Graduate Affairs Committee
June 28, 2005
3:30 p.m. - 5:00 p.m.
Inlow Hall Room 267

AGENDA

1. Approval of the minutes for May 24, 2005……Queener

2. Associate Dean's Report……Queener

3. Graduate Office Report……Queener

4. Graduate Student Organization Report ……Reuille

5. Committee Business
   Curriculum Subcommittee Report……Jones
   Fellowship Subcommittee Report……Koerner

6. Program Information……Queener
   a. MS Biotechnology Track.. Approval vote due
   b. PhD in Medical Neurobiology Curriculum Revision.. Approval vote due
   c. MBA Accounting Major.. Approval vote due
   d. Certificate in Public Health.. Approval vote due
   e. Executive Certificate in Library Management.. Approved and forwarded
   f. Certificate in Legal Informatics.. Returned to program for revision
   g. PhD in Bioinformatics.. Concept approved; proposal being prepared

7. Discussion

8. Next Meeting (September 27, 2005) and adjournment

Graduate Affairs Committee :

June 28, 2005 Minutes

Present: Margaret Adamek, Daniel Callison-Stand In, Pamela Crowell, Ain Haas, Elisabeth Hinshaw-Osgood, Marvin Kemple, Michael Kowolik, Jane Lambert, Sherry Queener, Simon Rhodes, Marianne Wokeck.

Guest: Gerry Oxford

Staff: David Koerner, Dswanda Jones.

Approval of the Minutes - Dr. Queener

Minutes from the May 24, 2005 Meeting Approved.

Graduate Office Report - Dr. Queener

(Reported Program Information)

Graduate Student Organization Report - Ms. Reuille

(No Report - Ms Reuille Did Not Attend)

Committee Business

Curriculum Subcommittee Report - Ms. Jones

The Committee reviewed 10 Courses, 5 were not approved, 2 were approved and 3 were approved contingent on minor changes.

Fellowship Subcommittee Report - Mr. Koerner

(No Report)

Program Information - Dr. Queener

- MS Biotechnology Track - Approved Contingent - Votes to be sent in Electronically. - Approved by GAC July 22, 2005
- PhD in Medical Neurobiology Curriculum Revision - Approved Contingent - Votes to be sent in Electronically. - Approved by GAC July 14, 2005
- MBA Accounting Major - Approved Contingent - Votes to be sent in Electronically. - Approved by GAC July 22, 2005
- Certificate in Public Health - Approved Contingent - Votes to be sent in Electronically. - Approved by GAC July 22, 2005
- Certificate in Legal Informatics - Returned to Program for Revision awaiting updates.
- PhD in Biostatistics - Proposal Being Prepared.
- PhD in Physiology - Approved Contingent - Votes to be sent in Electronically - Approved by GAC July 22, 2005
- PhD Minor in History - Approved
- MFA Track in Visual Arts - Proposal Being Prepared.
- MBA/MPA Dual Degree - Approved Contingent - Votes to be sent in Electronically. - Approved by GAC July 24, 2005

Discussion

It was agreed that this meeting will replace the August 23rd meeting.

Next Meeting

September 27, 2005

Meeting Adjourned 4:40 pm

IUPUI Graduate Office
620 Union Drive | Union Building, Rm 207 | Indianapolis, Indiana 46202
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June 24, 2005

Dr. Sherry Queener
Associate Dean of the Graduate School
IUPUI Graduate Office
Union Building, 518
620 Union Drive, Room 518
Indianapolis, In 46202

Dear Sherry,

I am enclosing a revised proposal for the Biotechnology track in the M.S. in Biochemistry and Molecular Biology degree and the supporting documents dealing with the replies to the three reviews of the proposal and copies of two new course requests. The bottom line is that we are proposing to change the original proposal to require that students prepare and defend an M.S. thesis for this M.S. track instead of the research paper that was described in the proposal that was discussed on January 25, 2005 at the IUPUI Graduate Affairs Committee meeting. Additionally, there is one rather minor change to develop a new course called Scientific Writing and Communication in Biotechnology that would substitute for Biochemistry student seminar courses.

