MBA/MS in Biochemistry (plan B) Dual Degree Proposal

This document contains a proposal for a dual degree between the Department of Biochemistry (MS degree, plan B) and the Weatherhead School of Management (MBA degree).

I. Background and Justification

The Department of Biochemistry at Case Western Reserve University offers the MS in Biochemistry program that caters to college graduates that strengthens their academic backgrounds prior to applying to medical school, graduate school or for enriching their credentials for the job market. The Weatherhead School of Management offers its MBA program that is recognized as an innovative approach to Management education and builds on a foundation of core skills to prepare graduates for what's happening in business right now. The dual degree program will prepare students to participate in the fields of medical research and management as well as give students an opportunity to develop expertise in areas of substantive interest. Moreover, dual degree students will be more likely to have greater job opportunities that are at the intersection of translational science and business. No additional courses or resources are anticipated to fulfill the respective schools' obligations in administering the dual degree program.

II. Administration

Weatherhead School of Management Liaison: Simon Peck, Associate Dean of MBA Programs & Associate Professor of Strategy

Biochemistry Department Liaison: William Merrick, Professor of Biochemistry, Department of Biochemistry.

III. Program Structure

If one were to acquire the MBA and MS degrees independently, it would require the completion of 60 hours for the MBA program and 36 hours for the MS program (a total of 96 credit hours). In the dual degree program, cross counting allows for a reduction in the total number of class hours to 75 credit hours for both degrees as described below. The 60 credit hour and 36 credit hour numbers are for the independent programs as accredited through the Board of Reagents in Columbus.

The proposed dual degree requires students to complete 75 credit hours. The MS in Biochemistry requires 27 credit hours of coursework for the completion of the MS degree (plan B). The Weatherhead School of Management requires 48 credit hours of coursework for the completion of the MBA program as part of the dual degree.

The first year of the dual degree requires the students to complete the mandatory management core classes and one elective totaling 30 credit hours of coursework towards the MBA part of the dual degree. As is illustrated below, there are a variety of ways in which to complete the requirements for the MBA and MS degrees with three examples shown below. Students have the flexibility to take the year-long elective either in the second or third year of the program. As a result of participating in the dual degree program, students will complete 9 fewer credit hours of biochemistry coursework than they would if they were in the MS program alone. Those 9 hours will be fulfilled by completing WSOM courses which will then be transferred towards completion of the MS degree. Students will complete 12 fewer hours of the MBA elective coursework than they would if they were in the MBA program alone. Those 12 hours will be fulfilled by completing Biochemistry and Biochemistry Electives that will then be transferred toward the completion of the MBA classes. Between the two programs there is a saving of 21 credit hours in the dual degree program over independent participation in both individual programs.

IV. Dual Degree Curriculum:

Students begin in the Weatherhead School of Management (WSOM) and complete the first year curriculum. For the Biochemistry MS degree, students would have multiple options with three examples shown below:

The fused MBA/MS program (preferred)

With this option, the student spreads the second MBA year and year of Biochemistry into two years. This allows the student to directly relate the basic science with the WSOM classes and should enhance the student's ability to select relevant WSOM classes in the third year. An advantage to the straight MBA class is the increased diversity brought to the classroom by a fellow student immersed in scientific study at the same time.

Year 1: First year WSOM curriculum.

	Semester 1		Semester 2	
	ACCT 401	(3)	MBAC 507	(3)
	MBAC 504	(3)	MBAC 508	(3)
	MBAC 512	(3)	MBAC 506	(3)
	MBAC 515	(3)	MBAC 517	(3)
	MBAC 511	(3)	ELECT 1	(3)
Year 2.	BIOC 407	(4)	BIOC 408	(4)
	BIOC elective	(3)	BIOC elective	(3)
	ELECT 3	(3)	ELECT 4	(3)
	MIDS 420A/ORBH 430A	(3)	MIDS 420A/ORBH 430A	(3)
Year 3	BIOC 601	(2)	BIOC 601	(2)

BIOC 412	(3)	BIOC 434	(3)
BIOC elective	(3)	EXAM 600	(1)
ELECT 5	(3)	ELECT 6	(3)

Research oriented MS

With this option, the student can use the maximal number of graduate credit hours to perform research in a biomedical laboratory. The student learns the ups and downs of what research is all about so that one better appreciates that often research progress is a jagged line, not a straight one. This may be especially attractive to students who may have had a positive experience in undergraduate research prior to entering the WSOM. As above, this student enriches the MBA student pool by increasing the diversity with respect to modern experimental science.

