for Pharmaceutical and Biotechnology Industries. BIOS 7100. Regulatory Affairs Graduate Education Program. College of Pharmacy.** (3 cr) Biostatistical issues regarding the introduction and regulatory approval of products, and their postmarket surveillance are considered. Data quality assurance, experimental design, clinical trials, power and sample size determination, uncertainty assessment, regression, survival analysis, and variable and model selection are considered. Non-traditional format: online study including teaching, assignments, discussion, problem-based learning, and case-based learning. Weekend seminar(s) totaling eight contact hours (multi-point video conference) using case-based and problem-based learning methods. Instructor: Paul Brooks
- B. Second semester: 9 credits**
- **Microbiology for Biomanufacturing and Industrial Biotechnology (new course required of both business tracks and all focus areas)** (3 cr) Understanding principles of selecting and using microbes to produce desired products. Kinetics and instruction on microbial growth, metabolism and biochemistry. Understanding product variety – metabolic products, secondary metabolites, biomass, proteins, DNA, RNA etc. Topics include: Microbial diversity and metabolism; Strain selection, engineering, optimization. Diverse applications of microorganisms in industrial settings including site visits. Instructors: Doran Peterson, Eiteman, Westpheling (Genetics).

- **Business Component. 3 cr specific to business track. Students choose 1 of 2 courses listed for each track in consultation with mentors. Both courses may be taken if desired.**
Large Company Track: **MGMT 7220 Project Management.** (3 cr) Planning, scheduling, organizing, implementing, and controlling of single and multiple projects. Explores traditional and new techniques for the dynamic environment of project management. Instructors: Amason, Napoleon. OR **EMBA 7200 Managerial Finance.** (3 cr) Focus on responsibilities, concerns, and methods of analysis employed by corporate financial managers, and the role of financial markets and institutions in the modern economy. Topics: capital structure, dividend policy, asset evaluation, capital budgeting, risk analysis, and portfolio theory. Instructor: Baginski/Harvey/Amason.
Small company Track: **EMBA 7800 Entrepreneurship & New Venture Creation.** Examination of the new venture process, from idea generation to startup to harvest. Emphasis is placed on the generation of a complete business plan for a new product or service. Topics: entrepreneurial leadership and infrastructure, assessment of viability, business plan development and presentation, and entrepreneurial finance. Instructors: Verbrugge or Hanks. OR **EMBA 7600 Financial Analysis & Cost Management.** Application of basic principles of finance and accounting to a broad array of management activities. Topics: financial forecasting with an emphasis on cash flows and financial needs, valuation of ongoing operations, evaluation of production alternatives, cost accounting systems, and advanced capital budgeting. Instructor: Amason

C. Summer Research Experience: (1 cr) required of both business tracks and all focus areas. Students will undertake industry-relevant research in either an industrial partner laboratory or an academic/institutional laboratory in collaboration with an industry partner. A project outline with specific goals and a timeline will be developed during the first week. A formal written report and a mini-symposium for oral presentation of research activities will showcase the experience and will provide practice for polishing professional communication skills. Examples are presented below. One experience might involve a MBB student interested in the small business track with a biofuels focus. The student will consult with an industry partner (e.g. C2 Biofuels), to evaluate performance of a new biocatalyst and determine its suitability for biofuel production from pretreated pine in large-scale fermentations. The student will work in collaboration with the business partner and an academic mentor to develop a testing protocol for their new yeast and would use the pilot scale fermentation facilities at UGA's BFF. Additional testing could be performed at the company facilities. The student could also work in laboratories on campus involved with this type of project (Doran Peterson, Davies, Eiteman, Westpheling, Lanzilotta).

A second scenario could involve Merial and a project already underway at the UGA Biobusiness Center or in the Merial production facilities in Athens. Merial is a large company involved in a number of veterinary products including HeartGuard, and Frontline. Researchers at UGA including Ralph Tripp are also very involved in animal vaccine development especially for poultry, and work on some of these vaccines is ongoing.

II. Year 2 (18 credits)

A. First Semester : (9 cr) 6 cr required of both business tracks and all focus areas, 3 cr elective course(s) from areas of focus list.

- **Process Development and Optimization (new course)** (3 cr) Classroom and computer training course introducing students to topics using both practice computer simulation* and hands on experience with laboratory equipment used in industry. Topics: Microbial kinetics in fermentors (Growth, nutrient uptake, product formation); Fermentation principles (Batch, fed-batch, continuous); Process design (Design for best economics); Designing processes for the product – industry sector requirements for operating at scale; Principles of process optimization (methods, statistical design (DOE), data mining, fuzzy logic/black box methods) Instructors: Coordinator: Davies, co-instructors: Doran Peterson, Eiteman, Lanzilotta.
- **Fermentation Engineering** (new course) (3 cr) Classroom, computer simulation* and lab based course (BFF fermentors). Topics: Mass transfer/mass balance in fermentors; physical factors in fermentation and their measurement and control; fermentor engineering, and the operation, control and modeling of different fermentors (air lift, plug flow, immobilized reactors, perfusion reactors); scale up/scale down; bioreactor control and operation (feedback control, sensors and measurement); fermentation and plant monitoring systems (PLC, SCADA, DCS); process control room practices (batch control software, programming, monitoring); data handling and mining; fermentor operation and hands on training. Instructors: Coordinator: Davies, Eiteman, Lanzilotta with guest lectures from representatives of companies including Broadley James, Innovative controls and DCI-Biolaffite.
- ***Computer Simulation:** Development of interactive training modules prior to hands-on work with actual equipment increases student confidence and enhances the probability of successful completion of the activity. Leeds University (UK) School of Biological Sciences (LU), and specifically subject matter expert Suzanne Bickerdike, will provide support in cyber-enabled learning and provide insight into European biomanufacturing training practices. UGA will provide funds for this collaboration. \$30,000 is currently committed by the Office of the Vice President for Research, the Graduate School, the BFF and the Department of Biochemistry and Molecular Biology. These computer simulation courses at Leeds University have resulted in increased enrolment, decreased failing grades and a 10% increase in average test scores.

B. Second Semester : (9 cr)

- **Group Research Project** (new course required of both tracks and all focus areas) (3 cr) Lab and research based course. Intensive course involving multi-level group structure with participants working as a team on an industry-relevant challenge. Teams will have access to laboratory resources (BFF, industry labs, and possibly government labs). Problems may have a business component as well as a technical aspect. One example of a “team” as defined by this project includes technical college biotech major; undergraduate biotech major; MBB student; PhD student and industry professional. Problems will be provided in collaboration with our industry partners and will include developing an outline, timeline, budget, and allocation of personnel and other resources. Instructors: Multiple.
- **Optional Business Course, Large Company Track.** MARK 7760 New Product Development (3 cr) Course focuses on the basic steps of new product development: opportunity identification, design, testing, and implementation. Students learn how to read and interpret new

product market research. Students are also able to enhance their creativity with research information and idea generating techniques. Instructor: Kumar.

- **Small Firm Track.** FINA 7160 Venture Capital Financing (3 cr) Venture capital in financing entrepreneurial growth companies. How venture capital is raised, invested, and then harvested for reinvestment. How professional venture capitalists analyze and structure potential investments.
- 3 cr elective course from areas of focus list, required for both business tracks: Optional courses for specific focus areas. Choose from the following courses for 3 credits for Semester 1, and 3 credits for semester 2 for a total of 6 credits during year 2. Students may elect to take additional courses in their area of interest as time and resources permit.

Track 1.:Biofuels/Biochemicals

Opportunities in a Bio-based Economy FORS8020 (1-3 cr)
Procurement & management of wood fiber supply (3 cr) FORS 7780 (Warnell School of Forestry and Natural Resources, WSFNR)

The Science of Sustainability (2 cr)
FANR 7750 (WSFNR)

Design of biochemical separations processed (3 cr) ENGR 4520/6520. - Design of Biochemical Separations Processes (Biological & Agricultural Engineering)
Biofuels and biochemicals industry and production (New Course- Westpheling)

Track 2: Industrial/environmental

Food fermentations (3 cr)
FDST(MIBO) 4120/6120-4120L/6120L: Food Fermentations (Food science)

Fermentation Engineering Laboratory (4 cr) BCHE 8210 - (Biological & Agricultural Engineering)
Design of biochemical separations processed (3 cr) ENGR 4520/6520. - Design of Biochemical Separations Processes (Biological & Agricultural Engineering)
Protein expression, protein science and purification (New Course – Lanzilotta)

Track 3: Pharmaceutical

Current Good Manufacturing Practices (3 cr) PHAR 6030.
Regulatory Affairs Graduate Education Program. Coll.Pharmacy.

Intro to pharmaceutical, biotechnology and device industries (4 cr) PHAR6010 (Coll. Pharmacy)
Process control and validation (3 cr) PHAR 6120 (College of Pharmacy)

Mammalian cell culture principles and methods (New Course -Tripp)

Inventory of faculty directly involved

For each faculty member, give the following data:

1. *Name, rank, academic discipline, institutions attended, degrees earned;*
2. *Current workload for typical semester, including specific courses usually taught; explain how workload will be impacted with the addition of proposed program;*
3. *Scholarship and publication record for past five years;*
4. *Professional activity;*
5. *Expected responsibilities in this program;*
6. *If it will be necessary to add faculty in order to begin the program, give the desired qualifications of the persons to be added, with a timetable for adding new faculty and plan for funding new positions.*

Not necessary to add faculty in order to begin the program.

List of Key Participants

The SMP in biomanufacturing and Bioprocessing (MBB) will involve an exceptionally interdisciplinary group of UGA faculty. Ten key faculty are listed.

E. Timothy Davies (PI) is Director of the Bioexpression and Fermentation Facility in the Dept. of Biochemistry and Molecular Biology, and is co-director of the MBB. His research interests are in biomanufacturing, process optimization, scale up and technology transfer. He has numerous industry links and has worked with more than 80 companies.

1. Education:

- 1995 University of Manchester Institute of Science and Technology
Ph.D. Chemical Engineering
1990 Queen Mary and Westfield College, University of London
Honours Microbiology, Class 2i

2. Current workload for typical semester: Dr. Davies is the current Director of the Bioexpress Fermentation Facility and does not routinely teach academic courses. As an integral part of this new major he will develop and co-teach two new courses: Process Development and Optimization (3 cr) and Fermentation Engineering (3 cr).

3. Scholarship and publication record for past five years:

Patent Li, X.-L.; Ljungdahl, L.G.; Azain, M.J.; Shah, A.; Davies, E.T.; Blum, D.L.; Kataeva, I. (2003). Phenolic acid esterases, coding sequences and methods. US Patent number 6602700.

Publication Davies, ET, Tellez, M and Unger, M. (2005). "*Pichia pastoris* and *E. coli* cross flow filtration and system bioreduction." Proceedings of the 10th Aachen Membrane Colloquium.

Scholarship Poster presentations at international conferences.

4. Professional activity

Selected Lectures / Conference Responsibilities

- 2008 IFPAC, Baltimore, MD, invited speaker
2007 Applied Biosystems, fermentation workshop convenor
2007 Southeastern Biofuels Conference, Tifton, GA, Invited Speaker
2006 Society Industrial Microbiology Annual Meeting, Baltimore, MD; workshop faculty
2005 10th Aachen Membrane Colloquium, Aachen, Germany, Invited Speaker
2004 Society Industrial Microbiology Annual Meeting, Anaheim, CA; Session Convener
2004 National Institute for Environmental Health Science; Invited speaker
2002 Society Industrial Microbiology Ann. Meeting, Philadelphia, PA; Session Convener
2001 Dept. of Biochemistry & Molecular Biology, UGA; Invited speaker
1994 International Conference on Bioprocess Engineering, Cuernavaca, Mexico; Speaker
1994 Society for General Microbiology 128th General Meeting, Cambridge, UK; Speaker
1993 6th European Congress on Biotechnology, Florence, Italy; Speaker

Awards and Grants

- 2008 Georgia Research Alliance Special award \$1,000,000
2007 NSF SBIR grant reviewer
2006-pres. Board of Directors, Biotechnology Program, Athens Technical College
2007-pres. Board of Directors, Biotechnology Program, Gwinnett Technical College
2007-2010 Member, Program Committee, Society for Industrial Microbiology
2003 Georgia Research Alliance Innovation Grants Program \$89,000

5. Expected responsibilities in this program; Dr. Davies is the PI of the NSF proposal submitted to help fund this initiative. He and Dr. Doran-Peterson will co-direct the new Master of Biomanufacturing and Bioprocessing degree. Dr. Davies will develop and teach two new courses. The first course entitled Process Development and Optimization (3 cr) is a classroom and computer training course introducing students to topics using both practice computer simulation and hands on experience with laboratory equipment used in industry. Topics include: Microbial kinetics in fermentors (Growth, nutrient uptake, product formation); Fermentation principles (Batch, fed-batch, continuous); Process design (Design for best economics); Designing processes for the product – industry sector requirements for operating at scale; Principles of process optimization (methods, statistical design (DOE), data mining, fuzzy logic/black box methods). Additional instructors include Doran- Peterson, Eiteman, and Lanzilotta.

The second course is entitled Fermentation Engineering (3 cr) and is a classroom, computer simulation and lab based course using the BFF fermentors. Topics include: Mass transfer/mass balance in fermentors; physical factors in fermentation and their measurement and control; fermentor engineering, and the operation, control and modeling of different fermentors (air lift, plug flow, immobilized reactors, perfusion reactors); scale up/scale down; bioreactor control and operation (feedback control, sensors and measurement); fermentation and plant monitoring systems (PLC, SCADA, DCS); process control room practices (batch control software, programming, monitoring); data handling and mining; fermentor operation and hands on training. Instructors: Davies, Eiteman, Lanzilotta with guest lectures from representatives of companies including Broadley James, Innovative controls and DCI-Biolaffite.

The BHSI will provide administrative support and the MBB will be offered by the UGA Graduate School. A *Steering Committee* with membership from UGA faculty and representatives from academic and industrial partners has been formed and will function during the design and implementation of the MBB. Once the MBB has been approved by the University System Board of Regents and it becomes operational, this committee will split into an *External Advisory Board* (consisting of industrial partner representation), a *Curriculum Committee* (consisting of UGA and academic partner faculty and representation from key industrial partners), and a faculty-led *Recruiting, Admissions and Retention Committee*.

A *Graduate Coordinator* will be selected to lead this last committee and will be the liaison between students and faculty/employers. Initial membership of all committees is provided.

Joy Doran Peterson (Co-PI) is Associate Professor of Microbiology and Chair of the UGA B3i group (described below). She is co-director of the MBB. Dr Peterson has 20 years of experience in microbial diversity, biomass conversion and biofuels research and has worked extensively with companies involved in developing clean fuels.

1. Education:

1994	University of Florida Ph.D in Microbiology and Cell Science
1986	University of South Florida Pre-Professional Sciences Post-Baccalaureate Certificate

1981 University of Georgia
B.S. Ed., Health Science

2. Current workload for typical semester:

MIBO 4090/6090, Prokaryotic Biology; every other year Spring semester. GRSC 7770, Graduate Instruction and Professional Development; every Fall. MIBO 4900L/4960H, Directed Research with Undergraduates; 1-4 students every semester. MIBO 7000/8900/9000, Directed Research with Graduate Students; 4 current PhD students. FORS 8020, Opportunities in a Biomass-based Economy (Co-teach); and BCHE 8210, Fermentation Engineering Laboratory (Co-teach). Currently developing a new course in Industrial Microbiology and Biotechnology and will lead the Biomanufacturing Seminar course if the new major is approved.

Typical workload for a year is one and a half courses. The Industrial Microbiology and Biotechnology course will be offered every spring semester and will comprise the major teaching responsibility. The Prokaryotic Biology course is being revised into Advanced Microbial Physiology and will be a newly required course for all Microbiology majors. Dr. Peterson will have minimal responsibility for the Advanced Microbial Physiology course in order to devote more time to the Industrial Microbiology course.

3. Scholarship and publication record for past five years:

Publications:

Doran-Peterson, J., S. Brandon, A. Jangid, E. DeCrescenzo-Henriksen, B. Dien, and L. Ingram. 2009. Simultaneous saccharification and fermentation and partial saccharification and co-fermentation of lignocellulosic biomass for ethanol production. *Biofuels: Methods and Protocols, Methods in Molecular Biology, vol. 581* (ed. J. R. Mielenz), pp. 263-280.

Cook, D., E. DeCrescenzo Henriksen, T. Rogers, and **J. Doran- Peterson**. 2008. *Klugiella xanthitipulae* gen. nov., sp. nov., a novel member of the family *Microbacteriaceae*. International Journal of Systematic and Evolutionary Microbiology. Intl. J. Systematic Evol. Microbiol. 58: 2779-2782.

Doran -Peterson, J., D.M. Cook, and S.K. Brandon. 2008. Microbial conversion of sugars from plant biomass to ethanol and lactic acid. The Plant Journal. 54(4):582-592.

Anderson, W.F., B.S. Dien, S.K. Brandon, and **J.D. Peterson**. 2008. Assessment of bermudagrass and bunch grasses as feedstock for conversion to ethanol. Applied Biochem. Biotechnol. 145:28-36.

Ximenes, E.A., S.K. Brandon, and **J.D. Peterson**. 2008. Evaluation of a *Hypocrea jecorina* enzyme preparation for the hydrolysis of Tifton 85 bermudagrass (Tifton 85). Applied Biochem. Biotechnol. 146:89-100.

Peterson, J. D., and L. O. Ingram. 2008. Respiration in an anaerobic environment with an internal electron acceptor to produce fuel ethanol. In J. Wiegel, R. Maier, and M.W.W. Adams, (ed.), Incredible anaerobes: from physiology to genomics to fuels. Annals of the New York Academy of Sciences. 1125:363-372.