I thought that it would be useful to give a brief history of this proposal and discuss the justification for this change in the proposal. The original proposal was submitted to the School of Medicine graduate advisors and your office at the end of last year, around November. Relatively minor modifications were made in response to the School of Medicine graduate advisors. The reviews of the program for the GAC were positive and approval was recommended. However, one reviewer expressed a concern that this was a 'watered down version of a full-blown academic degree." The reviewer suggested clarifying the proposal to indicate that the core courses were academically challenging and, in the discussion in GAC, that the requirements for the research paper were more completely described in the proposal. We believe that the change to require the M.S. thesis and defense more adequately addresses this concern.

After GAC action, Dean John Slattery indicated to us that he would like for all major degree proposals to be reviewed by external reviewers. Accordingly, the revised proposal was sent out for Graduate School review in April, 2005. There were three reviews. I enclose copies of the reviews with our responses. Briefly, Reviewer 1 was very positive and did not have major concerns.

Reviewer 2 commented, "Would two credit courses serve the purposes of the program and allow more lecture courses to obtain some depth and background?" We believe that participation in a written thesis and defense

is much more valuable to these students in their careers as advanced technicians than additional basic science lecture courses. We believe that the existing coursework in the program is sufficient for the students to understand the basic background and use of biotechnologies that are covered in the program. The reviewer was also concerned whether the students would have the appropriate background/prerequisites for the program, especially lab courses. Our reply is that we provide significant amounts of lecture-based instruction in all laboratory courses (perhaps 1 hour of lecture for 3-4 hours of lab time). The reviewer was also concerned about the future development of the program, especially the numbers of students. We are also concerned about this and are developing survey tools to evaluate the interest and impact of the training program.

Reviewer 3 had the greatest concern about the program: "The lack of more stringent requirements for the Masters degree in Biotechnology is a concern to this reviewer." The reviewer suggested that 1-2 additional elective courses be added to the degree because "without the additional course requirements this program would be effectively much less vigorous than that of the current Biochemistry M.S. degree program that requires a thesis." In response, we indicated that we did not believe that additional lecture-based coursework would be the best choice to achieve quality and equivalency to the existing M.S. We decided that requirement of the M.S. thesis and defense was a better way to achieve equivalency of the M.S. degrees in Biochemistry and Molecular Biology.

In addition to the thesis requirement, we made one change to the M.S. curriculum. We substituted 1 more credit of research (total of 9) and 1 credit of Scientific Writing and Communication in Biotechnology for the two credits of Biochemistry Seminar in the original proposal. We believe that this change will substantially facilitate the research thesis writing and defense process for these students.

We believe that this major change in the curriculum responds to reviewer concerns. Additional minor concerns and replies are directly presented in the reviews and changes to the proposal are underlined.

Sincerely,

William F. Bosron, Ph.D.
Chancellor's Professor
Professor of Biochemistry and Molecular Biology
Director of Biotechnology Training Program

Proposal for an M.S. in Biochemistry and Molecular Biology with a Specialization in Biotechnology

(Major revisions to the version approved by IUPUI GAC are underlined)

Introduction: The Department of Biochemistry and Molecular Biology currently organizes a Biotechnology Training Program to award a Certificate in Biotechnology from the IU Graduate School. This proposal for an M.S. in Biotechnology as a track or specialization in the M.S. in Biochemistry and Molecular Biology is a natural extension of the interest of students to pursue the M.S. in this area. The Biotechnology Training Program started in 2001 with funding from the Lilly Endowment INGEN program. The long-term goal was to create a program to train technicians for Indiana University School of Medicine and health-related, central Indiana industrial research laboratories. The Biotechnology Training Program works closely with School of Medicine core facilities to train technicians to optimally use core research resources. The program is described at http://www.medicine.iu.edu/~gradschl/biotechTraining/index.html .