Year 1: First year WSOM curriculum.

	Semester 1		Semester 2	
	ACCT 401	(3)	MBAC 507	(3)
	MBAC 504	(3)	MBAC 508	(3)
	MBAC 512	(3)	MBAC 506	(3)
	MBAC 515	(3)	MBAC 517	(3)
	MBAC 511	(3)	ELECT 1	(3)
Year 2.	BIOC 407	(4)	BIOC 408	(4)
	BIOC 412	(3)	BIOC 434	(3)
	BIOC 601	(2)	BIOC 601	(2)
	MIDS 420A/ORBH 430A	(3)	MIDS 420A/ORBH 430A	(3)
Year 3	BIOC 601	(2)	BIOC 601	(3)
	BIOC elective	(3)	EXAM 600	(1)
	ELECT 3	(3)	ELECT 4	(3)
	ELECT 5	(3)	ELECT 6	(3)

Alternatively, up to 6 credits of BIOC 601 could be taken during the summer after the first or second year (up to a maximum of 12 credits), freeing up time during the regular semesters.

Course work oriented MS

For the student who has had enough research exposure and wants the maximal breadth in the classroom, the course work oriented program may be the best choice. Although shown as having all the Biochemistry classes in the second year, this could just as easily be split where WSOM and Biochemistry classes are taken together in the second and third year.

Year 1: First year WSOM curriculum

	Semester 1		Semester 2	
	ACCT 401	(3)	MBAC 507	(3)
	MBAC 504	(3)	MBAC 508	(3)
	MBAC 512	(3)	MBAC 506	(3)
	MBAC 515	(3)	MBAC 517	(3)
	MBAC 511	(3)	ELECT 1	(3)
Year 2.	BIOC 407	(4)	BIOC 408	(4)
	BIOC 412	(3)	BIOC 434	(3)
	BIOC electives	(6)	BIOC electives	(6)
			EXAM 600	(1)
Year 3	MIDS 420A/ORBH 430A	(3)	MIDS 420A/ORBH 430A	(3)
	ELECT 3	(3)	ELECT 4	(3)
	ELECT 5	(3)	ELECT 6	(3)

ELECT = MBA elective

For elective courses for either the MBA or MS degrees, please see Appendix A or B, respectively.

As the first year curriculum of the WSOM is required before MBA electives are selected, the same is true for the Biochemistry portion where BIOC 407 and 408 are required, but the additional classes are very much up to the student. Depending on the student's orientation, BIOC 412 is highly recommended as it provides a solid base for how enzymes work. BIOC 434 focuses on structural biology and may be of particular use for students who see rational drug design as a part of their future.

Successful completion of the program would require 75 credits:

Total Hours in the Weatherhead School of Management:	48
Total Hours in the Department of Biochemistry:	27
Total Hours in the Dual Degree Program:	75

V. Dual Degree Student Advising

Dual degree students will be advised concerning matters related to the MBA degree by the Associate Dean of MBA Programs (currently Professor Simon Peck) . In addition, dual degree students will be granted priority registration for upper class courses, ensuring that they will be able to accommodate their scheduling needs in obtaining needed classes. Dual degree students will be advised concerning matters related to the MS in Biochemistry by Graduate Program Advisor as designated by the Graduate Education Committee of the Department of Biochemistry (currently Professor William Merrick).

By regulations of the School of graduate Studies, Master's students are required to maintain a GPA of 2.75 or greater within the School of Graduate Studies; this will be applied to the combined GPA for Biochemistry and approved elective courses. The MBA program requires a GPA of at least 2.5 and a grade of C or higher in WSOM core courses; this will apply to all courses taken towards the MBA degree. Twice a year, immediately after the end of the fall and spring semesters, or more frequently if necessary, the Associate Dean of MBA Programs at the WSOM and the Graduate Program Advisor of the Department of Biochemistry will meet to discuss the progress of all students in the program. Students performing unsatisfactorily in the MBA or the MS components of the program or both, will be given warning that they will have one semester to show substantial improvement. If not, they will be dismissed from the component(s) in which they are performing poorly.