Brandon, S.K., M.A. Eiteman, K. Patel, M.M. Richbourg, D.J. Miller, and **J.D. Peterson**. 2008. Hydrolysis of Tifton 85 Bermudagrass in a Pressurized Batch Hot Water Reactor. *J. Chemical Technol. Biotechnol.* 83:505-512.

Cook, D.M., E.L. Henriksen, R.A. Upchurch, and **J.D. Peterson**. 2007. Isolation of polymer-degrading bacteria and characterization of the hindgut bacterial community from the detritus-feeding larvae of *Tipula abdominalis*. *Appl. Environ. Microbiol.* 73(17):5683-5686.

Henriksen, E., D. Phillips, and **J. Peterson**. 2007. Polymyxin E production by *Paenibacillus amylolyticus*. *Lett. Appl. Microbiol.* 45:491-496.

Peterson, J.D. 2006. Ethanol production from agricultural residues. *International Sugar Journal.* 108(1287):178-180.

Anderson, W.F., **J. Peterson**, D.E. Akin, and W.H. Morrison III. 2005. Enzyme pretreatment of grass lignocellulose for potential high-value co-products and improved fermentable substrate. *Applied Biochem. Biotechnol.* 121(1-3):303-310.

Technical Publications for Trade Journals or Industry:

Baker S. A., M. D. Westbrook, W. D. Greene, K.C. Das, **J. D. Peterson**, and R. L. Izlar. Evaluation of integrated harvesting systems in pine stands of the Southern United States. Proceedings of the World Bioenergy Conference, Jonkoping, Sweden. May 27-29, 2008.

Greene D., S. Baker, K.C. Das, and **J. Doran-Peterson**. Logging residues show promise for biofuel production. Forest Resources Association, Inc. Technical Report. January 17, 2008.

Greene W. D., K.C. Das, **J. Doran-Peterson** Recovery of Small Stems and Forest Residues for Bio-Based Products and Energy. Industry Partner: Langdale Industries, Valdosta, GA. Technical report for the Traditional Industries program and industry partner.

Ethanol Production from Pulp and Paper Sludge. **Joy Doran-Peterson**, K.C. Das. Industry Partner: MeadWestvaco, Cottonwood, AL. Technical report for the Traditional Industries Program and industry partner.

4. Professional activity:

Professional Service:

- 2009 – 2010 American Society for Microbiology Division O (Fermentation and Biotechnology) Advisor
- 2009 – curr Southeast Regional Sun Grant Advisory Board Member
- 2009 Southeastern Universities Research Association (SURA) Energy Workshop Organizer and Participant
- 2009 – curr Technical and Scientific Advisory Board for PureVision Technology, LLC.
- 2009 – curr Scientific Advisory Board, Netherlands Project on Ethanol from Sugarbeet

- 2009 Symposium Organizer for Southeastern Regional American Chemical Society Meeting on Biofuels
- 2009 Session Convener for the Society for Industrial Microbiology Meeting
- 2008 – 2009 Division O (Fermentation and Biotechnology) Chair, American Society for Microbiology (ASM)
- 2008 – curr Director Biofuels, Biopower, and Biomaterials Initiative (B3I) Univ. of Georgia
- 2008 – curr Scientific Advisory Board for the Oklahoma Bioenergy Center
- 2008 Session Convener for the 30th Symposium on Biotechnology for Fuels and Chemicals
- 2008 Session Convener for the American Society for Microbiology General Meeting
- 2007 Session Convener for the Pacific Rim Conference on Biotechnology and Industrial Microbiology
- 2007 Division O Chair-Elect, American Society of Microbiology
- 2005 Division O Councilor, ASM
- 2005 Faculty of Engineering Advisory Board
- 2003 Division O Alternate Councilor, ASM
- Current *Ad hoc* reviewer: FEMS Microbiology Letters, Applied Biochemistry and Biotechnology, Journal of Polymer Chemistry, Journal of Industrial Microbiology and Biotechnology, Biotechnology Progress, and Current Microbiology.
- Current *Ad hoc* reviewer: United States Department of Energy, United States Department of Agriculture, and the Consortium for Plant Biotechnology Research.
- Current Editorial Board, Biotechnology for Biofuels, an open access, peer-reviewed online journal featuring high-quality studies describing technological and operation advances in the production of biofuels from biomass.

Memberships:

- American Society for Microbiology
- Southeastern Branch ASM
- International Society for Biocatalysis and Bioenergy
- Institute of Biological Engineering
- Society for Industrial Microbiology
- American Chemical Society
- Faculty of Engineering at UGA
- International Society for Microbial Ecology
- Southeast Agriculture and Forestry Energy Resources Alliance (SAFER)
- BIO and Georgia BIO

5. Expected responsibilities in this program: Joy Doran-Peterson is co-PI with Tim Davies and Allen Amason on an NSF proposal to help establish this new Master of Biomanufacturing and

Bioprocessing degree. She will develop a new course in Industrial Microbiology at the Master's level and will lead the Biomanufacturing Seminar course to be offered each Fall Semester. Davies and Peterson will serve as co-directors of the MBB with access to an administrative assistant as described above for Dr. Davies section. Dr. Doran-Peterson will also serve as the Graduate Coordinator of the program.

Allen C. Amason (Co-PI) is Department Head and Associate Professor of Management in the Terry College of Business. He will organize business classes and provide a link between STEM and business activities. He is an expert in business strategy with extensive industrial experience.

1. Education:

1984 BBA. Georgia Southern University Finance

1993 Ph.D. University of South Carolina Strategic Management/International Business

2. Current workload for typical semester:

Chair, Department of Management. Currently teaches Strategic Management EMBA 7550E. New MBB students will be added to current course. Teaching load will not be impacted.

3. Scholarship and publication record for past five years:

Amason, A. C. & Mooney, A. C. 2008. Icarus' paradox revisited: How strong performance sows the seeds of dysfunction in future strategic decision making. *Strategic Organization*, 6: 407 – 434.

Mooney, A.C., Holahan, P. & **Amason, A.C.** 2007. Managing conflict in teams: Gaining the benefits, avoiding the costs. *J. of Management Studies*, 44: 733-758.

Amason, A. C., Shrader, R. C., & Tompson, G. H. 2006. Newness and novelty: relating top management team composition to new venture performance. *Journal of Business Venturing*, 21: 125-148.

Mooney, A.C., Holahan, P., **Amason, A.C.** 2007. An alternative approach to understanding conflict management: Exploring the mutation from cognitive to affective conflict. In *Human Side of Project Leadership*, Reilly, R. R. (Ed.), pp. 61 – 102.

Amason, A. C. 2005. The competitive advantage of a scholarly journal: Adhering to the principles of the process of blind review. *Invited Editorial - Journal of Management*, 31: 157-161.

4. Professional activity:

- 2008 President, Southern Management Association
- 2007 – curr The Russian Foundation for Human Reproductive Health and Recovery
- 2007 Program Chair, Southern Management Association
- 2005 Director, Doctoral Consortium, Southern Management Association

- 2002 – 2005 Sr. Associate Editor, Journal of Management
- 2002 – curr Editorial Review Board, Journal of Managerial Issues
- 2001 – 2002 Director, Undergraduate Advancement in Leadership Program, Institute for Leadership Advancement, Terry College of Business
- 2000 – 2002 Academy of Management, Southern Management Association, Board of Governors, Southern Management Association
- 1999 – 2002 Associate Editor, International Journal of Conflict Management
- 1999 Chair, Strategy and Business Policy Track of the Southern Management Association
- 1998 – curr Case Review Board, Entrepreneurship Theory & Practice
- 1996 – 2003 Editorial Review Board, Academy of Management Journal
- 1996 – 2002 Editorial Review Board, Journal of Management
- 1987 – 1989 Board of Directors, Southeastern Fisheries Association
- 1985 – 1989 Plant Manager: Sea Garden Seafoods, Inc Valona, GA
- 1984 – 1985 Operations Analyst: Union Camp Corp Savannah, GA

5. Expected responsibilities in this program: Dr. Amason will organize business classes and provide a link between STEM and business activities. He is an expert in business strategy with extensive industrial experience and will teach the Strategic Management course. Strategic Management includes traditional corporate strategy combined with principles of organizational change to produce an overview of strategic management as a process for adapting the firm to its changing environment. Topics include practical issues related to mental frameworks, human behavior, environmental and competitor analysis, and change implementation.

Michael J. Adang is Professor of Entomology and Biochemistry and coordinator of the Bachelor of Science in Applied Biotechnology. He is involved in MBB development and provides a link to the undergraduate biotechnology program. Dr Adang has experience in the biotechnology industry, academia and entrepreneurialism and specializes in research on the Bt toxin and agricultural biotechnology. He is also CSO of Insectigen, a MBB partner company.

1. Education:

1981	Washington State University	Ph.D
1978	Washington State University	MS
1974	Indiana University	B.A.

2. Current workload for typical semester: Dr. Adang is the co-founder of InsectiGen and is also the co-founder of a Bachelor of Science Degree in Applied Biotechnology and serves as the director of the program. He also co-teaches the BCMB/BTEC/ENTO 6200 Biotechnology course devoted to applied aspects of biochemistry and molecular biology, with emphasis on use of recombinant DNA and protein engineering. He will integrate new MBB students into the existing course and thus minimal impact will result.

3. Scholarship and publication record for past five years:

Park, Y., Hua, G., Abdullah, M.A., Rahman, R., and **Adang, M.J.** 2009. Cadherin fragments from *Anopheles gambiae* synergize *Bacillus thuringiensis* Cry4Ba toxicity against *Aedes aegypti* larvae. Appl. Environ. Microbiol. Epub ahead of print. Oct. 2.

Hua, G., Zhang, R., Bayyareddy, K., and **Adang, M.J.** 2009. *Anopheles gambiae* alkaline phosphatase is a functional receptor of *Bacillus thuringiensis* jegathesan Cry11Ba toxin. Biochemistry. 48. 9785-9793.

Abdullah, M. A., Moussa, S., Taylor, M. D., and **Adang, M. J.** 2009. *Manduca sexta* (Lepidoptera: Sphingidae) cadherin fragments function as synergists for Cry1A and Cry1C *Bacillus thuringiensis* toxins against noctuid moths *Helicoverpa zea*, *Agrotis ipsilon*, and *Spodoptera exigua*, Pest Management Science. 65. 1097-1103.

Zhang, R., Hua, g., Andacht, T.M., and **Adang, M.J.** 2008. A 106-kDa aminopeptidase is a putative receptor for *Bacillus thuringiensis* Cry11Ba toxin in the mosquito *Anopheles gambiae* genome. Biochemistry. 47. 11263-11272.

Chen, J., Hua, G.H., Jurat-Fuentes, J.L., Abdullah, M.A., and Adang, M.J. 2007. Synergism of *Bacillus thuringiensis* toxins by a fragment of a toxin-binding cadherin. Proc. Natl. Acad. Sci. U.S.A. 104. 13901-13906.

Bayyareddy, K., Andacht, T. M., Abdullah, M. A., and **Adang, M. J.** 2009. Proteomic identification of *Bacillus thuringiensis* subsp. *israelensis* toxin Cry4Ba binding proteins in midgut membranes from *Aedes* (Stegomyia) *aegypti* Linnaeus (Diptera, Culicidae) larvae, Insect Biochem. Molec. Biol. 4. 279-286.

Park, Y., Abdullah, M. A., Taylor, M. D., Rahman, K., and **Adang, M. J.** 2009. Enhancement of *Bacillus thuringiensis* Cry3Aa and Cry3Bb toxicities to coleopteran larvae by a toxin-binding fragment of an insect cadherin, Appl. Environ. Microbiol. 75. 3086-3092.

Adang, M. J. et al. 2008. Peptides for inhibiting insects with an insect cadherin ectodomain. U.S. Patent 7,396,813.

Adang, M., Kemp, J.D. and Firoozabady, E. 2008. Insect resistant cotton plants. U.S. Patent 7,345,229

Griffitts, J.S., Haslam, S.M., Yang, T., Garczynski, S.F., Mulloy, B., Morris, H., Cremer, P.S., Dell, A., **Adang, M.J.**, Aroian, R.V. 2005. Glycolipids as receptors for *Bacillus thuringiensis* crystal toxin. Science, 307. 922-925.

4. Professional activity:

Synergistic Activities

- 2001 – 2006 Biocontrol Science and Technology
- 1998-curr Pesticide Biochemistry and Physiology
- 1995-2003 Applied and Environmental Microbiology

- Founder, Chief Scientific Officer, Vice President and Board Member, InsectiGen, Inc. Athens, GA.
- co-Founder and Director, Undergraduate Degree Program in Applied Biotechnology, University of Georgia, College of Agricultural and Environmental Scientist
- Intellectual Property Expert. Involved in writing over 20 patent applications. Expert consultant and witness in patent infringement litigations for major international companies including DowAgrosciences and Dupont.
- Teaching activities includes courses in Biotechnology, and Ethics and Communication in Biotechnology

5. Expected responsibilities in this program: Dr. Adang will provide a link to the undergraduate major in Biotechnology and will co-teach **Biotechnology BCMB (BTEC, ENTO) 6200. College of Agriculture and Environmental Science.** (3 cr) Applied aspects of biochemistry and molecular biology, with emphasis on use of recombinant DNA and protein engineering. Dr. Adang will also mentor student research and group projects as needed. If students enrolled in the MBB program have already completed this course, there are other courses that will be accepted (e.g. PBIO/CRSS/BIOL 6500 Introduction to Gene Technology)

W. Dale Greene is Professor in the Warnell School of Forestry & Natural Resources. He is involved in MBB program development and provides a link to the Master's in Forest Resources, exposing students interested in biofuels to training in feedstock sourcing and use. His research interests are in forest harvesting and biomass opportunities.

1. Education:

- 1986 Auburn University
Ph.D. Forestry
- 1983 Virginia Polytechnic Institute and State University
M.S. Forestry
- 1981 Louisiana State University
B.S. Forestry

2. Current workload for typical semester:

Fall semester, two sections of FORS 5720/7720 - one at Georgia and one at Clemson, each 3 hr class and a Freshman Seminar (1 hr). Spring semester, Senior Project (4 hrs but split between 3 instructors), FANR 1100 - 3 hr, and Biomass Seminar - 1 hr (split with another 1-3faculty). Maymester, teach 1/3 of our Maymester field course (4 hr).

Dr. Greene's role in the new Master's MBB program will involve having students take his existing courses but that would not increase Dr. Greene's workload. Students may also participate in research and group projects under Dr. Greene's direction.

3. Scholarship and publication record for past five years:

Refereed Publications:

Reddish, R.P., S.A. Baker, and **W.D. Greene**. (in review). Improving log trucking efficiency by using in woods scales. *Southern Journal of Applied Forestry*.

Das, K.C., K. Singh, B. Bibens, R. Hilten, S. Baker, **W.D. Greene**, and J.D. Peterson. (in review) Pyrolysis characteristics of forest residues obtained from different harvesting methods. *Applied Engineering in Agriculture*. (submitted December 2009)

Cass, R.D., S.A. Baker, and **W.D. Greene**. (in press) Costs and productivity impacts of roduct sorting on conventional ground-based timber harvesting operations. *Forest Products Journal* (accepted October 2009)

Hamsley, A.K, **W.D. Greene**, S.A. Baker, and G.E. Murphy. (in press) Individual stem value recovery of modified and conventional tree-length systems in the southeastern United States. *International Journal of Forest Engineering* (accepted October 2009)

Baker, S.A., M.D. Weststbrook, Jr., and **W.D. Greene**. 2010. Evaluation of integrated harvesting systems in pine stands of the southern United States. *Biomass & Bioenergy*. DOI:10.1016/j.biombioe.2010.01.014

Hamsley, A.K, **W.D. Greene**, and S.A. Baker. 2009. Comparison of value harvested by modified and conventional tree-length systems in the southeastern United States. *Forest Products Journal* 59(4): 29-34.

Baker, S.A. and **W.D. Greene**. 2008. Changes in Georgia's Logging Workforce, 1987-2007. *Southern Journal of Applied Forestry* 32(2): 60-68.

Westbrook, M.D., Jr., **W.D. Greene**, and R.L. Izlar. 2007. Utilizing forest biomass by adding a small chipper to a tree-length southern pine harvesting operation. *Southern Journal of Applied Forestry* 31(4): 165-169.

Greene, W.D. S.A. Baker, and T. Lowrimore. 2007. Analysis of Log Hauling Vehicle Accidents in the State of Georgia, USA, 1988-2004. *International Journal of Forest Engineering* 18(2): 52-57.

Hamsley, A.K., **W.D. Greene**, J.P. Siry, and B.C. Mendell. 2007. Improving timber trucking performance by reducing variability of log truck weights. *Southern Journal of Applied Forestry* 31(1): 12-16.

Egan, A.F., **W.D. Greene**, N. deHoop, J.H. Mayo. 2006. Unused logging production capacity in northern New England, USA. *International Journal of Forest Engineering* 17(1): 31-38.

Siry, J.P., **W.D. Greene**, T.G. Harris, Jr., R.L. Izlar, A.K. Hamsley, K. Eason, T. Tye, S.S. Baldwin, and C. Hyldahl. 2006. Wood supply chain efficiency and fiber cost – What can we do better? *Forest Products Journal* 56(10): 4-10.

Conradie, I.P., **W.D. Greene**, J.F. Cox, G.E. Murphy. 2005. Applying the Thinking Process of the Theory of Constraints: An exploratory research methodology to evaluate the lack of use of cut-to-length harvesting systems in the southeastern USA. *Journal of Forest Products Business Research* 2(1).

Greene, W.D., J.H. Mayo, C.F. deHoop, and A.F. Egan. 2004. Causes and costs of unused logging capacity in the southern USA and Maine. *Forest Products Journal* 54(5): 29-37.