The main use of start-up INGEN funding was to create a state-of-the-art teaching facility at the Biotechnology Research and Training Center (BRTC). The class room accommodates about 20 students with high resolution video projection and conferencing equipment and computer facilities for instruction at student desks. The 1200 sq. ft. open teaching laboratory will accommodate about 16 students at one time. There are separate support rooms for core instrumentation and cell culture. The teaching laboratory has good spectrum of basic core equipment for biochemical research and teaching. In addition to this, core facilities for gene expression analysis, genotyping, protein expression, animal experimentation, proteomics and metabolomics research are available at the BRTC.

The Biotechnology Certificate includes an introductory course in biochemistry and molecular biology, three hands-on laboratory courses in proteomics, cell biology and molecular biology, and interactive problem-based learning courses in biotechnology and responsible conduct of research. The core curriculum for the 17 credit, 1.5 year certificate program is shown in the following table. All courses have been offered at least twice. This curriculum is offered on a part-time basis with all classes beginning after about 3 PM in the afternoons. Our initial experience with the program indicates that problem-based learning in the G828 Concepts in Biotechnology course is very important in teaching integration of biotechnology principles into the flow of basic research projects. The interactions among students promoted by problem-based learning (identification of learning issues, searching the literature and data bases by computer, team discussions of research problems and presentations of learning issues in oral and written format) are very important in developing skills in communication, team-work, problem-solving, and accessing the scientific literature. We believe that this mixture of lecture, laboratory and problem-based learning experiences optimally prepares students to integrate new biotechnologies into a research or applied laboratory setting.

Course	Title	Credit	Type	Semester
B500	Introductory Biochemistry	3	Lecture	Fall, Year 1
G828	Concepts in Biotechnology	2	PBL	Fall, yr. 1
G841	Methods in Proteomics	3	Lab	Spring, yr. 1
G828	Concepts in Biotechnology	2	PBL	Spring, yr. 1
G890	Methods in Molecular Biology	3	Lab	Summer, yr. 1
G823	Methods in Cell Biology	3	Lab	Fall, yr. 2
G505	Responsible Conduct of Research	1	PBL	Fall, yr. 2
Total		**17**		**1½ years**

The Biotechnology Training Program Director is Bill Bosron and the Associate Director is Sonal Sanghani. David Allmann is Admissions Director. Bill Bosron is course director for G828, Concepts in Biotechnology, Paresh Sanghani for G841, Methods in Proteomics, Mark Lasbury and Chao Lee for G890 Methods in Molecular Biology, Sonal Sanghani for G823, Methods in Cell Biology. B500, Introductory Biochemistry (David Skalnik, course director) and G505, Responsible Conduct of Research (Mike Klemsz, course director) are presented to Biotechnology Training Program students at the BRTC classroom in late afternoon by video tape with a core faculty member present during playback to answer student questions.

The numbers of applicants, acceptances, matriculates and progress of students is shown below. We expect that the maximum program size will be 14 students per class per year in the next few years based on the level of interest in the 2003-4 and 2004-5 recruiting years. This class size fits well with the faculty resources for the program. We plan to initiate a survey of local employers with the help of BioCrossroads identify the need for such a graduate level training program by central Indiana employers. About 50% of our students are technicians at IUPUI, 30% are technicians at local industries like Lilly and Roche and 20% are seeking employment. In the 2002-3 group of 5 students who received the Certificate, two entered M.S. programs at IU and one entered an MBA program, so the Certificate seems to be a gateway to advanced degree programs. One student in the 2003-4 class and two students in the 2004-5 class are simultaneously pursuing both the Certificate and an M.S. at IU. Four students have submitted preliminary applications thus far for the proposed Biotechology track in the Biochemistry M.S. degree program. **We expect that about six students will enter the M.S. degree program per year.**