VI. Admissions

Target enrollment in the program is six or more students, achieved by admission of at least two students annually. Students wishing to enroll in the dual degree program initially apply to and are admitted into each program separately. The Weatherhead School of Management will waive the GMAT requirement for admission to the MBA program and will accept the GRE scores as used in the MS Biochemistry Program admissions process. In a recipricol manner, for students originating in the WSOM program, the requirement for the GRE will be substituted for by the GMAT for the MS in Biochemistry. Once the program is up and running, students will be able to submit a joint application to the WSOM, which will forward materials of students who are admissible to that program, to the Department of Biochemistry for their consideration. Once students have been admitted, they will consult with the Department of Biochemistry Department Liaison and Associate Dean for MBA Programs at the Weatherhead School of

Management to determine their appropriate course of MBA study and the MBA/MS Advisor of the Department of Biochemistry to determine their appropriate program of MS study.

VII. Tuition Revenue Mechanics:

A written agreement about the management of tuition revenues will exist between the Weatherhead School of Management and the Department of Biochemistry. The text of this agreement is shown below:

Graduate student tuition revenues filter back to the student's home school. The MS Biochemistry student's home is based in the Case School of Medicine. The MBA student's home is based within the Weatherhead School of Management. It is anticipated the dual MBA/MS students will be home based in the School of Management. The School of Management will reimburse the Department of Biochemistry for BIOC coded courses taken on a semiannual basis. This will be completed prior to completion of semester, but after the close of all registration activity for the semester. After the deadline for class withdrawal, an accounting of all BIOC coded courses taken by MBA home-based dual degree students will be conducted by the Biochemistry Program Administrator. The MS program will send the accounting in the form of an "invoice memo" to the School of Management. The School of Management will complete a journal entry so that 75% of the Weatherhead rate of tuition for the total tally of BIOC courses can be transferred to the CSOM from WSOM (INC905070, account 405140). See the example below:

MBA/MS dual degree student, third year (The fused program)

Fall	Spring	credits MBA	credits SOM
BIOC 601 (2)	BIOC 601 (2)		4 hours
BIOC 412 (3)	BIOC 434 (3)		6 hours
BIOC elective (3)	EXAM 600 (1)		4 hours
Elective 5 (3)	Elective 6 (3)	6 hours	
Elective 7 (3)		3 hours	
Total		9 hours	14 hours

Elective 5, 6 and 7 are MBA classes

Cost of tuition for full time MBA student (2013/2014 academic year) $1,466 per credit hour; cost per credit hour in Graduate Studies is $1,608

Tuition flow to the WSOM = 9 x $1,466 = $13,194

Tuition flow to the Department of Biochemistry = 14 x $1,608 x 75% = $16,884

VIII. Approval Signatures:

Dean, Weatherhead School of Management *Dr. Robert E. Widing*	X
Chair, Department of Biochemistry *Dr. Michael A. Weiss*	X
Dean, School of Medicine *Dr. Pamela B. Davis*	X
Dean, School of Graduate Studies Dr. Charles Rozek	X

IX. Student Activities:

Both the Dean for MBA Programs of the WSOM and the MBA/MS advisor of the Department of Biochemistry will regularly contact students in the program by email with information about activities and to verify proper progress.

Students are encouraged to participate in regular WSOM and Department of Biochemistry activities as well as those targeted to them. Under the direction of the Associate Dean for MBA Programs of the WSOM, all MBA students enrolled in dual degree program will meet twice a year in a colloquium retreat (approximately one-half day in length). The purposes of the retreat are (1) to ensure the programs are meeting the expectations of the students and the faculty in charge, (2) to capture the benefits of the interdisciplinary experience, (3) to socialize the dual degree students as a group, instead of small groups of isolated students, and (4) to explore the intellectual and professional challenges of doing interdisciplinary work.