Conradie, I.P., **W.D. Greene**, and M.L. Clutter. 2004. The impact of a mill policy to discourage overweight log trucks. *Southern Journal of App Forestry* 28(2): 132-136.

Ulmer, J.R., **W.D. Greene**, M.L. Clutter, and J.H. Mayo. 2004. Consistency ratings for assessing the impact of variations in mill demand on logging crew production and cost. *Forest Products Journal* 54(7/8): 57-63.

Conradie, I.P., **W.D. Greene**, and G.E. Murphy. 2004. Value recovery with harvesters in southeastern USA pine stands. *Forest Products Journal* 54(12): 80-84.

de Hoop, C.F., A.F. Egan, **W.D. Greene** and J.H. Mayo. 2004. Are "Preferred Supplier" Contractors Representative of the Logging Business Community? A Survey Analysis. *Business Research Yearbook*. International Academy of Business Disciplines. Radford, VA. 5 pp. ISBN 1-889754-08-0.

4. Professional activity:

Universities:

- 2010 - curr Meigs Selection Committee
- 2000 – 2002 Curriculum Committee
- 1996 – 1999 University Council Elected Member
- 1996 – 1997 University Council Executive Committee
- 1996 – 1997 Faculty Admissions Committee Chairman
- 1995 – 1996 Ad-Hoc Enrollment Management Committee
- 1993 – 1997 Faculty Admissions Committee
- 1991 – 1993 Faculty Affairs Committee
- 1991 – 1993 Facilities Committee
- 1990 – 1993 University Council Elected Member

Promotion & Tenure:

- 2008 – 2009 University Review Committee Chairman
- 2006 – 2009 University Review Committee
- 1998 – 2001 University Appeals Committee

Warnell Standing Committees:

- 2006 – curr Curriculum Chairman
- 1998 – 2000 Teaching Effectiveness

- 1992 – 1995 Lands Chairman
- Administrative
- Research Coordination & Review
- Undergraduate Affairs

Service to the Forestry Community:

- 2008 Council on Forest Engineering National Chairman
- 2007 – 2008 Georgia State Board of Registration for Foresters Chairman
Appointed by Governor Perdue
- 2006 – 2008 Georgia Forestry Foundation Treasurer
- 2004 Georgia State Board of Registration for Foresters Appointed by
Governor Perdue
- 1993 – 2001 Treasurer
- 1993 Council on Forest Engineering National Chairman
- 1992 – curr Georgia Forestry Association Board of Directors
- 1990 Council on Forest Engineering Southern Chairman

5. Expected responsibilities in this program: Dr. Greene’s role in the new Master’s MBB program will involve having students take his existing courses but that would not increase Dr. Greene’s workload. Students may also participate in research and group projects under Dr. Greene’s direction.

Paul Brooks is Assistant Dean for Non-Traditional Education and Outreach at the College of Pharmacy. He runs programs in Regulatory Affairs. He is involved in MBB development and provides a link for SMP students interested in pharmaceutical biomanufacturing to relevant courses and will assist with developing non-traditional training programs.

1. Education:

- 1987 Mercer University Southern School of Pharmacy
Doctor of Pharmacy
- 2010 Institute of Higher Education, University of Georgia
Ed.D. (anticipated completion date)

2. Current workload for typical semester:

Administrative oversight of UGA’s college of pharmacy outreach education and external degree programs. Units include: The Office of Postgraduate Continuing Education and Outreach, The Office of Regulatory Affairs & Clinical Trials Graduate Education Programs; The Nontraditional Doctor of Pharmacy Pathway Program and other units including, Instructional Technology Modalities, Biomedical Continuing Education and Strategic Planning; Educational outreach programs that extend to the University, community, and state initiatives on health maintenance and the treatment of disease. Graduate Coordinator for Pharmaceutical & Biomedical Regulatory Affairs and faculty of record for PHAR 5200, 5210, 5220, 6800, 6900, 7000, 7300 and PHRM 4800.

Dr. Brooks will assist in distance learning application, administration, design, and utilization of existing regulatory affairs curricula for this new degree program designed for working professionals. These are administrative responsibilities for which Dr. Brooks is currently involved and therefore, will not adversely impact his current workload.

3. Scholarship & publication record for past five years.

McDuffie CM, **Brooks PJ**. Awarded in 2007, \$12,000 grant from University of Georgia Learning Technologies Grant to make video recordings of class lectures available for download on computers and iPods for on-demand viewing.

Tackett RL., Perri M., McDuffie C, **Brooks PJ**. Awarded in 2007, \$396,000 (2-year) from The Attorney General Consumer and Prescriber Education Grant Program for a two-year study on prescriber education for health care professionals about pharmaceutical industry marketing practices.

Brooks, PJ. Awarded in 2006, \$192,140 (2-year) grant from Board of Regent's Intellectual Capital Partnership Program (ICAPP) for development and operation of a Graduate Certificate in Clinical Trials Design and Management.

Brooks PJ, Hodges JL. Awarded in 2006, \$15,000 sub-contract from UGA Institute of Gerontology from U.S. Department of Health and Human Services grant to develop a plan and web-delivery of continuing education of geriatric practitioners.

4. Professional activity:

- 2010 – curr UGA Provost's Committee on Distance Learning Education
- 2008 – curr President's Council for SACS reaccreditation
- 2006 – curr University of Georgia College of Pharmacy: Curriculum Committee
- 2002 – curr University of Georgia College of Pharmacy: Dean's Administrative Council
- 2001 – curr University of Georgia College of Pharmacy: Executive Committee

5. Expected responsibilities in this program:

Dr. Brooks will assist in distance learning application, administration, design, and utilization of existing regulatory affairs curricula for this new degree program designed for working professionals.

Anthony C. Capomacchia is Associate Professor in Pharmaceutical and Biomedical Sciences. He has significant administrative experience in graduate student and minority student recruitment, funding and retention in conjunction with the Sloan Foundation. Dr Capomacchia will be on the MBB recruiting and admissions committee.

1. Education:

1976 University of Florida Ph.D Pharmacy

1969 University of Florida BS Pharmacy/Chemistry

2. Current workload for typical semester :

Fall - PHRM 4120 Pharmaceutics Skills lab I: 20 hours face-to-face contact every other week; preparation time 5 hours every other week. Average semester hour workload is about 188 hours prep time

Fall PHRM 8020 Introduction to Pharmaceutical Science: 2 hours + 5 hours prep: Average semester workload 7 hours.

Spring - PHRM 4130 Pharmaceutics Skills Lab II: 20 hours face-to-face contact every other week; preparation time 5 hours every other week. Average semester hour workload is about 188 hours.

3. Scholarship and publication record for past five years:

Publications (in reverse chronological order):

X. Yuan and **AC Capomacchia**, “Physicochemical Studies of the Binary Eutectic of Ibuprofen and Ketoprofen for Enhanced Transdermal Drug Delivery”, accepted, Drug Development and Industrial Pharmacy, February, 2010.

S.T. Garner, B. Israel, M. Thakare, P. Azadi, H. Ahmed, J.W. Beach, and **AC Capomacchia**, “Glucosamine/NSAID Mutual Prodrug Synthesis and Transdermal Permeation”, Drug Development and Industrial Pharmacy, under revision December 2009.

Jarrod W. Collier, Mohan Thakare, Solomon T. Garner, Bridg’ette Israel, Hisham Ahmed, Saundra Granade, Deborah L. Strong, James C. Price, and **AC Capomacchia**, “Accelerated dissolution testing for controlled release microspheres using the flow-through dissolution apparatus”, Pharmaceutical Development and Technology, 14 (1), 9 – 17, 2009.

AC. Capomacchia, Solomon T. Garner, J. Warren Beach, “Glucosamine and Glucosamine/Anti-Inflammatory Mutual Prodrugs, Compositions, and Methods”, US Patent Application Publication No.: US2008/0020997 A1, January 24, 2008.

Wooley, R., Ritchie, B., **Capomacchia, A.C.**, “Methods and Compositions for Promoting Wound Healing”, US Patent Application Publication No.: US2007/0003508 A1, January 4, 2007.

Solomon Garner, Bridg’ette Johnson-Israel, Trina Abney, Parastoo Azadi, and **AC Capomacchia**, “Preliminary studies on transdermal permeability of N-acetyl-glucosamine (NAG): a glucosamine metabolite, Pharmaceutical Development and Technology, 12:169 - 174, 2007.

Anthony C. Capomacchia, Solomon T. Garner, J. Warren Beach, “Glucosamine and Glucosamine/Anti-Inflammatory Mutual Prodrugs, Compositions, and Methods” World Intellectual Property Organization, International Publication Number WO2005/116086 A2, 8 December 2005.

Xudong Yuan and **AC Capomacchia**, “The Binary Eutectic of NSAIDs and Two Phase Liquid System for Enhanced Membrane Permeation”; *Pharmaceutical Development and Technology*, 1:1-10, 2005.

Pending Patent Applications

AC Capomacchia, ST Garner, JW Beach, National Stage Mexican Patent Application, “Glucosamine and glucosamine/anti-inflammatory mutual prodrugs, compositions, and methods”, filed 12 October 2006.

BW Ritchie, **AC Capomacchia**, RE Wooley, International Patent Application (Application No. PCT/US2006/025788) for “Methods and Compositions for Promoting Wound Healing” filed June 29, 2006.

AC Capomacchia, ST Garner, JW Beach, International Patent Application No. PCT/US2005/011739) “Glucosamine and glucosamine/anti-inflammatory mutual prodrugs, compositions, and methods”, filed April 7, 2005.

BW Ritchie, **AC Capomacchia**, RE Wooley, US Patent Application No. 11/173,824 for “Methods and Compositions for Wound Healing”, July 1, 2005; this application claims priority from US Patent Application No. 10/812,668, filed March 30, 2004, which is a continuation in part of US Patent Application No. 10/739,841, filed December 18, 2003, which is a continuation in part of Patent Application No. 09/955,657, filed September 18, 2001, which claims the benefit of US Provisional patent 60/234,375, filed September 20, 2000, and US Provisional Application No. 60/435,413 filed December 19, 2002.

AC Capomacchia, ST Garner, JW Beach, US Patent application 235.00560201, “Glucosamine and glucosamine/anti-inflammatory mutual prodrugs, compositions, and methods”, 7 April 2005.

4. Professional Activity:

- Multicultural Graduate Program Development/Maintenance:
- Developed and maintain the largest funded STEM (science, technology, engineering, mathematics) minority graduate student program at UGA; funded by the Alfred P. Sloan Foundation (APSF), NIH-NIGMS: UGA-NCAT Bridges to the Doctorate program, UGA Graduate School, and the department.
Program annual recruitment travel: GA, SC, AL, NC, VA, and TN; 182 auto trips to various HBCUs. The program enjoys a ninety-seven percent retention

rate (34/35 students). Currently there are 8 students in the program; 5 more are poised to enter.

5. Expected responsibilities:

Dr. Capomacchia will actively recruit students into the program through visits to regional institutions and attendance at regional graduate fairs and will participate in mentoring students accepted into the program with emphasis on retaining and graduating all students accepted into the program.

Mark Eiteman is Professor of Engineering with research interests in metabolic engineering and fermentation technology for fuels and chemicals. He is director of the Master's in Biological Engineering in the College of Agriculture and Environmental Sciences. He will be on the MBB curriculum committee and provides a link for students interested in engineering aspects of biomanufacturing to relevant courses.

1. Education:

1991	University of Virginia	Ph.D. Chemical Engineering
1988	University of Virginia	M.S. Chemical Engineering
1986	Virginia Tech	B.S. Chemical Engineering

2. Current workload for typical semester:

ENGR 3520, Mass Transport and Rate Phenomena, 3 h (fall semester)
ENGR 4510/6510, Biochemical Engineering, 3 h (spring semester)
ENGR 4520/6520, Biochemical Separation Processes, 3 h (fall semester)
BCHE 2910, Introduction to Biochemical Engineering Design, 2 h (fall semester)
BCHE 3180, Engineering Laboratory III, 2 h (instruct one or two 3 week labs)
BCHE 4XXX, Biochemical Engineering Laboratory, 2 h (spring semester; instruct one or two 3 week labs)

My instructional responsibilities will not be impacted by the addition of this program.

3. Scholarship and publication record for last five years:

E. Altman, **M. A. Eiteman**, "The Potential for Using *Escherichia coli* and Other Organisms to Produce Recombinant Ingredients for the Cosmetic Industry," in *Microorganisms and Cosmetics*, Anthony O'Lenick Jr. (ed.) Allured Books, Carol Stream, IL, pp. 385-394, 2009.

Y. Zhu, **M. A. Eiteman**, S. A. Lee, E. Altman, "Conversion of glycerol to pyruvate by *Escherichia coli* using acetate- and acetate/glucose-limited fed-batch processes," *Journal of Industrial Microbiology and Biotechnology*, (2010).

S. Lu, **M. A. Eiteman**, E. Altman, "Effect of Flue Gas Components on Succinate Production and CO₂ Fixation by Metabolically Engineered *Escherichia coli*," *World Journal of Microbiology and Biotechnology*, (2009) doi:10.1007/s11274-009-0185-1

S. Lu, **M. A. Eiteman**, E. Altman, "Effect of CO₂ on Succinate Production in Dual-Phase *Escherichia coli* Fermentations," *Journal of Biotechnology*, 143:213-223 (2009) doi: 10.1016/j.jbiotec.2009.07.012

S. Lu, **M. A. Eiteman**, E. Altman, "pH and Base Counterion Affect Succinate Production in Dual-Phase *Escherichia coli* Fermentations," *Journal of Industrial Microbiology and Biotechnology*, 36:1101-1109 (2009) doi: 10.1007/s10295-009-0594-z

A. Singer, **M. A. Eiteman**, E. Altman, "DNA Plasmid Production in Different Host Strains of *Escherichia coli*," *Journal of Industrial Microbiology and Biotechnology*, 36:521-530 (2009) doi: 10.1007/s10295-008-0522-7

M. A. Eiteman, S. A. Lee, R. Altman, E. Altman, "A Substrate-Selective Co-Fermentation Strategy with *Escherichia coli* Produces Lactate by Simultaneously Consuming Xylose and Glucose," *Biotechnology and Bioengineering*, 102(3):822-827 (2009) doi: 10.1002/bit.22103

Y. Zhu, **M. A. Eiteman**, R. Altman, E. Altman, "High Glycolytic Flux Improves Pyruvate Production by a Metabolically Engineered *Escherichia coli* Strain," *Applied and Environmental Microbiology*, 74(21):6649-6655 (2008) doi: 10.1128/AEM.01610-08

Y. Zhu, **M. A. Eiteman**, E. Altman, "Indirect Monitoring of Acetate Exhaustion and Cell Recycle Improve Lactate Production by Non-Growing *Escherichia coli*," *Biotechnology Letters*, 30:1943-1946 (2008) doi: 10.1007/s10529-008-9775-5

M. A. Eiteman, S. A. Lee, E. Altman, "A Co-Fermentation Strategy to Consume Sugar Mixtures Effectively," *Journal of Biological Engineering*, 2:3 (2008) doi: 10.1186/175-1611-2-3

G. Lee, R. N. Carrow, R. R. Duncan, **M. A. Eiteman**, M. W. Rieger, "Synthesis of Organic Osmolytes and Salt Tolerance Mechanisms in *Paspalum vaginatum*," *Environmental and Experimental Botany*, 63:19-27 (2008) doi: 10.1016/j.envexpbot.2007.10.009

S. K. Brandon, **M. A. Eiteman**, K. Patel, M. M. Richbourg, D. J. Miller, William F. Anderson, J. D. Peterson, "Hydrolysis of Tifton 85 Bermudagrass in a Pressurized Batch Hot Water Reactor," *Journal of Chemical Technology and Biotechnology*, 83:505-512 (2008) doi: 10.1002/jctb.1824

G. N. Vemuri, **M. A. Eiteman**, J. E. McEwen, L. Olsson, J. Nielsen, "Increasing NADH Oxidation Reduces Overflow Metabolism in *Saccharomyces cerevisiae*," *Proceedings of the National Academy of Sciences*, 104(7), 2402-2407 (2007) doi: 10.1073/pnas.0607469104

Y. Zhu, **M. A. Eiteman**, K. DeWitt, E. Altman, "Homolactate Fermentation by Metabolically Engineered *Escherichia coli*," *Applied and Environmental Microbiology*, 73(2), 456-464 (2007) doi: 10.1128/AEM.02022-06

M. A. Eiteman, E. Altman, "Overcoming Acetate in *Escherichia coli* Recombinant Protein Fermentations," *Trends in Biotechnology*, 24(11), 530-536 (2006) doi: 10.1016/j.tibtech.2006.09.001

G. M. Smith, S. A. Lee, K. C. Reilly, **M. A. Eiteman**, E. Altman, "Fed-Batch Two-Phase Production of Alanine by a Metabolically Engineered *Escherichia coli*," *Biotechnology Letters*, 28, 1695-1700 (2006) doi: 10.1007/s10529-006-9142-3

G. N. Vemuri, E. Altman, D. P. Sangurdekar, A. B. Khodursky, **M. A. Eiteman**, "Overflow Metabolism in *Escherichia coli* During Steady-State Growth: Transcriptional Regulation and Effect of the Redox Ratio," *Applied and Environmental Microbiology*, 72(5), 3652-3661 (2006) doi: 10.1128/AEM.72.5.3653-3661.2006

G. N. Vemuri, **M. A. Eiteman**, E. Altman, "Increased Recombinant Protein Production in *Escherichia coli* Strains with Overexpressed Water-Forming NADH Oxidase and a Deleted ArcA Regulatory Protein," *Biotechnology and Bioengineering*, 94(3), 538-542 (2006) doi: 10.1002/bit.20853

4. Professional activity:

- 2010 Session Chair, Institute of Biological Engineering Annual Meeting, Bioprocessing and Natural Products Session, Cambridge, Massachusetts
- 2009 Fellow of the Institute of Biological Engineering
- 2009 Editor-in-Chief, Journal of Biological Engineering
- 2009 Session Chairman, Institute of Biological Engineering Annual Meeting, Biofuels Session, Santa Clara, California
- 2008 Session Chairman, Institute of Biological Engineering Annual Meeting, Advances in Engineering Microbial Metabolism Session, Chapel Hill, North Carolina
- 2007 Session Chairman, Recent Advances in Fermentation Technology VII, St. Petersburg Beach, Florida
- 2006 Session Chair, 28th Symposium on Biotechnology for Fuels and Chemicals, Bioprocessing Research Session, Nashville, Tennessee

5. Expected responsibilities in this program:

Dr. Eiteman will help develop courses in Biochemical Engineering and will assist in the curriculum development for additional courses including: Industrial Microbiology and Biotechnology, Process Development and Optimization, and Fermentation Engineering. Dr. Eiteman will serve on the curriculum committee and will help provide a bridge to undergraduate engineering majors.