Year	Inquiries	Applicants	Acceptances	Matriculates	GPA	Finished 1st Year	Received Certificate
2002-3	-	11	9	7	3.3	5	5
2003-4	50	28	14	13	3.3	9	5[a]
2004-5	90	19	9	9	3.3	9	

[a] Four students from the 2003-4 class are still working on their Certificate

Objectives of the M.S. Program: The overall objective of the new M.S. degree is to offer working technicians in the Central Indiana workforce an opportunity to enhance their research skills in modern biotechnologies that are critical to health sciences research. To achieve this goal, we will create a new track in the M.S. degree program in Biochemistry and Molecular Biology that focuses on Biotechnology. The core curriculum of the new M.S. track is the 17 credits of the Biotechnology Certificate program. The M.S. track would be expanded to a total of 30 credits for the M.S. degree. The expanded 13 credits will include one more academic 3 credit graduate course, a 1 credit scientific writing tutorial, 9 credits of research supervised jointly with a faculty mentor and a School of Medicine core director. We expect that the program can be completed part-time in 3 years (see table below) or full time in 2 years (see table in appendix).

Unique Features and Strengths of the Program: The initial success of the Biotechnology Certificate program, as described above, is the most important feature and strength of the program. Out of the 7 students who entered the program 2002-3, 5 received Certificates. In the 2003-4 class of 13 students, 5 received the Certificate, 4 dropped out and 4 remain in the program and are scheduled to receive the Certificate by the end of 2005. Our retention rate from matriculation through the first year of the curriculum is 23/29 or 79%. A second major strength of the program is the outstanding research Core resources and course instructors available to the Biotechnology Training Program. Eight of the School of Medicine Core Facilities http://www.medicine.iu.edu/research/cores/ participate in the Training Program. In general, these are the most frequently utilized basic science cores at the School. A third major strength is the quality of the new teaching and laboratory space for the program at the Biotechnology Research and Training Center.

There is interest in M.S. degrees. Two of the five students who received Certificates in 2002-3 class are currently pursuing or received M.S. degrees from IU. Three of the 18 students in the 2003-4 and 2004-5 classes are pursuing the Certificate and M.S. degrees simultaneously. Four additional students have submitted preliminary applications for the proposed Biotechology track in this new Biotechnology M.S. degree program. **Hence, we believe that about 40% of the Certificate matriculates or about 6 students per year will go on to pursue a Biotechnology track in the M.S. in Biochemistry and Molecular Biology program**.

Curriculum: The 30 credit curriculum for the proposed M.S. program includes the 17 credits for the approved Biotechnology Certificate plus one elective graduate course in Basic Sciences (3 credits), 9 credits of research with a faculty mentor using a School of Medicine core facility and a 1 credit tutorial in scientific writing and communication. A thesis will be required (see below).

The elective course options in the spring of year 2 options are: Protein Structure and Function, B807, Cellular Biochemistry and Regulation, B810, Infectious Microbes and Host Interactions, J510, Graduate Neuroanatomy, D527 or Advanced Molecular Biology Methods G910 (the summer of year 2). All of the above courses are approved

by the IUPUI Graduate Affairs Committee for use in graduate degree programs. They have been used for many years as core courses for M.S. and Ph.D. programs at the School of Medicine. Other elective graduate-level science courses in the PU School of Science or IU School of Medicine can be used with approval of the faculty advisory committee.