In addition, prior to registration, the Associate Dean of MBA Programs meets with each dual degree student to review their schedule and to explore any other issues on which they need guidance and advice. All new students will be partnered with an experienced student to address questions the students may have about the program and life as a graduate student at Case. These students will initially be drawn from the ranks of WSOM and Biochemistry students, but when the program is up and running, from advanced MBA/MS Biochemistry students. A get-acquainted dinner will be organized during registration week in the fall to facilitate this process.

To fulfill the MS degree portion of the dual degree program, students will focus their capstone writing requirement (EXAM 600) on the subject of their work in the Department of Biochemistry. The MBA/MS Advisor from that department will serve as a co-supervisor of this research.

Other appropriate activities for the MBA/MS students include attending the weekly Departmental Seminar and Student Seminars, as well as annual named

lectureships, participating in annual retreats, and one or more journal clubs. Additional events include the general Department of Biochemistry picnics and the Annual Holiday Party in December.

X. Advantages of the Joint Degree Program

There are several advantages to the students in the MBA/MS program. The key advantage will be the integration of the two disciplines during the time of the students receive their training, thus allowing the students to develop a unique focus on their studies in each of the two disciplines. In addition, the usual Master's of Science in Biochemistry is a two year program but the students in the dual degree program will be able to complete the program requirements in just 12 months beyond the time required for obtaining the MBA degree.

Appendix A - Weatherhead School of Management Elective Courses

In addition to the required Weatherhead core courses + MS Biochemistry courses listed on Table 1, dual degree candidates are required to take 21 credit hours from the following list of elective courses.

ACCT 403	Survey of Accounting
ACCT 414	Corporate Reporting & Analysis
ACCT 418	Fraud, Governance and Reporting
ACCT 431	Tax Practice: Analysis, Planning and Communications
ACCT 480	International Tax
ACCT 495	Advanced Accounting Seminar: Taxation & Wealth Transfer
ACCT 495	Advanced Accounting Seminar: Taxation & Pers Fin Planning
ACCT 495	Advanced Accounting Seminar: Tax Reporting & Nonprofits
ACCT 495	Advanced Acct. Seminar – Val. Of Tax Liabilities
ACCT 495	Advanced Acct. Seminar – Forensics & Fraud
BAFI 403	Financial Management
BAFI 404	Financial Modeling
BAFI 427	Green Finance
BAFI 428	Financial Strategy & Value Creation
MSFI 430/BAFI 430	Derivatives of Risk Management
BAFI 440	Advanced Corporate Finance
BAFI 444	Entrepreneurial Finance
BAFI 450	Mergers & Acquisitions
BAFI 480	International Financial Management
BLAW 417	Legal Environment for Managers – MBA
ECON 421	Health Economics & Strategy
ENTP 419	Entrepreneurship and Personal Wealth Creation
ENTP 428	Entrepreneurship & Innovation
ENTP 444	Entrepreneurial Finance
LHRP 431	Negotiation for Managers
MGMT 440	Leadership Assessment and Development II
MGMT 464	Business Ethics
MGMT 467	Commercialization & Intellectual Property Management aka FUSION
MIDS420 A & B	Design in Management: Concept and Practices
MKMR 405	Business Marketing
MKMR 408	Marketing Metrics
MKMR 411	Customer Relationship Management
MKMR 421	Marketing Value Creation
OPMT 420	Six Sigma and Quality Management
OPMT 450	Project Management
MKMR/OPMT 475	Supply Chain Logistics
MKMR/OPMT 476	Strategic Sourcing

OPMT 477	Enterprise Resource Planning in the Supply Chain
OPRE 402	Stochastic Models with Applications
OPRE 411	Optimization Modeling
OPRE 432	Computer Simulation
OPRE 433	Probability, Forecasting & Statistics
OPRE 435B	Integrated Problem Solving in OR and SC
ORBH 403	Developing Interpersonal Skills for Managers
ORBH 430 A & B	MBA Institute In Sustainable Value and Social Entrepreneurship I & II
ORBH 450	Executive Leadership
ORBH 460	Women in Organizations
ORBH 491	Managing Diversity and Inclusion
PLCY 419	Entrepreneurship and Personal Wealth Creation
PLCY 425	Chief Executive Officer
PLCY 494	Managerial Consultancy

Appendix B

Department of Biochemistry courses and electives for the MBA/MS program. Please note: this list is not all-inclusive.