Ralph Tripp is Professor and Georgia Research Alliance (GRA) Chair of Animal Health Vaccine Development in the College of Veterinary Medicine, and a GRA eminent scholar. He has biopharmaceutical company affiliations, and is founder of Argent Diagnostics, Inc. As a GRA eminent scholar program he works on federal relations and emphasizes transfer

of technology from research to commercialization. He will be on the MBB curriculum committee.

1. Education:

1989 Oregon State University Ph.D. Immunology
1984 Franklin Pierce College B.A. Microbiology

2. Current workload for typical semester:

- 100% research appointment with guest lectures in
 - IDIS 8590: Disease Intervention Strategies Journal Club; direct
 - IDIS 8591: Advanced Concepts of Virology; 2 guest lecture/semester
 - CBIO 8100: Advanced Immunology; 1 guest lecture/semester
 - Gateway Seminar Series; guest lecture

Postgraduate Mentoring (since 2004)

Post-Doctoral Fellows in Laboratory:

Jeremy Driskell; Christine Henderson; Jennifer Harcourt, UGA/CDC, Sunny Liu; Abhijeet Bakre; Yan Zhen; Jenna Dare, UGA/CDC, Patricia Bosso, Shanna Siegel, Rene Alvarez, Sarachandra Shandmukh

Research Associates in Laboratory:

Leslie Jones, UGA; Debra Haas, UGA; Abhijeet Bakre, UGA; Paula Brooks, UGA; Jackelyn Crabtree, UGA; Geraldine Saavedra, UGA; Rene Alvarez, Alnylam Pharmaceuticals; Jennifer Humberd, UGA; Jamie Barber; UGA; Xiuzhen Yan, UGA.

Technicians:

Justin Abell, UGA; Thomas Poore, UGA; Bessie Wu, UGA/Emory Univ.; JunXuie Fu, UGA; Jess Neil, UGA; Raydel Maier, UGA; Carla Sturkie; UGA; Derek Williams

Undergraduate Mentoring (since 2004)

Georgia Veterinary Scholars Program (GVSP):

John Glidewell, Samantha Shields, Tammy Powell, Yandace Brown, Kamisi Campbell, Koren Moore

Summer Undergraduate Research Program (SURP):

Okwudinanka Igwe, Whitney Ellis, Bridgett Heath, Jenny Franks, Ria McCoy, Nikita Shemsko,

Center for Undergraduate Research Opportunities (CURO):

Craig Hayes, Jennifer Werner, Joseph Rimando, Lindsey Carter, Patricia Mitchell, Jonathan Keegan, Sonja Pandit, Karen Cureton, Jess Neil, Erica Shantha

Franklin Pierce Advantage Program:

Ben Goudreau, Liesel Bauer, Craig Weeks, Colleen Goss

Peach State Louis Stokes Alliance for Minority Participation (PSLAMP):

Ashley Jackson

ORISE Program with the CDC: Shannon Brown

3. Scholarship and publications record for past five years:

Vaccination to induce antibodies blocking the CX3C-CX3CR1 interaction of respiratory syncytial virus G protein reduces pulmonary inflammation and virus replication in mice. Zhang W, Choi Y, Haynes LM, Harcourt JL, Anderson LJ, Jones LP, **Tripp RA**. *J Virol*. 2010 Jan;84(2):1148-57.

Quantitative surface-enhanced Raman spectroscopy based analysis of microRNA mixtures. Driskell JD, Primera-Pedrozo OM, Dluhy RA, Zhao Y, **Tripp RA**. *Appl Spectrosc*. 2009

Potent high-affinity antibodies for treatment and prophylaxis of respiratory syncytial virus derived from B cells of infected patients. Collarini EJ, Lee FE, Foord O, Park M, Sperinde G, Wu H, Harriman WD, Carroll SF, Ellsworth SL, Anderson LJ, **Tripp RA**, Walsh EE, Keyt BA, Kauvar LM. *J Immunol*. 2009 Nov 15;183(10):6338-45.

Animal models for evaluation of influenza vaccines. **Tripp RA**, Tompkins SM. *Curr Top Microbiol Immunol*. 2009;333:397-412.

Replication and pathogenesis associated with H5N1, H5N2, and H5N3 low-pathogenic avian influenza virus infection in chickens and ducks. Mundt E, Gay L, Jones L, Saavedra G, Tompkins SM, **Tripp RA**. *Arch Virol*. 2009;154(8):1241-8.

Fabrication and characterization of a multiwell array SERS chip with biological applications. Abell JL, Driskell JD, Dluhy RA, **Tripp RA**, Zhao YP. *Biosens Bioelectron*. 2009 Aug 15;24(12):3663-70.

Therapeutic monoclonal antibody treatment targeting respiratory syncytial virus (RSV) G protein mediates viral clearance and reduces the pathogenesis of RSV infection in BALB/c mice. Haynes LM, Caidi H, Radu GU, Miao C, Harcourt JL, **Tripp RA**, Anderson LJ. *J Infect Dis*. 2009 Aug 1;200(3):439-47.

RNA interference-mediated silencing of the respiratory syncytial virus nucleocapsid defines a potent antiviral strategy. Alvarez R, Elbashir S, Borland T, Toudjarska I, Hadwiger P, John M, Roehl I, Morskaya SS, Martinello R, Kahn J, Van Ranst M, **Tripp RA**, DeVincenzo JP, Pandey R, Maier M, Nechev L, Manoharan M, Kotelianski V, Meyers R. *Antimicrob Agents Chemother*. 2009 Sep;53(9):3952-62.

Therapeutic applications of RNAi for silencing virus replication. **Tripp RA**, Tompkins SM. *Methods Mol Biol*. 2009;555:43-61

Respiratory syncytial virus proteins modulate suppressors of cytokine signaling 1 and 3 and the type I interferon response to infection by a toll-like receptor pathway. Oshansky CM, Krunkosky TM, Barber J, Jones LP, **Tripp RA**. *Viral Immunol*. 2009 Jun;22(3):147-61.

Human metapneumovirus establishes persistent infection in the lungs of mice and is reactivated by glucocorticoid treatment. Liu Y, Haas DL, Poore S, Isakovic S, Gahan M, Mahalingam S, Fu ZF, **Tripp RA**. *J Virol*. 2009 Jul;83(13):6837-48.

The host response and molecular pathogenesis associated with respiratory syncytial virus infection. Oshansky CM, Zhang W, Moore E, **Tripp RA**. *Future Microbiol*. 2009 Apr;4:279-97.

Treatment with respiratory syncytial virus G glycoprotein monoclonal antibody or F(ab')₂ components mediates reduced pulmonary inflammation in mice. Miao C, Radu GU, Caidi H, **Tripp RA**, Anderson LJ, Haynes LM. *J Gen Virol*. 2009 May;90(Pt 5):1119-23.

Respiratory syncytial virus activates innate immunity through Toll-like receptor 2. Murawski MR, Bowen GN, Cerny AM, Anderson LJ, Haynes LM, **Tripp RA**, Kurt-Jones EA, Finberg RW. *J Virol*. 2009 Feb;83(3):1492-500.

Respiratory syncytial virus (RSV) attachment and nonstructural proteins modify the type I interferon response associated with suppressor of cytokine signaling (SOCS) proteins and IFN-stimulated gene-15 (ISG15). Moore EC, Barber J, **Tripp RA**. *Virol J*. 2008 Oct 13;5:116

RNA interference inhibits respiratory syncytial virus replication and disease pathogenesis without inhibiting priming of the memory immune response. Zhang W, **Tripp RA**. *J Virol*. 2008 Dec;82(24):12221-31.

Rapid microRNA (miRNA) detection and classification via surface-enhanced Raman spectroscopy (SERS). Driskell JD, Seto AG, Jones LP, Jokela S, Dluhy RA, Zhao YP, **Tripp RA**. *Biosens Bioelectron*. 2008 Dec 1;24(4):923-8.

Molecular and cellular mechanisms in the viral exacerbation of asthma. Tauro S, Su YC, Thomas S, Schwarze J, Matthaei KI, Townsend D, Simson L, **Tripp RA**, Mahalingam S. *Microbes Infect*. 2008 Jul;10(9):1014-23.

Recombinant vaccines for influenza virus. **Tripp RA**, Tompkins SM. *Curr Opin Investig Drugs*. 2008 Aug;9(8):836-45.

Identification and classification of respiratory syncytial virus (RSV) strains by surface-enhanced Raman spectroscopy and multivariate statistical techniques. Shanmukh S, Jones L, Zhao YP, Driskell JD, **Tripp RA**, Dluhy RA. *Anal Bioanal Chem*. 2008 Mar;390(6):1551-5.

Serum mannose-binding lectin levels are linked with respiratory syncytial virus (RSV) disease. Ribeiro LZ, **Tripp RA**, Rossi LM, Palma PV, Yokosawa J, Mantese OC, Oliveira TF, Nepomuceno LL, Queiróz DA. *J Clin Immunol*. 2008 Mar;28(2):166-73.

Bioconjugated nanoparticle detection of respiratory syncytial virus infection. **Tripp RA**, Alvarez R, Anderson B, Jones L, Weeks C, Chen W. *Int J Nanomedicine*. 2007;2(1):117-24.

An in vitro model of the leukocyte interactions associated with granuloma formation in Mycobacterium tuberculosis infection. Birkness KA, Guarner J, Sable SB, **Tripp RA**, Kellar KL, Bartlett J, Quinn FD. Immunol Cell Biol. 2007 Feb-Mar;85(2):160-8.

Rapid and sensitive detection of respiratory virus molecular signatures using a silver nanorod array SERS substrate. Shanmukh S, Jones L, Driskell J, Zhao Y, Dluhy R, **Tripp RA**. Nano Lett. 2006 Nov;6(11):2630-6.

Counting single native biomolecules and intact viruses with color-coded nanoparticles. Agrawal A, Zhang C, Byassee T, **Tripp RA**, Nie S. Anal Chem. 2006 Feb 15;78(4):1061-70.

Respiratory syncytial virus G protein and G protein CX3C motif adversely affect CX3CR1+ T cell responses. Harcourt J, Alvarez R, Jones LP, Henderson C, Anderson LJ, **Tripp RA**. J Immunol. 2006 Feb 1;176(3):1600-8.

Respiratory syncytial virus (RSV) infects neuronal cells and processes that innervate the lung by a process involving RSV G protein. Li XQ, Fu ZF, Alvarez R, Henderson C, **Tripp RA**. J Virol. 2006 Jan;80(1):537-40.

Perspective on the host response to human metapneumovirus infection: what can we learn from respiratory syncytial virus infections? Mahalingam S, Schwarze J, Zaid A, Nissen M, Sloots T, Tauro S, Storer J, Alvarez R, **Tripp RA**. Microbes Infect. 2006 Jan;8(1):285-93.

Cytokines and respiratory syncytial virus infection. **Tripp RA**, Oshansky C, Alvarez R. Proc Am Thorac Soc. 2005;2(2):147-9.

Real-time detection of virus particles and viral protein expression with two-color nanoparticle probes. Agrawal A, **Tripp RA**, Anderson LJ, Nie S. J Virol. 2005 Jul;79(13):8625-8.

Monoclonal antibodies to SARS-associated coronavirus (SARS-CoV): identification of neutralizing and antibodies reactive to S, N, M and E viral proteins. **Tripp RA**, Haynes LM, Moore D, Anderson B, Tamin A, Harcourt BH, Jones LP, Yilla M, Babcock GJ, Greenough T, Ambrosino DM, Alvarez R, Callaway J, Cavitt S, Kamrud K, Alterson H, Smith J, Harcourt JL, Miao C, Razdan R, Comer JA, Rollin PE, Ksiazek TG, Sanchez A, Rota PA, Bellini WJ, Anderson LJ. J Virol Methods. 2005 Sep;128(1-2):21-8.

The immune response to human metapneumovirus is associated with aberrant immunity and impaired virus clearance in BALB/c mice. Alvarez R, **Tripp RA**. J Virol. 2005 May;79(10):5971-8.

4. Professional activity:

Editorial Boards/Committees/Memberships:

- 2010 – curr Academic Editor, PLoS ONE
- 2006 – curr **Scientific Advisory Boards:** Aerovectrx, Argent Diagnostics;
Consultant: Dharmacon/ThermoFisher, Trellis Biosciences, Alnylam Pharmaceuticals

- 2003 – curr UGA Biomedical and Health Sciences Institute, UGA nanoscale Science and Engineering Center, UGA Toxicology, American Association of Immunologists, American Society for Virology, American Society for Microbiology, Federation of American Societies for Experimental Biology, American Association for the Advancement of Science, Executive Board of the Faculty of Infectious Diseases
- 1998 – curr NIH study section reviewer: Ad hoc: Immunity and Host Defense, Drug Discovery Review, Therapeutics Biodefense, Cooperative Research Partnerships for Biodefense and Emerging Infectious Diseases, Chemical & Biological Defense Program, Immunotherapeutics, Biosensors, Special Emphasis Panels (PO1, SO1), ARRA Grants, VIRA, International: UK Action Research Project Grants, Australian NHMRC Project Grants, National Vaccine Program Office, Wellcome Trust, Ontario Food Safety Research Program, DEFRA, United Kingdom, Science Foundation Ireland, US/Israel Binational Science Foundation
- 1998 – curr Associate Editor: Cellular Immunology, Virology; Ad hoc reviewer: American Thoracic Society, Blood, Journal of Immunology, Journal of Immunologic Methods, Journal of Virology, Nature, Nature Immunology, Journal of General Virology, Virology, Virus Research, Archives of Virology, Pediatric Infectious Diseases, Clinical Infectious Diseases, Journal of Infectious Diseases, Vaccine, Cellular Microbiology, Clinical Infectious Diseases, Emerging Infectious Diseases, American Journal of Respiratory Cell and Molecular Biology, Cytokine, Microbes and Infection, Pharmacology, Nanomedicine, Expert Review of Anti-infective Therapy, Expert Reviews of Vaccines, ACS Nano, NanoLetters, Virus Genes

5. Expected responsibilities in this program: Dr. Tripp will provide input for curriculum development and will serve on the curriculum committee. He will also develop and coordinate a course on Mammalian cell culture principles and methods that will be offered as an elective in Track Three: Pharmaceutical.

William Lanzilotta is Associate Professor of Biochemistry & Molecular Biology with research expertise in protein structure and function. He has industrial biotechnology experience and several commercial collaborations. He will be on the MBB curriculum committee.

1. Education:

1998	Utah State University	Ph.D.	Biochemistry
1994	Fort Lewis College	B.A.	Chemistry

2. Current workload for typical semester:

Dr. Lanzilotta currently teaches 1/2 BCMB 8010, 1/3 BCMB 8110, 1/3 BCMB 8180, and 1/4 CHEM 8220, four undergraduate students in BCMB 4960 (independent research) and three graduate students. Average one full class per year as traditional class/contact hours, not including research students. Dr. Lanzilotta also serves as one of the departmental advisors and typically advise about 40 BCMB undergraduates per semester.

It is anticipated that my instructional duties associated with this proposal will fit synergistically within existing research programs and classes focused on pathway engineering and enzyme production. This would be primarily at the graduate level.

3. Scholarship and publication record for the past five years:

Medlock, A. E., Carter, M. Dailey, T. A., Dailey, H. A., **Lanzilotta, W. N.** Product Release Rather than Chelation Determines Metal Specificity for Ferrochelatase. (2009) *Journal of Molecular Biology* 393(2), 308-319.