The 9 credits of research will be taken in the spring and summer of year 2 and both semesters of year 3 (part-time). It is expected that students will spend at least one half-day in the laboratory per week per fall or spring term for each credit of research. This should be viewed as a minimum commitment and the research time will likely be more depending on the individual research project. The research project will be collaboratively directed by a faculty research mentor using a School of Medicine core facility and the director of the Research Core (or their designee). Both directors will be members of the student's Thesis Committee. The Chair of the Thesis Committee must be a member of the Graduate Faculty of the Department of Biochemistry and Molecular Biology. At least two of the Committee members must be members of the IU Graduate Faculty. The Director of the Biotechnology Program and Chair of the Department of Biochemistry and Molecular Biology will have final approval of the Thesis Committee. It is expected that the student will first work in the Core to learn basic methodologies. The faculty research mentor will assign a research project using the core facility. The student will write the M.S. thesis on the core methodologies and completed research. In the thesis, the student should provide appropriate introductory material on the core methodology and scientific goal of the research. Results should be completely presented in figures and tables. The student should discuss the utility of the core methods and significance of results. The student will defend the thesis in a meeting of the Thesis Committee. In the Spring semester of year 2 of the part-time program, students will enroll in a one credit tutorial course in Scientific Writing and Communication (Bill Bosron, course director) that will guide them in the preparation of the research proposal, thesis and oral defense.

Title	Number	Credit	Type	Semester
Introductory Biochemistry	B500	3	Lecture	Fall, yr. 1
Concepts in Biotechnology	G828	2	PBL	Fall, yr. 1
Methods in Proteomics	G841	3	Lab	Spring, yr. 1
Concepts in Biotechnology	G828	2	PBL	Spring, yr. 1
Methods in Molecular Biology	G890	3	Lab	Summer, yr. 1
Methods in Cell Biology	G823	3	Lab	Fall, yr. 2
Responsible Conduct of Research	G505	1	PBL	Fall, yr. 2
Elective	Varies	3	Lecture/lab	Spring, yr. 2
Scientific Writing and Communication in Biotechnology	**New**	**1**	**Tutorial**	**Spring, yr. 2**
Research in Biotechnology	**New**	**1**	**Research**	**Spring, yr. 2**
Research in Biotechnology	**New**	**2**	**Research**	**Summer, yr. 2**
Research in Biotechnology	**New**	**3**	**Research**	**Fall, yr. 3**
Research in Biotechnology	**New**	**3**	**Research**	**Spring, yr. 3**
Total		**30**		**3 Years**

New courses are in bold and course requests are appended.

Degrees to be Awarded (and performance levels): The degree will be an M.S. in Biochemistry and Molecular Biology with a specialization or emphasis in biotechnology. We will request that the specialization in biotechnology be listed on the M.S. degree diploma, if possible. A comparison of the proposed M.S. track in Biotechnology to the current M.S. in Biochemistry and Molecular Biology and the Certificate in Biotechnology is shown below. While the 3-4 core courses differ, the general M.S. requirements such as 30 total credits, 9 credits of research and a thesis with thesis defense are similar.

Part-time students must complete the certificate program before proceeding on to research in the M.S. The program is designed to be completed in 3 years part-time with the ~2 courses per term starting after 3 PM in the afternoons (table above). A 2 year full-time alternative is included in the Appendix but we expect few students to use this alternative.

	Original MS in Biochemistry	**New Biotechnology Track (part-time)**	Biotechnology Certificate
Total credits	≥30	**30**	17
Undergraduate Degree and GPA	≥3.0	**≥3.0**	≥3.0
GRE for admission	Required	**Not required**	Not required
Participation in B890 Student Seminar	Required	**Not Required**	Not required
B807 Protein Structure and Function (3 cr)	Required [1]	**Elective[2]**	Not required
B810 Cellular Biochemistry & Regulation (3 cr)	Required [1]	**Elective[2]**	Not required
G817 Eukaryotic Cell Biology (2 cr)	Required [1]	**Elective[2]**	Not required
G865 Fundamental Molecular Biology (3 cr)	Required [1]	**Elective[2]**	Not required
G505 Responsible Conduct of Res. (1 cr)	Required	**Required**	Required
B500 Intro Biochemistry (3 cr)	Not required (elective)	**Required (substitutions shown at right)**	Required; may substitute B807, G817, G865, G910, K540, or C636
G828 Concepts in Biotechnology (2 cr)	Not required	**Required (twice)**	Required (twice)
G841 Methods in Proteomics (3 cr)	Elective	**Required**	Required
G890 Methods in Molecular Biology (3 cr)	Elective	**Required**	Required
G823 Methods in Cell Biology (3 cr)	Elective	**Required**	Required
Research	6 – 9 credits	**9 credits**	Not required
Scientific Writing and Communication	Not required	**Required**	Not required
Final Examination	Written thesis, oral examination	**Written thesis, oral examination**	Not required