BIOC 407: Introductory Biochemistry (4 credits): Overview of the macromolecules and small molecules key to all living systems. Topics include: protein structure and function; enzyme mechanisms, kinetics and regulation; membrane structure and function; bioenergetics; hormone action; intermediary metabolism, including pathways and regulation of carbohydrate, lipid, amino acid, and nucleotide biosynthesis and breakdown.

BIOC 408: Molecular Biology: Genes and Genetic Engineering (4 credits): An examination of the flow of genetic information from DNA to RNA to protein. Topics include: nucleic acid structure; mechanisms and control of DNA, RNA, and protein biosynthesis; recombinant DNA; and mRNA processing and modification. Where possible, eukaryotic and prokaryotic systems are compared. Special topics include yeast as a model organism, molecular biology of cancer, and molecular biology of development. Current literature is discussed briefly as an introduction to techniques of genetic engineering.

BIOC 412: Introduction to Physical Biochemistry (3 credits): Interactions between biomolecules are discussed in a system-based approach that stresses quantitative and structural characterization. Topics discussed include site-directed mutagenesis of enzymes, DNA-protein and protein-protein interactions (protein-ligand interactions, with emphasis on protein – nucleic acid interactions).

BIOC 420. Molecular Genetics of Cancer (3 credits)**:** Using a combination of lectures and student presentations, this course provides an in-depth analysis of cancer as a genetic disease in the Mendelian sense of inheritance and in the sense of causation by somatic mutation. The objectives of the course are to examine both the proto-oncogenes and tumor suppressor genes that are the targets of oncogenic mutations and the mechanisms of mutational change. Discussions emphasize experimental approaches used to identify and study oncogenes and tumor suppressor genes. This course also covers viral mechanisms of oncogenesis which involve interactions between viral proteins and the products of cellular proto-oncogenes or tumor suppressor genes.

BIOC 430: Advanced Methods in Structural Biology I (a series of 1 credit courses): An in-depth introduction to biophysical techniques used to quantify macromolecular structures. The major parts of the course will deal with the use of nuclear magnetic resonance to derive a 3-D structures of macromolecules in solution. Other topics include electron spin resonance, absorption, fluorescence and circular dichroism spectroscopies, Raman and infrared spectroscopies and methods used in modeling.

BIOC 434: Proteins and Enzymes (3 credits): A detailed consideration of the structure and function of proteins and enzymes. Topics include: enzyme structure, kinetics, and mechanisms; structural biology of proteins and protein-DNA complexes; and techniques for structural analysis.

BIOC 452. Nutritional Biochemistry and Metabolism (3): Mechanisms of regulation of pathways of intermediary metabolism; amplification of biochemical signals; substrate cycling and use of radioactive and stable isotopes to measure metabolic rates.

BIOC 620: Transcription and Gene Regulation (3 credits): Topics will include Structure of bacterial and eukaryotic RNA polymerases; regulation of transcription initiation; gene-specific eukaryotic transcription factors; promoter clearance; the role of the RNA polymerase II CTD; transcription elongation: pausing and arrest; transcription control in HIV; coupling of transcription and RNA processing.

EPBI 408. Public Policy and Aging (3 credits): Overview of aging and the aged. Concepts in the study of public policy. Policies on aging and conditions that they address. The politics of policies on aging. Emergent trends and issues.

EPBI 431. Statistical Methods I (3 credits): Application of statistical techniques with particular emphasis on problems in the biomedical sciences. Basic probability theory, random variables, and distribution functions. Point and interval estimation, regression, and correlation. Problems whose solution involves using packaged statistical programs.

EPBI 432. Statistical Methods II (3 credits): Methods of analysis of variance, regression and analysis of quantitative data. Emphasis on computer solution of problems drawn from the biomedical sciences. Design of experiments, power of tests, and adequacy of models.

GENE 500 – Advanced Eukaryotic Genetics I (3 credits) Fundamental principles of modern genetics; transmission, recombination, structure and function of the genetic material in eukaryotes, dosage compensation, behavior and consequences of chromosomal abnormalities, mapping and isolation of mutations, gene complementation and genetic interactions. Recommended preparation: BIOL 362.