Medlock, A., Dailey, T. A., Ross, T. A., Dailey, H. A., and **Lanzilotta, W. N.** A pi-Helix Selective for Porphyrin Deprotonation and Product release in Human Ferrochelatase (2007) *Journal of Molecular Biology* 373(4) 1006-1016

Medlock, Amy; Swartz, Larkin; Dailey, Tamara A.; Dailey, Harry A.; **Lanzilotta, William N.** (2007). Substrate interactions with human ferrochelatase. *P.N.A.S.* 104(6) 1789-1793

Swartz, L., Kuchinskas, M., Li, Huiing, Poulos, T. L., and **Lanzilotta, W. N.** (2006) Redox-Dependent Structural Changes in the *Azotobacter vinelandii* Bacterioferritin: New Insights Into the Ferroxidase and Iron Transport Mechanism. *Biochemistry* 45(14) 4421-4428

Iyer, R. A., Silaghi-Dumitrescu, S., Kurtz, D. M., and **Lanzilotta, W. N.** (2005) High-resolution crystal structures of *Desulfovibrio vulgaris* (Hildenborough) nigerthrin: facile, redox-dependent iron movement, domain interface variability, and peroxidase activity in the rubrerythrins. *J. Bio. Inorganic. Chem.* 10(4) 407-416

Silaghi-Dumitrescu, R., Kurtz, D. M., Ljungdahl, L. J., and **Lanzilotta, W. N.** (2005) X-ray Crystal Structures of *Moorella thermoacetica* FprA. Novel Diiron Site Structure and Mechanistic Insights into a Scavenging Nitric Oxide Reductase *Biochemistry* 44(17) 6492-6501

4. Professional activity:

- 2010 Discussion Leader at the Gordon Research Conference on the “Chemistry and Biology of Tetrapyrroles”
- 2009 NSF Panel member, SBIR – Biofuels Processing (BC) Panel
- 2009 Ad Hoc NSF panel Member, MCB Panel
- 2008 speaker, Gordon Research Conference; “Tetrapyrroles, The Chemistry and biology of”
- 2008 Heart Association Reviewer, Region II Basic Cell & Molecular Biology 1 Peer Review Committee
- 2006 NIH Special emphasis panel, SBIR / STTR – Chemistry and Biophysics
- 2006 Invited Speaker, Utah State University
- 2005 Invited Speaker, University of Kentucky, Department of Chemistry
- 2005 Invited Speaker, Virginia Polytechnic Institute and State University, Department of Biochemistry

- 2005 – curr Reviewer, JBIC
- 2004 – curr Panel Member, SBIR – Biotechnology (BT) Panel

5. Expected responsibilities in this program:

Dr. Lanzilotta will co-teach a practical course on metabolic pathway engineering and will help to supervise graduate student's progression through the program as a thesis advisor (P.I.).

Outstanding programs of this nature in other institutions

List three outstanding programs of this nature in the country, giving location name, and telephone number of official responsible for each program. Indicate features that make these programs stand out. When available, append descriptive literature of the outstanding program. Indicate what aspects of these outstanding programs, if any, will be included in your program.

A brief background describing the Professional Science Master's Program approach and number of programs is presented to inform the reader of the intent of our new major. Although we are not specifically requesting to start a new type of degree program (i.e. Professional Science Master's as compared to a traditional Master's degree), we are modeling the proposed program after the guidelines set by the National Professional Science Master's Association (www.npsma.org). In these types of programs, some universities call the program a Professional Science Master's degree and some use the more traditional designation of Master of Science or Master of Bioscience. A list of resources for more information is provided below and three examples of programs are presented. The closest match to the type of program we envision is the Master of Bioscience (MBS) with a Bioprocessing focus at the Keck Graduate Institute of Applied Life Sciences. A second very new program just launched this year is the University of Illinois Professional Science Master's (PSM) program in Bioenergy. The third program with some overlap with our proposed new focus area is the PSM degree in Microbial Biotechnology at North Carolina State University. NCSU's program lists aligning NCSU's academic goals with the goals of corporations in biotechnology and pharmaceutical sectors as their primary mission.

Resources for more information

Organizations and Initiatives

- [Council of Graduate Schools - ScienceMasters.com](http://www.sciencemasters.com)
- [National Professional Science Master's Association](http://www.npsma.org)
- [National Association of System Heads \(NASH\) PSM Initiative](http://www.nashpsm.org)

Selected Publications

- [A master's degree with a business spin gains popularity](#). Nature Medicine 15, 465 (2009), doi:10.1038/nm0509-465. (Access using this link may be restricted.)
- [AAAS: The New Masters of Science](#). Science News, Magazine of the Society for Science and the Public.
- [Professional Science Master's is 21st century MBA](#). Science News, Magazine of the Society for Science and the Public.
- [Promoting Professional Science Master's Degrees](#). Inside Higher Ed.
- [Taken for Granted: An Alternative to the Ph.D. Track](#). Science Careers, from the journal *Science* / AAAS (10.1126/science.caredit.a0900083).

Contact Information

Keck Graduate Institute of Applied Life Sciences Master of Bioscience with Bioprocessing Focus, www.kgi.edu/x1598.xml <http://www.kgi.edu/Prospective-Students/Admissions.html>
Dr. Matthew S. Croughan, Matthew.Croughan@kgi.edu (909) 607-8838

Illinois Professional Science Master's in Bioenergy, University of Illinois at Urbana-Champaign <http://psm.illinois.edu/prospectivestudents/programs/bioenergy.htm>, Dr. Hans Blaschek, blaschek@illinois.edu (217) 333-8224
North Carolina State University Master's of Microbial Biotechnology, <http://www.microbiology.ncsu.edu/graduate/MMB/opinions.html>
Dr. Paul Hamilton, Department of Microbiology, MMBprogram@ncsu.edu, (919) 513-7206

Inventory of pertinent library resources

Indicate--in numbers of volumes and periodicals--available library resources (including basic reference, bibliographic, and monographic works as well as major journal and serial sets; include any on-line resources) which are pertinent to the proposed program. How do library resources compare to those at institutions listed in section 6? What additional library support must be added to support the proposed program, and what is the plan for acquiring this support? Library resources coupled with online journal accessibility are sufficient for the program needs.

Student Qualifications

Describe the desired qualifications of the students who will be recruited and admitted to the proposed program, including ethnic populations that will be targeted.

Students admitted to the program will meet requirements from the Graduate School including the following:

- Bachelor's degree from a regionally accredited U.S. institution or a comparable degree from a recognized institution abroad
- Grade point average of 3.0 or higher (4.0 scale) for the last 60 hours of undergraduate work and for any graduate work
- Graduate Record Examination (GRE) score

In addition,

- International students whose native language is not English must have a TSE score of at least 50 or a TOEFL Academic Speaking Test (TAST) score of 26 for acceptance. A TOEFL test without this speaking test component may not be substituted.

MBB student recruitment will begin immediately after approval and funding through advertisement including web site, targeted advertisement in print and online media, email distribution to selected undergraduate programs, and at selected conferences. The MBB group will seek affiliation with the National Professional Science Master's Association which will increase visibility. Both majority and minority students will be targeted at UGA and throughout the State and region by these means. Students will be required to have a background preparation in one of the STEM disciplines or a closely related field prior to acceptance into the program.

The MBB Diversity Coordinatory will work closely with the Office of Diversity and Outreach in the Graduate School, and with existing UGA minority programs such as the PeachState Louis Stokes Alliance for Minority Participation and the Alfred P. Sloan Foundation Minority Graduate Research Program to recruit minority students from UGA and utilize existing relationships and feeder programs with State HBCUs including Fort Valley State U, Savannah State U, Albany State U, Spellman College, and Morehouse U; and regional HBCUs Florida A&M U, North Carolina Central U, North Carolina A&T U to recruit minority students from the State and region. In addition to advertisement, attendance at regional graduate and professional fairs to promote the MBB will occur along with day trips to regional institutions to interview and recruit prospective majority and minority students. Attendance at fairs is known to increase visibility and interest in both the visiting institution and programs it offers. Dr. Capomacchia has been engaged in this activity since 1994 with almost 200 trips to various fairs throughout the region (GA, AL, FL, SC, TN, and VA). Dr. Mensa-Wilmot has also attended many national and regional recruitment fairs such as ABRCMS. Day trips are especially important since they convey extreme interest and time investment to both the student interviewed and his/her institution. This is particularly true for minority students and their HBCU. Drs. Mensa-Wilmot and Capomacchia have experience with these activities and will be responsible for implementing and maintaining the recruitment program.

Facilities

Describe the facilities available for the proposed program. How do these facilities and equipment compare to those of excellent programs elsewhere? What new facilities and equipment are required, and what is the plan for acquiring these facilities and equipment?
We currently do not require additional facilities.

Description of Facilities and Resources available to SMP in Biomanufacturing and Bioprocessing students and faculty

Teaching Resources

Many classrooms and lecture rooms of varying size are available for use for lectures, seminars tutorials and MBB meetings. In addition to rooms available in the Coverdell Health Sciences Building, the Fred C. Davison Life Sciences Complex, the Biological Sciences Building and the Driftmeier Engineering Building, UGA has a state-of-the-art teaching center – the Zell B. Miller Learning Center (<http://www.sl.c.uga.edu/>) equipped with traditional classrooms and lecture theatres, study rooms, computer teaching labs and project rooms. The Fred C. Davison Life Sciences Complex has a state of the art computer training classroom that is adjacent to the BFF, and so convenient for combined cyber-based and lab based classes.

Research & Laboratory Resources

Due to the large number of faculty and company partners that will be involved in the SMP in Biomanufacturing and Bioprocessing, there is an enormous array of equipment and resources available to students in the program. A brief highlight of the available equipment follows below.

The Bioexpression and Fermentation Facility (BFF) consists of five integrated divisions providing a full range of services for biomanufacturing: a fully equipped 2000 ft² molecular

biology lab for strain development and manipulation; a 5000 ft² fermentation pilot plant for fermentation optimization, scale up and downstream processing; a 1000 ft² protein purification suite with ancillary 250 ft² fill/finish suite; a 150 ft² analytical suite; and a 1500 ft² BSL3 suite with two rooms, one dedicated to mammalian cell culture and the other to high throughput screening and protein purification. The facility was built in 1992 and is staffed by a full-time Ph.D director 13 staff, including four PhD level scientists. Selected equipment relevant to the project includes the following (see also <http://bff.uga.edu/equipment/category/overview/>): Fermentation and Cell Culture Equipment: DAS GIP Fed Batch Pro multiplexed fermentation unit with eight 1L fully automated fermentors; 7 New Brunswick Scientific Bioflo 3000 7.5L fermentors; Seven stainless steel fully controlled and automated sterilize in place fermentors: 2x32L; 150L; 250L; 500L; 600L; 900L; New Brunswick Scientific Celligen 310 14L cell culture bioreactor; Sartoris WAVE 20L bioreactor; Siemens PCS7 box distributed control system receiving global plant data from all pilot plant fermentors and ancillary equipment; two automated sampling systems. Other microbial and cell Culture Equipment: 10 Incubators, including 6 CO₂ incubators, 3 bench top incubator/shakers, 7 floor incubator/shakers, 3 laminar flow sterile hoods, Coy anaerobic chamber, Downstream Processing: 3 Sharples Continuous centrifuges; Whisperfuge continuous centrifuge; 6 floor centrifuges; three table top centrifuges; Beckman Optima TLX table top ultracentrifuge; 7 Microcentrifuges; 3 bench top tangential flow filtration (TFF) systems with numerous filter cartridges; NCSRT Purosep Pro pilot scale TFF system with dual pumps (up to 600 L/min) and process scale filter holder with filters; 3 sonicators; French Press with 40 ml capacity cell; Gaulin pressure homogenizer with 100 g cells/minute lysis capacity; Niro pressure homogenizer with 400g cells/minute lysis capacity.

Analytical: Beckman XG Span 8 robotic system fully equipped for high throughput (HTP) ELISA and other analyses, equipped with state of the art paradigm optical system with all available optical cartridges; 2 Gas Chromatography systems, 6 analytical HPLC systems with UV/vis, diode array, RI, and fluorescence detectors; 2 microplate readers, one, UV/vis detecton, one fluorescence, 4 spectrophotometers, Shimadzu RF-5301PC spectrofluorophotometer ; YSI glucose analyzer; gel imaging system with camera and analysis software; three light microscopes including one with built in digital camera and imaging software; approximately 10 gel systems for DNA and protein gels; Protein Purification: Seven FPLC systems (GE & Biorad) with flow rates from 50ml/min to 150ml/min; Four preparative HPLC systems (Waters & Rainin) with flow rates from 50ml/min to 800ml/min. Large number of FPLC columns up to 18L capacity; Large number of HPLC columns up to 3" (1L) including 1", 2" and 3" column packing station. Ancillary Equipment: 2 shelf lyophilizers; two bulk lyophilizers; pilot spray dryer, 2 cold rooms, 2 autoclaves, 2 dish washers; 2 hot air dryers; 5 HPLC grade water purifiers; 3 ice machines; eight -80oC freezers; four -20oC freezers; Seven refrigerators; approximately 75 pipettors; 3multi-channel pipettors; >20 desk top and lap top computers; one centralized computer server.

The Department of Microbiology at the University of Georgia houses multi-user equipment such as autoclaves, freeze-drying facilities, storage facilities, automated dishwashers, Coy Anaerobic Glove boxes, a BioRad Scanning spectrophotometer, scintillations counters, FPLC units, a phospho/fluoro-imager, an isothermal titration calorimeter, one Model 7520 Cambridge Technology Inc. microplate reader, various types of PCR thermocyclers, and 10L, 20 L, 100L volume fermenters.

The laboratory of Dr. Joy Doran Peterson in the Department of Microbiology has renovated facilities for work with aerobic and anaerobic microorganisms. The laboratory contains 3 multistation fermentation units capable of pH and temperature controlled fermentations, each with capacity to run 5 fermentations at a time. Dr. Peterson's laboratory contains a DIONEX DX-600 High Performance Ion Chromatograph with ED50A chemical detector with PeakNet 6 Bundled Workstation, a Shimadzu LC-20AT solvent Delivery Unit with UV-Vis and RI detector and autosampler, two Shimadzu gas chromatographs-one with and FID detector and one with a TCD detector, Hamilton Biosafety Cabinets, spectrophotometers, pH meters, Dounce tissue grinders, Fotodyne Gel-Pro Analyzer 4.0 software with system, Fotodyne FOTO/Analyst Investigator Eclipse Dual Light Workstations, Millipore Milli-RO Plus Reverse Osmosis System, Millipore Milli-Q Ultrapure Water System, Promega Vac-Man (R) 96 Vacuum Manifold, Fisher Biotech Semi-Dry Blotting Unit, analytical balances, Labconco Auto Densi- Flow, Beckman Benchtop Centrifuges, Precision Scientific Circulating Water Bath, Hofer PS 3000 DC Power Supply, Buchler Density Gradient Forming System, Vacuubrand Chemistry Diaphragm Pumps, Electrophoresis Power Supply EPS 600, Spectrum CF-1 Fraction Collector, Pharmacia Biotech GradiFrac with HiLoad Pump P-50, FisherBiotech Horizontal MiniGel Systems, BioRad Mini-Protean II protein gel electrophoresis kits with power supplies, Labconco Multistatic Pump, Hofer Hybridization Oven, Pharmacia Biotech Monitor UV-1, Pharmacia Biotech Recorder REC, Beckman Ultracentrifuge, Fisher Sonic Dismembrator Model 550, Savant Integrated SpeedVac System, Savant Automatic Environmental SpeedVac, Various stirring hot plates, Pharmacia Biotech VacuGene XL Vacuum Blotting System, Precision General Purpose Water Baths, Hofer HE 100 Supersub Horizontal Unit, incubators of varying size and temperature, Pharmacia Biotech Ultrospec 3000, Hofer Ultraviolet Crosslinker, Ericomp TwinBlock System, New Brunswick Environmental Incubator Shakers, Thermodyne Thermokool, Gilson Microfractionator, Revco Ultralow Temperature (-80_C) Freezer, Olympus BX40 Fluorescence microscope, Leica Sterozoom 3 Dissecting microscope and light source, two Coy Anaerobic Glove boxes with oxygen sensors, Bioscreen Growth Curves chamber for optical density measurements in controlled 200 unit trays, computers and printers, waterbaths, microcentrifuges, vortex mixers, microwaves, micropipettors and pipetaids, multichannel pipettors, refrigerators, and miscellaneous glassware and chemicals.

The Center for Molecular BioEngineering occupies 6,000 sq. ft. of recently renovated space in the Driftmier Engineering Building at the University of Georgia. The Center has a dedicated media facility and houses all of the equipment necessary for metabolic engineering projects. Media Preparation: two dishwashers; three autoclaves; two 10 cu. ft. drying ovens; automatic Petri-plate pouring machine (360 plate capacity). Culture Maintenance: two class IIB biosafety cabinets; 5 cu. ft. anaerobic glove box; eight 4 liter capacity water bath shakers; four 4 liter capacity air shakers; six 5 cu. ft. incubators (two are equipped with roller drums); two 21,000 rpm floor centrifuges; 8,000 rpm bench-top centrifuge with swinging bucket assembly. Biochemistry and Molecular Biology: two cold rooms (one with 100 cu. ft. capacity and one with 200 cu. ft. capacity); 72 cu. ft. chromatography refrigerator with internal outlets and lighting; three 17 cubic foot -20°C freezers; two 17 cubic foot -80°C freezers (one with CO2 back up); 18.2 MOhm water purification unit; two flaked ice machines that use 18.2 Mohm feed water; four DNA gel electrophoresis setups; four SDS PAGE setups complete with western blot capability; two fast ramp thermocyclers with heated lids; electroporator with capacitance

expander; visible spectrophotometer for cell sampling; two UV/visible six cell spectrophotometers with micro sample readers; incubator shaker for hybridizations; digital imaging system with cooled video camera and dual transilluminator complete with white and UV lights for photographing both DNA and protein gels; digital Petri-plate imaging system with macro lens camera; automatic speed-vac concentrator (for drying DNA samples and concentrating protein samples); dual-label scintillation counter; automatic French press with large and micro cells; 550W sonic disruptor with large and microtip probes; UV crosslinker; four stationary water baths for sample incubation; four microfuges. Fermentation: eight 2.5 L fermentors with temperature, pH, and dissolved oxygen control (two have automated substrate feed control); two 5.0 L fermentors; 20 L fermentor; two online (i.e., real-time) glucose/xylose/lactate/glutamine/glutamate analyzers; three programmable feed pumps (for exponential and linear feeds); two CO₂/O₂ off-gas analyzers; numerous mass flow controllers. Analysis: three gas chromatographs with electron capture, thermal conductivity, flame ionization, nitrogen-phosphorus, Sievers sulfur detectors; four high-pressure liquid chromatographs with fluorometric, refractive index, UV/visible, diode array and conductivity detectors; two GC/MS for gas or headspace analysis; dual column GC/MS with thermodesorption, cryofocussing and sniff port; substantial support facilities for chemical analysis exist elsewhere on the University of Georgia campus that may be used in the course of this study.