NTRN 410. History of Food and Nutrition (3 credits)**:** Investigations of the development of nutrition as a science and interactions with medicine, agriculture, public health and dietetics. Food and technological effects on health.

NTRN 433. Advanced Human Nutrition I (4 credits)**:** Emphasis on reading original research literature in energy, protein and minerals with development of

critical evaluation and thinking skills. Prereq: NTRN 201 and CHEM 223 and BIOL 348 or equivalent.

NTRN 434. Advanced Human Nutrition II (3 credits)**:** Emphasis on reading original research literature on vitamins with development of critical evaluation and thinking skills. Prereq: NTRN 433 or consent.

PATH 410 – Aging and the Nervous System (1 credit) Lectures and discussion on aspects of neurobiology of aging in model systems; current research on Alzheimer's, Parkinson's, and Huntington's diseases.

PATH 416. Fundamental Immunology (4 credits) Introductory immunology providing an overview of the immune system, including activation, effector mechanisms, and regulation. Topics include antigen-antibody reactions, immunologically important cell surface receptors, cell-cell interactions, cell-mediated immunity, innate versus adaptive immunity, cytokines, and basic molecular biology and signal transduction in B and T lymphocytes, and immunopathology. Three weekly lectures emphasize experimental findings leading to the concepts of modern immunology. An additional recitation hour is required to integrate the core material with experimental data and known immune mediated diseases. Five mandatory 90 minute group problem sets per semester will be administered outside of lecture and recitation meeting times. Graduate students will be graded separately from undergraduates, and 22 percent of the grade will be based on a critical analysis of a recently published, landmark scientific article.

PHOL 481. Medical Physiology (6 credits) Physiology is the dynamic study of life. It describes the vital functions of living organisms and their organs, cells, and molecules. For some, physiology is the function of the whole person. For many practicing clinicians, physiology is the function of an individual organ system. For others, physiology may focus on the cellular principles that are common to the function of all organs and tissues. Medical physiology deals with how the human body functions, which depends on how the individual organ systems function, which depends on how the component cells function, which in turn depends on the interactions among subcellular organelles and countless molecules. Thus, it requires an integrated understanding of events at the level of molecules, cells, and organs. Medical Physiology I is a lecture course (3, 2 hr. lectures/week). It is the first of a two-part, comprehensive survey of physiology that is divided into four blocks: Block 1 covers the physiology of cells and molecules, signal transduction, basic electrophysiology, and muscle physiology; Block 2 covers the nervous system; Block 3 covers the cardiovascular system, and; Block 4 covers the respiratory system. Grading in the course will be based on performance on multiple choice/short essay examinations administered at the end of each block with each examination weighted according to the number of lectures contained in that block.

PHRM 413. Molecular and Genomic Pharmacology (3 credits)**:** The primary goal of this seminar style course is the development of a critical approach to the evaluation and design of research in the broad context of the interaction of receptors with endogenous ligands and with drugs and the determination of the polygenetic basis of disease states and interindividual variation in responsiveness to drugs. Lectures and/or journal article presentation will illustrate the application of fundamental principles of chemistry, biochemistry, thermodynamics, genomics, and pharmacology to experimental problem solving. Students and faculty participate as discussion leaders.

Appendix C

MBA/MS programs in the United States

University of Michigan – environment

Boston University – information systems

Stanford University – environment and resources

Rice University – environmental analysis, subsurface geoscience, nanoscale physics

University of Texas – engineering

University of Pennsylvania – engineering, telecommunications, biotechnology and cognitive science

Bentley University – information technology

New York University – mathematics in finance

University of Pittsburgh – engineering

Massachusetts Institute of Technology – engineering

Columbia University – engineering

Purdue University – agricultural economics

Indiana University – biology, chemistry, information science, geology, math, physics

Rutgers University - biomedical sciences

Johns Hopkins University – biotechnology

Chapman University – food science

Fordham University – information systems

Boston College – nursing

Towson University – nursing

University of Utah – bioengineering

Brigham Young University – mechanical engineering

University of Illinois – electrical and computer engineering

University of Florida – pharmacy

Washington University – biomedical engineering

Clark University – environmental science and policy

Montclair State University – chemistry

Loyola University – pharmacy and therapeutics

Arizona State University – industrial engineering