The Department of Biochemistry and Molecular Biology, and Dr William Lonazilotta have significant laboratory resources for protein chemistry and structure research:

Protein Chemistry: Major equipment items related to protein chemistry includes; Biocad Intergral 100 FPLC/HPLC with UV, pH, and RI detector, autosampler and fraction collector; Beckman L-8 80M Ultracentrifuge with numerous fixed angle and swinging bucket rotors capable of large and small scale protein isolation; Two, Douglas Instruments IMPAX I-5 crystallization robots (One aerobic, one anaerobic); Two, Coy Laboratorys Inc; Type B anaerobic chambers (~200 cubic feet of anaerobic work space) CSC Isothermal Titration Calorimeter Protein Solutions DLS Forma Scientific upright and Revco chest -80 freezers; VWR Brand 4 degree and -20 freezers Shimadzu UV-1601 spectrophotometer with computer interface; Pharmacia Biotech Phasta System Two Olympus PT 80 microscopes with camera mount; Several incubators and floor shakers for bacterial culture; Two Perkin Elmer GenAmp PCR Systems; The Lanzilotta laboratory also contains numerous small equipment items such as a pH meter, heating blocks, stir plates, shaking water baths. Structural Biology: The Department of Biochemistry and Molecular Biology is unique in the extended capabilities in structural biology and protein chemistry. The department currently has four X-ray generators equipped with CCD detectors and cryo-streams. In addition to the common Cu-edge (1.54 angstroms) X-rays used by most in-house X-ray sources, the department also has a Cr-edge (2.22 angstroms) X-ray source which allows for direct phasing from the sulfur anomalous scattering.

Other Available Resources at UGA:

- Microbiology Scientific Computing and Visualization Laboratory (MSCVL). This facility in the Biological Sciences Building contains the software and peripherals to access literature, databases, internet resources, sequence analysis and associated data visualization programs.
- Center for Advanced Ultrastructural Research (CAUR). This facility houses a scanning and

two transmission electron microscopes, confocal laser microscopes, and preparation and teaching rooms. It is staffed with a director and technicians.

- Molecular Graphics Laboratory (MGL). This facility, in the Chemistry Building, is equipped with 11 Silicon Graphics Indigo and IBM workstations that run a wide range of molecular simulation and analysis programs. The facility, with a Ph.D. director, is an official mirror site of the Brookhaven Protein Data Bank and the Cambridge Crystallographic Database.
- Complex Carbohydrate Research Center. The CCRC occupies an ~140,000 sq.ft. building specifically designed for the interdisciplinary and equipment-intensive nature of carbohydrate science, as well as to foster analytical service and training. CCRC NMR facility has three high-field NMR spectrometers (300-, 500-, and 600-MHz), fully equipped for biomolecular studies of liquids and solids. In addition, the GRA- UGA 800-MHz NMR facility is located in the CCRC building. This facility is supported by the Georgia Research Alliance and the University of Georgia and is a regional resource for high-field NMR studies of biological macromolecules. The CCRC recently accepted delivery of a Varian Unity Inova 900-MHz spectrometer, making the CCRC one of the first institutions world-wide to receive this state-of-the-art spectrometer. This instrument is the centerpiece of the Southeast Collaboratory for Biomolecular NMR and is funded by the National Institute of General Medical Sciences and the Georgia Research Alliance. Mass Spectrometry facility houses two Micromass Q-TOF 2 electrospray ionization mass; a ThermoFinnigan LCQ; a ThermoFinnigan LCQ Advantage; two ThermoFinnigan LTQ; a ThermoFinnigan LTQ-FT; HP 2025 MALDI-TOF mass; Applied Biosystems 4700 Proteomics Analyzer (TOF/TOF); Applied Biosystems Voyager DE-Pro (MALDI-TOF); as well as three HP GC-MSD mass spectrometers. CCRC Computational Laboratory is equipped with three computer clusters: a 128 CPU 32-bit HPC system (HP Proliant series with ultra low latency Myrinet Interconnects, based on dual Xeon P4 3.06 GHz, 1GB nodes), a 16 CPU 64-bit HPC system (HP RX2600 series with ultra low latency Myrinet Interconnects, based on dual Itanium 2 1.3 GHz, 2GB nodes) and a 16 node Grid system for code and hardware optimization (comprised of a mixture single and dual Xeon P4 nodes). Data storage in the Computational Laboratory is provided by two 2 TB fileserver (RAID 10) with data protection enhanced by a 100 TB auto-loading tape backup system. Both Unix (SGI Octane) and Linux (HP xw4100) workstations are employed for molecular visualization and support a variety of software packages. The workstations are located in a dedicated user laboratory, which is augmented by the necessary peripheral devices, including printers, CD/DVD writers and scanners.
- Molecular Genetics Instrumentation Facility (MGIF). Housed in the Life Sciences Building, this facility is fully equipped for the sequencing and synthesis of DNA and peptides. The facility is staffed with a Ph.D. director and two technicians.
- Cell Sorting Facility. Two facilities are located on campus, one in the Biological Sciences Building. These facilities are fully staffed with a director and technicians.
- Research Computing Resource. The RCR is a distributed computing cluster. Software includes the Wisconsin GCG sequence analysis programs, the PHYLIP suite for phylogenetic analyses, and a variety of population and evolution analysis programs. RCR also maintains a complete copy of sequence databases (e.g. GenBank, EMBL, SwissProtein, and PIR). The facility is maintained by the University Computing Network Services.

Administration

Describe how the proposed program will be administered within the structure of the institution.

Organization: Drs. Davies and Peterson will serve as co-directors of the MBB with access to an administrative assistant. The BHSI will provide administrative support (see budget justification). The MBB will be offered by the Department of Microbiology. A *Steering Committee* with membership from UGA faculty and representatives from academic and industrial partners has been formed and will function during the design and implementation of the MBB. Once the MBB has been approved by the University System Board of Regents and it becomes operational, this committee will split into an *External Advisory Board* (consisting of industrial partner representation), a *Curriculum Committee* (consisting of UGA and academic partner faculty and representation from key industrial partners), and a faculty-led *Recruiting, Admissions and Retention Committee*. A *Graduate Coordinator* will be selected to lead this last committee and will be the liaison between students and faculty/employers. Initial membership of all committees is provided.

Management: The MBB *Steering Committee* has already been formed and has functioned initially as a design team to assemble this proposal. They will continue to provide design input as the proposal for the MBB is submitted. After the program is approved, the *Recruiting & Admissions Committee* (led by the *Graduate Coordinator*) will begin advertisement of the program (by web site, targeted advertisement in print and online media, email distribution to selected undergraduate programs at regional institutions, brochures for distribution at targeted meetings) and develop selection criteria (in addition to criteria set by the UGA Graduate School) for admission to the MBB. Professors Tony Capomacchia and Kojo Mensa-Wilmot will serve as the diversity coordinators within the *Recruiting, Admissions and Retention Committee*. They will work with existing minority engagement programs such as the PeachState Louis Stokes Alliance for Minority Participation and the Sloan Foundation and take advantage of existing relationships with regional HBCUs (e.g., Fort Valley State, Savannah State) to assure the inclusion of underrepresented minority SMP candidates.

During recruitment of the first class of students, the *Curriculum Committee* will develop the tracking plan for MBB students; including assessment of the success of the students in terms of learning outcomes, training, and placement (see below). As students begin the program this committee will also gauge the viability of the curriculum plan and make adjustments as necessary. The *Curriculum Committee* will include a subcommittee for industrial partnerships, whose tasks include organization of team projects with technical school partners and guiding the design and placement of students into internship programs. This subcommittee will also be responsible for extracurricular activities that include the industrial partners, such as a seminar series at which industrial scientists introduce to MBB candidates a view of potential career paths and technology providers provide an introduction to opportunities in their companies.

Assessment

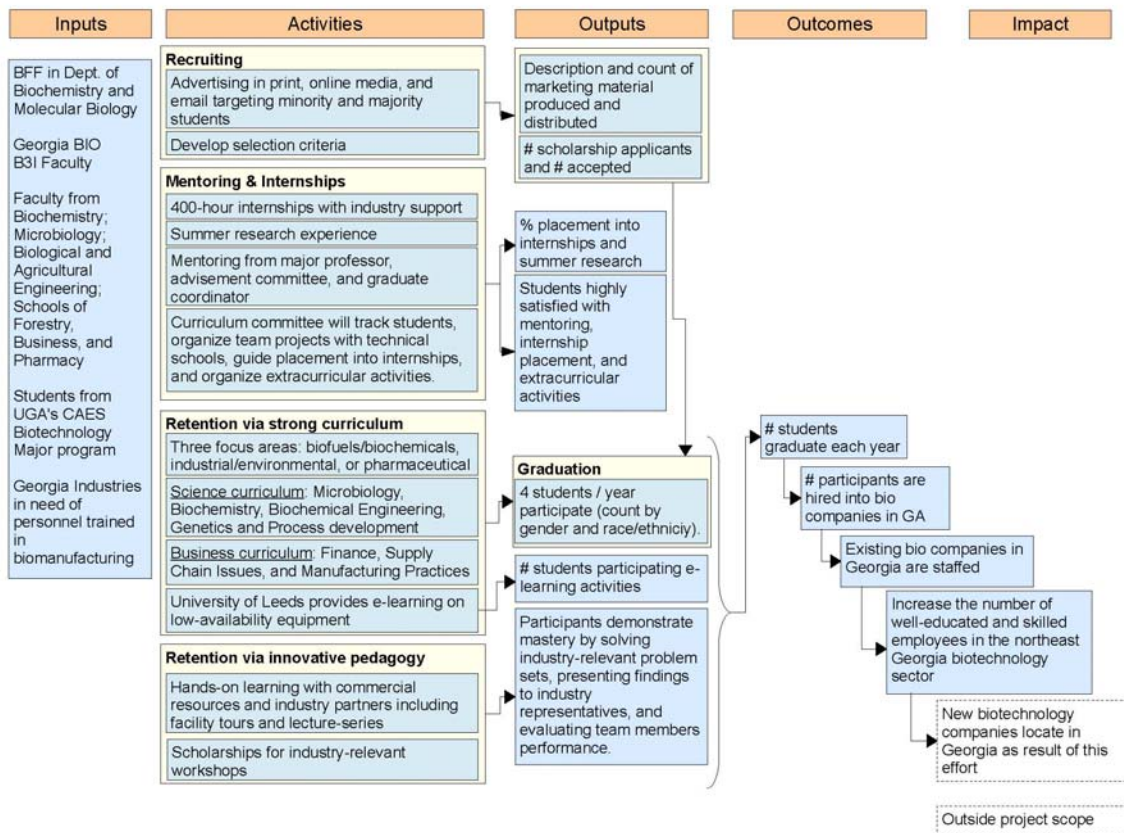
Indicate the measures that will be taken to assess the effectiveness of the program and the learning outcomes of students enrolled.

The evaluation of the MBB program will be conducted by The Findings Group, LLC, an independent evaluation organization specializing in K-16 STEM evaluation. The proposed evaluation plan is designed to provide objective feedback of both performance and results measures. The evaluation of the project emanates from the logic model (below) and is designed to provide ongoing, formative feedback as well as a summative evaluation.

Evaluation Questions and Methods

1. **Recruiting:** We will track the production, dissemination, and target audiences for the recruiting material and ask what percentage of students apply for and are accepted into the program and what effect recruiting efforts have on bringing students into the program. We will collect production and dissemination data and track success through an applicant and participant database. The data will be analyzed using descriptive statistics and the ratio of recruiting material produced to material disseminated to applicants to acceptances.
2. **Mentoring:** The evaluation asks what impact mentoring activities have on student success, and answers that question through a participant survey and through participant interviews or focus groups. Data will be analyzed using descriptive statistics for forced-response items and qualitative analysis for open-ended items and interview transcripts.
3. **Retention:** We seek to understand how participants react to their program of study, what scientific and business content knowledge participants have learned, and how effective the pedagogical techniques have been at retaining students. These are answered using end-of-course evaluations, pre/post content knowledge assessments, and interviews/focus groups. We will produce descriptive statistics for course evaluations; descriptive statistics, effect size, and significance tests for pre/post assessments; and a qualitative analysis of interview transcripts.
4. **Graduation:** The evaluation asks what number and percentage of students graduate from the program, how long it takes them to graduate, what they would have done had they not attended the program (to establish a counterfactual), what percentage advance or continue to the biomanufacturing workforce, and to what extent the program supports the needs of industry leaders. The number of graduates, time-to-graduation, and number entering the workforce is tracked through the participant database and analyzed using descriptive statistics. Participant entry into the workforce and learning what they would have done had they not entered the program will be gathered through interviews/focus groups and analyzed along with the other interview data using a grounded theory approach. We will also survey industry partners to learn how well the program is meeting industry needs and analyze the data using descriptive statistics.

Master of Biomufacturing and Bioprocessing



Reporting Schedule

Evaluation data will be reported on a schedule that maximizes its use. Ongoing performance and results data will be delivered to program staff as soon as possible, and an annual synthesis of the data will also be reported to program staff and for accountability purposes.

Evaluation Use

The program staff has identified specific areas where evaluation data may alter the program. Evaluation findings may affect the mechanisms used to recruit and retain participants, mentoring relationships, program pedagogy, curriculum content, and student assessment.

Accreditation

Where applicable, identify accrediting agencies and show how the program meets the criteria of these agencies. Append standards and criteria to the proposal. Provide evidence that the institution has notified SACS of its intent to apply for a change in degree level, if appropriate.

Not applicable.

Affirmative Action impact

Indicate what impact the implementation of the proposed program will have on the institution's desegregation and affirmative action programs. Include information relating to faculty, staff, administrators, and students in this section.

MBB student recruitment will begin immediately after approval and funding through advertisement including web site, targeted advertisement in print and online media, email distribution to selected undergraduate programs, and at selected conferences. Both majority and minority students will be targeted at UGA and throughout the State and region by these means. The SMP Diversity Coordinator will work with existing UGA minority programs such as the PeachState Louis Stokes Alliance for Minority Participation and the Alfred P. Sloan Foundation Minority Graduate Research Program to recruit minority students from UGA and utilize existing relationships and feeder programs with State HBCUs including Fort Valley State U, Savannah State U, Albany State U, Spellman College, and Morehouse U; and regional HBCUs Florida A&M U, North Carolina Central U, North Carolina A&T U to recruit minority students from the State and region. In addition to advertisement, attendance at regional graduate and professional fairs to promote the MBB will occur along with day trips to regional institutions to interview and recruit prospective majority and minority students. Attendance at fairs is known to increase visibility and interest in both the visiting institution and programs it offers. Dr. Capomacchia has been engaged in this activity since 1994 with almost 200 trips to various fairs throughout the region (GA, AL, FL, SC, TN, and VA). Dr. Mensa-Wilmot has also attended many national and regional recruitment fairs such as ABRCMS. Day trips are especially important since they convey extreme interest and time investment to both the student interviewed and his/her institution. This is particularly true for minority students and their HBCU. Drs. Mensa-Wilmot and Capomacchia have experience with these activities and will be responsible for implementing and maintaining the recruitment program.

Student mentoring is an integral part of any successful graduate program like SMP since it may significantly impact student retention and thereby program success. Mentoring is particularly important for minority students since in the South many students present with relatively low self esteem. The classic definition that a mentor is trusted counselor, guide and teacher holds in academia and will assure student/program success and retention if adhered to by the major professor, three member advisement committee and SMP Graduate Coordinator. They will review each student's academic and research progress every six months in the fall and spring to assure students are on track to graduate in the two year program period allotted by the SMP. Student retention is inextricably tied to the success of MBB program and will be assured by the mentoring procedure outlined above and the experience of the SMP recruitment faculty, Drs. Mensa-Wilmot and Capomacchia. Dr. Capomacchia has extensive experience managing the Alfred P. Sloan Minority Graduate Research program since 1999 in which thirteen College of Pharmacy and other UGA faculty participate. The retention rate for the program is 96% (29/30) with five additional students entering in 2009; seven are currently in the program; 21 have graduated (17 doctoral dissertations, 5 MS theses, 31 publications).

Degree inscription

Indicate the degree inscription which will be placed on the student's diploma upon his completion of this program of study. Be sure to include the CIP code for the program.

Master of Biomanufacturing and Bioprocessing

Fiscal and enrollment impact, and estimated budget

Complete the following pages to indicate the expected EFT and head count student enrollment, estimated expenditures, and projected revenues for the first three years of the program. Include both the redirection of existing resources and anticipated or requested new resources.

Institutional commitment of funds should be consistent with the centrality and level of priority that are assigned to the program in the proposal. Second and third-year estimates should be in constant dollars--do not allow for inflationary adjustments or anticipated pay increases. Include a budget narrative that is descriptive of significant line items and the specific redirection of resources envisioned.

I. ENROLLMENT PROJECTIONS	FY 11	FY12	FY 13
(indicate basis for projections in narrative)	First Year	Second Year	Third Year
A Student majors			
1. Shifted from other programs	0	0	0
2. New to institution	7	14	14
TOTAL MAJORS	7	14	14
B. Course sections satisfying program requirements			
1. Previously existing	6	12	15
2. New	2	3	0
TOTAL PROGRAM COURSE SECTIONS	8	15	15
C. Credit hours generated by those courses			
1. Existing enrollments	0	0	0
2. New enrollments	154	280	280
TOTAL CREDIT HOURS	154	280	280
D. Degrees awarded			
	0	7	7
	(yr 2)	(yr 3)	(yr 4)
II. COSTS	EFT Dollars	EFT Dollars	EFT Dollars
A. Personnel—reassigned or existing positions			
8. Faculty	2.2 198,000	2.2 203,940	2.2 210,058
9. Part-time faculty	0	0	0
10. Graduate assistant	0	0	0
11. Administrators	0	0	0
12. Support staff	0.5 26,114	0.5 26,897	0.5 27,704
13. Fringe benefits	61,958	63,817	65,731
14. Other personnel costs	0	0	0
TOTAL EXISTING PERSONNEL COSTS	286,072	294,654	303,493

B. Personnel – new positions			
8. Faculty	0	0	0
9. Part-time faculty	0	0	0
10. Graduate assistant	0	0	0
11. Administrators	0	0	0
12. Support staff	0	0	0
13. Fringe benefits	0	0	0
14. Other personnel costs	0	0	0
TOTAL NEW PERSONNEL COSTS	0	0	0
	First Year	Second Year	Third Year
C. Start-up costs (one-time expenses)			
4. Library/learning resources	0	0	0
5. Equipment	0	0	0
6. Other	0	0	0
D. Physical facilities: construction or major renovation	0	0	0
TOTAL ONE-TIME COSTS	0	0	0
E. Operating costs (recurring costs—base budget)			
1. Supplies/expenses	1,000	1,030	1,060
2. Travel	2,000	2,060	2,120
3. Equipment	0	0	0
4. Library/learning resources	0	0	5.
5. Other	0	0	0
TOTAL RECURRING COSTS	3,000	3,090	3,180
GRAND TOTAL COSTS	289,072	297,744	306,673

III. REVENUE SOURCES

A. Source of funds			
1. Reallocation of existing funds	289,072	297,744	306,673
2. New student workload	0	0	0
3. New tuition	0	0	0
4. Federal funds	0	0	0
5. Other grants	0	0	0
6. Student fees	0	0	0
7. Other	0	0	0
Subtotal new state allocation requested	0	0	0
GRAND TOTAL REVENUES	289,072	297,744	306,673

C. Nature of funds			
3. Base budget	289,072	297,744	306,673
4. One-time funds	0	0	0
GRAND TOTAL REVENUES	289,072	297,744	306,673

Appendix A:
Letters of Support

November 11, 2009

Dr. E. Timothy Davies
Director, Bioexpression and Fermentation Facility
University of Georgia
120 Green Street,
Athens, GA 30602

Dear Dr. Davies,

The Biotechnology Program of Athens Technical College (ATC) enthusiastically offers this letter of commitment to the University of Georgia's proposal for the establishment of a Science Master's Program (SMP) in Biomanufacturing. We endorse this effort and recognize the importance of training in this field for the continued growth of the American biotechnology industry and for the expanding industry in Georgia specifically.

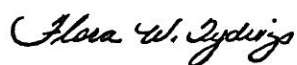
Georgia has a thriving biotechnology industry, and is part of the southeastern region which ranks sixth nationally among biotechnology hubs (*Beyond Borders 2009*, Ernst & Young report). The industry is a focus for economic development in the State due to the sustainability and quality of life it provides. Biomanufacturing is a key component to the success of many biotechnology companies and it is crucial that the State trains competent leaders in this area. The students trained in the SMP in Biomanufacturing program will find an existing industry in Georgia in the industrial, veterinary, nutraceutical, and pharmaceutical industries and will also have the opportunity to become sector leaders in the nascent cellulosic biofuel industry.

ATC will assist the SMP program fully within its areas of expertise and influence. This support will include

- Assignment of ATC biotechnology associate degree students to team biomanufacturing projects supervised by SMP students
- Access to equipment and laboratory facilities in the new 65,000 ft² Life Science building at ATC
- Access to training in Good Manufacturing Practices via online classes at ATC.

The funding of this SMP in Biomanufacturing will benefit the State, the population of Georgia, and the nation as a whole. We fully support the PIs and the University of Georgia in this effort.

Sincerely,



Flora W. Tydings, Ed.D
President

University of Leeds
Miall Building
Leeds LS2 9JT

T +44 (0) 113 343 7600
T (PA) +44 (0) 113 343 2863
E (Faculty Business) fbspdr@leeds.ac.uk
E (Non Faculty Business) t.g.benton@leeds.ac.uk



UNIVERSITY OF LEEDS

17 November 2009

To whom it may concern

National Science Federation - Development of e-learning materials

I am writing in support of the above application from Dr Suzanne Bickerdike. Should the application for funding be successful, I confirm that Dr Bickerdike will be able to carry out the work in the Faculty of Biological Sciences at the University of Leeds.

A handwritten signature in black ink that reads "Tim Benton". The signature is written in a cursive style with a large initial 'T' and a long, sweeping underline.

Professor Tim Benton

November 9, 2009

E. Timothy Davies Ph.D.
Director , Bioexpression and Fermentation Facility
University of Georgia
Life Sciences Building · 1057 Green Street
Athens, GA 30602-7229

Dear Dr. Davies:

Georgia Bio is pleased to offer its support for the University of Georgia's (UGA) proposal for a Professional Science Master's in Biomanufacturing and Bioprocessing (MBB). This degree will prepare future leaders in technical skills and methods while giving them a foundation in business practices. A shortage of technical managers is a limitation for growth of the biotechnology industry in Georgia. UGA, with a number of unique assets, is an ideal site for training a new generation of biomanufacturing leaders.

Life sciences is a strategic industry for Georgia. From 2001 to 2007, the number of life sciences jobs grew twice as fast as the number of jobs in all other industries. In 2007, private establishments in the life sciences industries provided 15,190 jobs and over \$961 million in wages. Another 2,751 jobs were provided by agricultural life sciences industries. In addition, life sciences research at the state's colleges and universities generated another 14,919 jobs on- and off-campus in 2006.

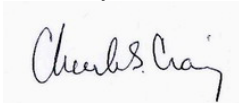
Georgia Bio (GaBio), founded in 1989, is a non-profit, membership-based association that represents the interests of nearly 300 pharmaceutical, biotechnology and medical device companies, medical centers, universities, research institutions, government groups and other organizations involved in discovery and application of life sciences products and related services. The association conducts business and economic development activities; advocates on behalf of the industry on public policy matters; educates the public about the benefits of life sciences research and product development; and provides a network for the exchange of ideas, information and opportunities.

We value our partnership with UGA and your program, and commit the following support:

- Assistance in developing internship opportunities for MBB students with our member companies.
- Assistance in obtaining commitments for presentations and/or seminars from technical, regulatory, and business experts in our member organizations.
- Securing commitments for company tours.
- Facilitating connections to promising students and teachers from area high schools and two-year programs for student project teams.
- Discounted registration for your students to the annual Georgia Life Sciences Summit, which draws more than 700 professionals.

Funding of the MBB program will not only benefit existing companies, but also will enable Georgia to demonstrate the availability of talent to attract emerging biotech companies and larger established companies to the area. We fully support you in this effort.

Sincerely,



Charles S. Craig
President
Georgia Bio
404-920-2043
charles.craig@gabio.org



INNOVATIVE CONTROLS
624 RELIABILITY CIRCLE
KNOXVILLE, TN 37932



Dr E. Timothy Davies
Director, Bioexpression and Fermentation Facility
University of Georgia
120 Green Street,
Athens, GA 30602

Dear Dr Davies,

We enthusiastically offer this letter of commitment to the University of Georgia's proposal to the National Science Foundation for the establishment of a Science Master's Program in Biomanufacturing. As technology providers to the biomanufacturing industry we have observed the development of this industry in its many forms: from pharmaceutical manufacturing to commodity chemical and biofuel production; and from products that support agriculture and environmental stewardship to those that impact national security. As the industry has grown we have also noted that there is a lack of high quality training programs for biomanufacturing leaders. The program being developed at UGA will fill a critical need.

As biomanufacturing technology providers it is essential to us that operators are trained in the most modern methods and aware of technology developments in production environments. For that reason we are excited to engage with the SMP in biomanufacturing at UGA and to provide support and expertise in the training of the next generation of biomanufacturing leaders. This support will include:

- Participation in instruction on site through lectures, seminars, labs and workshops; through distance learning; or by assisting UGA faculty.
- The provision of equipment, supplies or information on state of the art hardware, software and reagents.
- The provision of information about new products and techniques in the marketplace.
- Participation in operations, planning and curriculum committees for the SMP in biomanufacturing.
- Participation in the evaluation of students and the program as a whole.

The SMP in biomanufacturing will benefit our companies both directly and indirectly through the growth of the biomanufacturing industry. Having graduates entering the workforce with the best information on new and state-of-the-art technologies will also greatly benefit the hiring companies and will allow the students to select the best available opportunities in the market. We fully support the PIs and the University of Georgia in this effort and look forward to becoming involved in the program.

Sincerely,

Richard D. Consoli
President
Innovative Controls



November 15, 2009

Dr. E. Timothy Davies
Director, Bioexpression and Fermentation Facility
University of Georgia
120 Green Street,
Athens, GA 30602

Dear Dr. Davies,

We enthusiastically offer this letter of commitment to the University of Georgia's proposal to the National Science Foundation for the establishment of a Science Master's Program in Biomanufacturing. As technology providers to the biomanufacturing industry we have observed the development of this industry in its many forms: from pharmaceutical manufacturing to commodity chemical and biofuel production; and from products that support agriculture and environmental stewardship to those that impact national security. As the industry has grown we have also noted that there is a lack of high quality training programs for biomanufacturing leaders. The program being developed at UGA will fill a critical need.

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Sincerely,

Kim A. Davis
Chief Executive Officer
NCSRT, Inc.



The University of Georgia

November 16 2009

Office of Vice President for Research

Dr E. Timothy Davies
Director, Bioexpression and Fermentation Facility
University of Georgia
120 Green Street
Athens, GA 30602

Dear Tim:

The Office of the Vice President for Research enthusiastically supports the development of a Science Master's Program in Biomanufacturing embodied in the proposal to the National Science Foundation. We recognize your outstanding leadership of a group of faculty in this truly interdisciplinary training and workforce development project. Training in this field is critically important for the continued growth of the biotechnology industry nationally and in Georgia specifically.

A major aspect of this program is the early establishment of key partnerships with industries, state agencies, technical colleges, and minority programs. These partnerships have not only been critical to creating a curriculum and program that will produce the "designer" workforce that this industry, state, and country need, but will also establish relationships that UGA can tap in the future for other collaborative endeavors. We join the Graduate School in providing our full support for the rapid approval through UGA channels of this SMP.

One of the key pieces of infrastructure that defines UGA to be the perfect site for this workforce development program is the facility that you direct, the Bioexpression and Fermentation Facility. OVPR has supported and will continue to support the operation and upgrade of this facility as a key research support facility on campus. For example, OVPR successfully negotiated a recent \$1M infusion of equipment from the Georgia Research Alliance. The NSF reviewers can be assured that UGA will continue to support this key infrastructure.

In addition, OVPR will commit to providing a \$10,000 contribution to the cost of acquiring the e-learning content and consultation from Leeds University, assuming you can obtain the other components of this funding and subject to the NSF proposal's success.

We envision other very positive effects of this program. The Georgia BioBusiness Center (GBBC) is a life science business incubator on the UGA campus, and OVPR's vehicle for the encouragement of entrepreneurial activity. The companies residing in the GBBC are forming the foundation of the bioscience industry in Northeast Georgia. Access to a workforce uniquely trained through the proposed Biomanufacturing program would greatly benefit those organizations. Graduates educated in both business and science would also help to attract new life science companies to the area, and encourage new entrepreneurial ventures at the University.

We look forward to a successful NSF proposal and to an exciting new training program in this critical segment of our national economy in the 21st century.

Sincerely,

David Lee
Vice President for Research

Margaret Wagner-Dahl
Associate Provost for Economic Development
Director, Georgia BioBusiness Center

November 11, 2009

Dr E. Timothy Davies
Director, Bioexpression and Fermentation Facility
University of Georgia
120 Green Street,
Athens, GA 30602

Dear Dr Davies,

We wholeheartedly endorse and support the University of Georgia's proposal to the National Science Foundation for the establishment of a Science Master's Program in Biomanufacturing. We rely on a well trained workforce to ensure the quality, safety and availability of our products and the availability of well trained team leaders in the area of biomanufacturing will be enhanced by this program. We believe that production volumes in the biomanufacturing areas of pharmaceuticals, biofuels, biochemicals, nutraceuticals, biological agricultural and environmental will increase in the future, and training a generation of biomanufacturing scientists will be essential for the USA to maintain its position of leadership in biotechnology.

We actively support efforts to develop the workforce in this area. We believe that the philosophy of UGA's SMP in biomanufacturing, focusing on hands on training; computer based simulation; access to state of the art industrial-grade equipment; team based project solving training involving multilevel groups and an engaged faculty will make this program one of the best in this field and an model for future training programs. This approach requires an engaged and highly supportive commercial sector, and we are delighted to have the opportunity to provide this level of support. This support will include:

- Participation in instruction on site through lectures, seminars, labs and workshops; through distance learning; or by assisting UGA faculty.
- Meeting with students in seminar and small group sessions to give them greater understanding of the importance of good science in the business environment.
- Internship opportunities for qualified students as part of their educational training
- Participation in the evaluation of students and the program as a whole.
- Consideration of qualified job candidates for relevant open positions in our firms.
- Participation in laboratory, plant or company tours for groups of SMP students.
- Participation in operations, planning and curriculum committees for the SMP in biomanufacturing.

The funding by the NSF of this SMP in biomanufacturing will benefit our company and the wider biotechnology industry. Increasing the pool of well trained Master's level graduates entering the workforce with the best information on new and state-of-the-art technologies is critical for the continued growth of our companies. We fully support the PIs and the University of Georgia in this effort and look forward to becoming involved in the program.

Sincerely,



Kurt Creamer
Connectivity Manager

Novozymes North America, Inc.
77 Perry Chapel Church Road
P.O. Box 576
Franklinton, North Carolina 27525

November 11, 2009

Dr E. Timothy Davies
Director, Bioexpression and Fermentation Facility
University of Georgia
120 Green Street,
Athens, GA 30602

Dear Dr Davies,

We wholeheartedly endorse and support the University of Georgia's proposal to the National Science Foundation for the establishment of a Science Master's Program in Biomanufacturing. We rely on a well trained workforce to ensure the quality, safety and availability of our products and the availability of well trained team leaders in the area of biomanufacturing will be enhanced by this program. We believe that production volumes in the biomanufacturing areas of pharmaceuticals, biofuels, biochemicals, nutraceuticals, biological agricultural and environmental will increase in the future, and training a generation of biomanufacturing scientists will be essential for the USA to maintain its position of leadership in biotechnology.

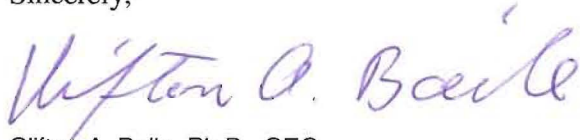
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critical for the continued growth of our companies. We fully support the PIs and the University of Georgia in this effort and look forward to becoming involved in the program.

Sincerely,

A handwritten signature in purple ink that reads "Clifton A. Baile". The signature is written in a cursive style with a large, prominent initial 'C'.

Clifton A. Baile, Ph.D., CEO



The University of Georgia®

Office of the Senior Vice President for Academic Affairs and Provost

November 11, 2009

Dr. E. Timothy Davies
Director, Bioexpression and Fermentation Facility
University of Georgia
120 Green Street
Athens, Georgia 30602

Dear Dr. Davies:

The University of Georgia enthusiastically offers this letter of commitment to the interdisciplinary group of university faculty that you are leading in the development of a Science Master's Program in Biomanufacturing and in the proposal to the National Science Foundation in support of this program. We endorse this effort and recognize the importance of training in this field for the continued growth of the biotechnology industry and for the industry nationally and in Georgia specifically.

The establishment of this program will be a timely and important addition to the range of educational opportunities available at the University of Georgia. The cooperation of faculty from so many university departments and divisions will create a truly interdisciplinary program. This will be enhanced by the key partnerships that have been forged with industrial partners, state agencies, technical colleges, and minority programs. The cooperation with these partners is something that the University supports.

The wider goals of the SMP in Biomanufacturing are ideally suited for specialized education in the future: training of professionals ready for immediate placement in a high need industry; interdisciplinary training; hands-on practical training in multi-level groups; and the use of novel high impact training methods and internships. As such, the SMP in Biomanufacturing is likely to become a model program at the University of Georgia and will be used as a model for the development of other professional STEM programs. This makes the University's interest and support of this program even greater, and the impact of NSF funding of the program will have a large impact and potential return on investment.

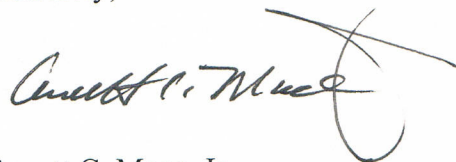
The University appreciates that the NSF requirement for an early intake of students on this program requires that institutional approval and support of the SMP is essential for its success. The administration wishes to assure you that while applications are being, and will need to be, made through the proper channels, everything possible will be done to assist you and your co-

Dr. E. Timothy Davies
November 11, 2009
Page 2

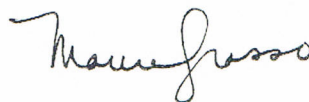
applicants and instructors in putting the pieces in place to have the new program ready for a first intake of students in the 2011 academic year. The Graduate School is working closely with the faculty leaders of this proposal to insure both the highest academic quality of the program and rapid approval of the program. The Graduate School is pleased to be the administrative home of this interdisciplinary program, particularly given the impressive number of different schools and colleges represented by faculty participating in the program. In addition, to help insure a strong start to the program, the Graduate School will contribute a total of four assistantships to help attract the best students to the program.

We want to reiterate our support for the PIs and the full group of faculty that will be involved in the SMP in Biomanufacturing and strongly urge the NSF review panel to fund this important and strategic program.

Sincerely,



Arnett C. Mace, Jr.
Senior Vice President for Academic Affairs
& Provost



Maureen Grasso
Dean
The Graduate School



115 Transtech Drive
Athens, GA 30601
Tel: 706 548 9292

November 11, 2009

Dr E. Timothy Davies
Director, Bioexpression and Fermentation Facility
University of Georgia
120 Green Street,
Athens, GA 30602

Dear Dr Davies,

We wholeheartedly endorse and support the University of Georgia's proposal to the National Science Foundation for the establishment of a Science Master's Program in Biomanufacturing. We rely on a well trained workforce to ensure the quality, safety and availability of our products and the availability of well trained team leaders in the area of biomanufacturing will be enhanced by this program. Production volumes in the biomanufacturing areas of pharmaceuticals, biofuels, biochemicals, nutraceuticals, biological agricultural and environmental will increase in the future, and training a generation of biomanufacturing experts will be essential for the USA to maintain its position of leadership in biotechnology.

The philosophy of UGA's SMP in biomanufacturing, focusing on hands on training; computer based simulation; access to state of the art industrial-grade equipment; team based project solving training involving multilevel groups and an engaged faculty will make this program one of the best in this field and an model for future training programs. This approach requires an engaged and highly supportive commercial sector. Our support will include:

- Participation in instruction on site through lectures, seminars, labs and workshops; through distance learning; or by assisting UGA faculty.
- Meeting with students in seminar and small group sessions to give them greater understanding of the importance of good science in the business environment.
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- Participation in the evaluation of students and the program as a whole.
- Consideration of qualified job candidates for relevant open positions in our firms.
- Participation in laboratory, plant or company tours for groups of SMP students.
- Participation in operations, planning and curriculum committees for the SMP in biomanufacturing.

The funding by the NSF of this SMP in biomanufacturing will benefit our companies and the wider biotechnology industry. Increasing the pool of Master's level graduates entering the workforce with training on the latest in technology is critical for the continued growth of our companies.

Sincerely,

Michele D. Baxley, Merial Site Director





November 18, 2009

Dr E. Timothy Davies
Director, Bioexpression and Fermentation Facility
University of Georgia
120 Green Street,
Athens, GA 30602

Dear Dr Davies,

We offer this letter of support for the establishment of a Science Masters program in Biomanufacturing at the University of Georgia. We encourage this effort and recognize the importance of training in this field for the continued growth of the American biotechnology industry and for the industry in Georgia specifically.

Georgia's thriving biotechnology industry is one of the priorities for economic development in the state. This industry offers a variety of careers that can provide sustainability and quality of life to those who are directly employed by it. Additionally, this industry supports many indirect positions that are considered to be important to our economy.

Biomanufacturing is a key component to the success of many biotechnology companies and it is important that the state trains competent leaders in this area. The students trained in the Science Master's Program in Biomanufacturing will expect to find an existing industry in Georgia in the industrial, veterinary, nutraceutical and pharmaceutical industries and will also have the opportunity to become sector leaders in the nascent cellulosic biofuel industry.

The Georgia Centers for Innovation (COI) will assist the Science Master's Program within its areas of expertise and influence. Georgia's Centers of Innovation provides unique, technology-oriented support to emerging and high growth enterprises in the areas of aerospace, agribusiness, energy, life sciences, logistics and advanced manufacturing. Each of the six centers provides direct access to university and technical college applied research, commercialization resources, technology connections, matching grant funds, potential investor networks and key government agencies. A common goal across all of the centers is to cut red tape, streamline connections and to seek university generated technology solutions to industry-led challenges. Within this framework the Centers create a pro-growth, innovative business environment for industries critical to Georgia's expansion.

The funding of this Science Master's Program in Biomanufacturing will benefit the state and the population of Georgia and the nation as a whole. We support the PIs and the University of Georgia in this effort.

Sincerely,
Stacy Williams Shuker, Ph.D – Director – COI for Life Sciences
Donnie Smith – Director – Director – COI for Agribusiness
Jill Stuckey – Director – COI for Energy
John Zegers, Director – COI for Manufacturing



November 18, 2009

Dr. E. Timothy Davies
Director, Bioexpression and Fermentation Facility
University of Georgia
120 Green Street
Athens, GA 30602

Dear Dr. Davies,

We wholeheartedly endorse and support the University of Georgia's proposal to the National Science Foundation for the establishment of a Science Master's Program in Biomanufacturing. We rely on a well trained workforce to ensure the quality, safety and availability of our products and the availability of well trained team leaders in the area of biomanufacturing will be enhanced by this program. We believe that production volumes in the biomanufacturing areas of pharmaceuticals, biofuels, biochemicals, nutraceuticals, biological agricultural and environmental will increase in the future, and training a generation of biomanufacturing scientists will be essential for the USA to maintain its position of leadership in biotechnology.

We actively support efforts to develop the workforce in this area. We believe that the philosophy of UGA's SMP in biomanufacturing, focusing on hands on training; computer based simulation; access to state of the art industrial-grade equipment; team based project solving training involving multilevel groups and an engaged faculty will make this program one of the best in this field and an model for future training programs. This approach requires an engaged and highly supportive commercial sector, and we are delighted to have the opportunity to provide this level of support. This support will include

- Participation in instruction on site through lectures, seminars, labs and workshops; through distance learning; or by assisting UGA faculty.
- Meeting with students in seminar and small group sessions to give them greater understanding of the importance of good science in the business environment.
- Internship opportunities for qualified students as part of their educational training
- Participation in the evaluation of students and the program as a whole.
- Consideration of qualified job candidates for relevant open positions in our firms.
- Participation in laboratory, plant or company tours for groups of SMP students.
- Participation in operations, planning and curriculum committees for the SMP in biomanufacturing.

The funding by the NSF of this SMP in biomanufacturing will benefit our companies and the wider biotechnology industry. Increasing the pool of well trained Master's level graduates entering the workforce with the best information on new and state-of-the-art technologies is critical for the continued growth of our companies. We fully support the PIs and the University of Georgia in this effort and look forward to becoming involved in the program.

Sincerely,



Joseph M. Patti, PhD
Senior Vice President, Research and Development
Chief Scientific Officer

JMP/kbk



The University of Georgia

Department of Microbiology
527 Biological Sciences Building
Athens, Georgia 30602-2605

Franklin College of Arts and Sciences

TEL 706-542-1434
FAX 706-542-2674

April 14, 2010

To Whom It May Concern:

RE: Institution: University of Georgia
School/College/Division/Institute: Arts and Sciences
Department: multiple, housed in the Microbiology Department
Name of Proposed Program: Master of Biomanufacturing and Bioprocessing (MBB)
Degree: Master of Biomanufacturing and Bioprocessing Major: Biomanufacturing
and Bioprocessing

The Microbiology Department of the College of Arts and Sciences will serve as the Academic Home for the new program: Master of Biomanufacturing and Bioprocessing, although faculty from many different colleges and departments are involved in the program. Dr. Joy Doran-Peterson in the Microbiology Department is Co-Director of the new program with Dr. Tim Davies in Biochemistry and Molecular Biology. Dr. Doran-Peterson will also be the new Graduate Coordinator and Faculty Program Manager for the new Degree.

The Microbiology Department supports this new program in principle and believes Dr. Doran-Peterson will perform well in her new capacity as described above. She is currently developing two courses, one a seminar course and the other a course in Industrial Microbiology, that will serve the new program. The new Master of Biomanufacturing and Bioprocessing furthers the mission of UGA and the Microbiology Department by allowing UGA to be responsive to the evolution of the state's educational and economic needs. The program also affords UGA the opportunity to have closer contact and interaction with public and private institutions throughout the state as well as with the citizens it serves. The Master of Biomanufacturing and Bioprocessing (MBB) will advance the model for introducing highly technical STEM methods to motivated science students by preparing them for immediate engagement in an industry that is short of leaders equipped with the necessary technical skills combined with experience in business and project management skills. As Department Head of Microbiology, this letter confirms our support of this vision and we are committed to helping develop the MBB as a landmark program at UGA.

Sincerely,

William B. Whitman, Ph.D.
Head, Microbiology Department

Appendix B:
Three selected programs for comparison

Keck Graduate Institute of Applied Life Sciences Master of Bioscience with Bioprocessing Focus, www.kgi.edu/x1598.xml <http://www.kgi.edu/Prospective-Students/Admissions.html>
Dr. Matthew S. Croughan, Matthew_Croughan@kgi.edu (909) 607-8838

Illinois Professional Science Master's in Bioenergy, University of Illinois at Urbana-Champaign
<http://psm.illinois.edu/prospectivestudents/programs/bioenergy.htm> , Dr. Hans Blaschek,
blaschek@illinois.edu (217) 333-8224

North Carolina State University Master's of Microbial Biotechnology,
<http://www.microbiology.ncsu.edu/graduate/MMB/opinions.html>
Dr. Paul Hamilton, Department of Microbiology, MMBprogram@ncsu.edu, (919) 513-7206



[Prospective Students](#)

[The MBS Program](#)

[MBS Curriculum](#)

[Medical Devices and Diagnostics](#)

[Pharmaceutical Discovery and Development](#)

[Bioprocessing](#)

[Business of Bioscience](#)

[Clinical and Regulatory Affairs](#)

[Complete First-Year Course List](#)

[Complete Second-Year Course List](#)

[PhD Programs Offered at KGI](#)

[Post Doc Masters Program](#)

[Postbaccalaureate Premedical Certificate Program \(PPC\)](#)

[Certificate in Bioscience Management](#)

[Dual PharmD/MBS](#)

[Faculty & Research](#)

[Careers in Bioscience](#)

[Team Masters Project](#)

[The REU Program:](#)

[K12 Program](#)

[Podcasts](#)

MBS Curriculum

KGI's two-year Master of Bioscience degree program educates technically savvy professionals for the bioscience industry. Students learn to:

- Catalyze development of basic life sciences research into useful new products, processes and services
- Address the business and ethical leadership challenges confronting the applied life sciences
- Build professional skills essential to the industry workplace including public speaking, team leadership and dynamics, and project management
- Understand how the bioscience industry operates-considering the scientific, intellectual property and regulatory issues that dominate the industry



Entrepreneurial activities that promote the translation of basic science and engineering knowledge into beneficial products are actively encouraged throughout the program.

First Year

The first year of the MBS program provides a common educational experience for all students. At the end of this year, students have been exposed to a wide range of bioscience industry issues and activities. Please see the complete list of [first-year courses](#).

Initial Projects

During orientation at KGI, first-year students participate in the Initial Projects. These intensive, projects require students to work in teams and perform a retrospective analysis of an event that occurred in the life sciences industry, e.g., the discovery of a new drug or the development of a new technology or device. The teams are given a variety of resources including the opportunity for discussion with an individual who was intimately involved in the event. The project culminates in a written report and a public presentation to the KGI community. The Initial Projects are not graded, but a prize is given for the best presentation.

Following orientation, first-year students take a common set of interdisciplinary applications-oriented technical courses, business courses and a bioindustry ethics course.

Applications-Oriented Technical Courses

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www.kgi.edu

Because of the effectiveness that an interdisciplinary approach brings to solving bioscience industry problems, KGI integrates three disciplines, systems biology, computational biology, and bioengineering, in a set of technical courses taken by all first-year students. The courses are Molecular Biotechnology; Systems Biology; Mathematical and Computational Methods for the Applied Life Sciences; Computational Biology; Medical Diagnostics; Medical Devices; Pharmaceutical Discovery and Development; Bioprocess Engineering Principles and Biologics. These courses highlight specific industry applications and follow the format of lectures that meet once or twice per week with hands-on projects that occur regularly throughout the semester.

Lecture Courses in Business and Bioethics

In addition to science and engineering courses, first-year students take a fixed set of courses that provide basic backgrounds in business and management of bioscience industries, and bioethics.

Summer Internship

Between the first and second years, students participate in a required, paid internship in a bioscience company. The summer internship actively engages students in the issues and current techniques associated with particular industry sectors and provides an understanding of the climate and culture of business. A summer internship represents approximately 400 hours of work.

Second Year

Team Masters Projects

The capstone of the MBS program is the Team Masters Project in which teams of three to five students work with sponsoring companies to solve real problems. This project replaces the Masters thesis work required in traditional programs.

Students form interdisciplinary teams and work with faculty and industrial advisors to perform contract research. Student teams create budgets, develop timelines, and describe deliverables. At the end of the academic year, they present confidential and non-confidential reports of their work.

Career Focus Tracks

Coursework during the second year of the MBS curriculum allows students to achieve depth in an area that closely follows a specific industry career path. KGI's career focus tracks provide in-depth knowledge of specific functional areas of the bioscience industry. Each specialized program offers participation in real-world industry experiences and interaction with industry leaders coupled with a cutting-edge curriculum taught by faculty with extensive industry experience.

Career focus tracks currently offered are:

- [Medical Devices and Diagnostics](#)
- [Bio/Pharmaceutical Discovery and Development](#)
- [Bioprocessing](#)

- [Business of Bioscience](#)
- [Clinical and Regulatory Affairs](#)

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Bioenergy

Faculty coordinator: Hans Blaschek, blaschek@illinois.edu, (217) 333-8224

[Introduction](#) | [CABER](#) | [Careers](#) | [Specializations](#) | [Degree Requirements](#) | [Admission Requirements](#)

Introduction

The world has reached a turning point in energy production. As consumption rises, so does the demand for cleaner, renewable energy. The University of Illinois is rising to the challenge.

The Professional Science Master's degree program in Bioenergy centers on advanced and innovative methods of energy production. Bridging science with business, the program blends the technology and science of biofuels with the business skills necessary to transfer scientific knowledge to practical application.

CABER – Center for Advanced Bioenergy Research

The Center for Advanced Bioenergy Research ([CABER](#)) at Illinois leads the way in bioenergy research and education. Built on Illinois' expertise in energy and sustainability, CABER is committed to bioenergy R&D and to creating a well-educated scientific-technical workforce in bioenergy and related biosciences.

Careers

As bioenergy technologies grow, so do bioenergy career opportunities. The Illinois PSM in Bioenergy provides excellent preparation for careers in advanced cellulosic ethanol bio-refineries. Careers in the bioenergy lifecycle — from feedstock supply to biofuel transportation and distribution — are also attractive options for Bioenergy graduates. Bioenergy scientists, managers, and engineers with leadership, entrepreneurship, technology management, and other business skills will be well-prepared for positions of significant responsibility.

Specializations

In consultation with a faculty advisory, Bioenergy students select a specialization that best suits their personal and professional interests. Specializations are available in

- plants, soils, and feedstocks;
- production, processing and use;
- environment, economics and policy & law; and
- tools and methods.

Degree Requirements

The MS degree in Bioenergy requires the completion of 42 semester hours as prescribed in the following four curricular components:

- [Science](#)
- [Business](#)
- [Internship](#)
- [Industry Seminar](#)

The program is designed to be completed in 16-months of full-time study on the Urbana-Champaign campus. Summer enrollment is required while completing the internship. A thesis is not required.

Admission Requirements

- Bachelor's degree from a regionally accredited U.S. institution or a comparable degree from a recognized institution abroad
- Grade point average of 3.0 or higher (4.0 scale) for the last 60 hours of undergraduate work and for any graduate work
- Graduate Record Examination (GRE) score
- Test of English as a Foreign Language (TOEFL) score of 590 or higher (paper-based test) or 243 or higher (computer-based test) for applicants whose native language is not English



Master's of Microbial Biotechnology. Science. Business. Academia. Industry.

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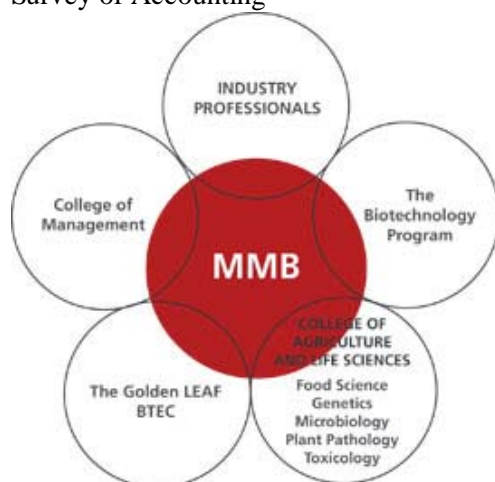
curriculum



The [academic training](#) is performed by several departments in the [College of Agriculture and Life Sciences](#), the [College of Management](#), the Golden Leaf [Biomufacturing Training and Education Center](#) (BTEC), and the [Biotechnology Program](#). Students choose from a variety of courses in microbiology, genetics, toxicology, food science, plant pathology, statistics, biotechnology and MBA-level business courses.

Fall Semester Year 1

Microbial Physiology and Regulation
Survey of Accounting



[Industry Cases](#)

Spring Semester Year 1

Immunology
Core Techniques in Biotechnology
Industry Cases

Summer Year 1

Industrial Internship

Fall Semester Year 2

[Science Elective](#)

[Biotech Elective](#)

Biotech Elective

Industry Cases

Spring Semester Year 2

[Business Elective](#)

Business Elective

Industry Cases

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industry cases



The professional training takes place in collaboration with industry professionals from various companies through a new four-semester course: Industry Case Studies. Students work in teams to solve forefront matters. They finish each project by making a presentation and by completing a report, often a business plan. Industry professionals from **GlaxoSmithKline**, **Labcorp**, **EnSolve Biosystems**, **Syngenta**, **Novozymes**, **Wyeth Vaccines**, **Argos Therapeutics**, **Embrex/Pfizer**, **Mallinckrodt/Tyco Healthcare**, **Mycosynthetix**, **Global Patent Strategies**, **Biolex Therapeutics**, **Diosynth-RTP**, **Biogen Idec** and **Woodall & Associates** have served as instructors.