[1] Traditional MS students are required to take 3 of the 4 core courses for the PhD program.
[2] Only one elective is required for new Biotechnology MS.

Admissions Requirements: Since part-time students must complete the Certificate first, the admissions requirements include those for the Biotechnology Certificate Program. That is: a baccalaureate degree in biology, chemistry or a related field and an overall and science GPA of 3.0 on a 4.0 scale. Students should have an Organic Chemistry course and a Biology course with a laboratory. Applicants must provide letters of recommendations from 3 individuals familiar with their academic record and potential to succeed in the M.S. program as well as a personal statement describing why they are applying to the program. It is expected that the majority of students will be working in a biotechnology-related area and will complete the program as a part-time student. GRE is not required for the Certificate and will not be required for the MS, since most students will complete the Certificate first. The IUPUI ESL exam is required for students who graduated from an undergraduate school outside of the U.S. In order for students to be admitted to the M.S. from the Certificate, they must have an overall GPA of ≥ 3.0 in the Certificate program. If the student has a grade less than B- in B500 or one of the core laboratory courses, the faculty advisory committee will require that the student take an additional course to demonstrate academic proficiency.

Students can be admitted directly to the 2 year, full-time M.S. program described in the appendix. We believe that few students will elect this option. In this case, they will take a more concentrated load. We will require the GRE examination as an additional predictor of student potential in addition to GPA and letters of recommendation for those desiring the full-time, 2 year version of the M.S.

Clientele to be served: The major source of students for the Biotechnology M.S. will be our own technicians at IUPUI as well as employees of local biotechnology industries. Employees at Eli Lilly & Co., Roche Diagnostics, Dow Agrosciences and other local biotechnology companies have participated in the Certificate program. Another source of students will be individuals seeking a change in career, especially women who wish to reenter the workforce after raising a family. The M.S. program will be a comprehensive educational opportunity to allow the student to be competitive for positions in the biotechnology workforce. Additionally, we believe that the Biotechnology M.S. program will be a gateway into our research-based Ph.D. programs. Most of the courses in the M.S. program are approved for graduate credit and could be used for a Ph.D. with appropriate approvals.

Student Financial Support Available: There is no student fellowship or tuition funding available for this M.S. program. However, employees of Indiana University are eligible for a graduate fee courtesy of $908.33 per semester which covers 3 credits per semester. Most local biotechnology companies will cover fees for an employee. Students may also apply for financial aid. As shown in the table comparing biotechnology programs at other institutions, our estimated tuition and lab fee costs of $6,506 for the program are substantially lower than other programs nationally.

Evidence of Student Demand: As shown in the table on page 2, we have had between 11 and 28 applications for the Biotechnology Certificate in the past 3 years. Between 7 and 13 student matriculated into the Certificate program. We expect this demand will increase as the research enterprise grows at IUPUI. Our retention of matriculated students through the first year is 79% and we have awarded 10 Certificates so far.

Employment Possibilities for Graduates: As indicated in the Introduction, about 80% of our Certificate students are already employed. We believe that this will be true for the M.S. students in this part-time program. We have created a survey to gather outcomes information on recent graduates about employment. We expect that their credentials would be substantially enhanced by the program.

Relevant Faculty Expertise: The following faculty are members of the Biotechnology Admissions/Advisory committee and participate significantly in the training program. Dr. William Bosron, Director, Chancellor's Professor and Professor of Biochemistry and Molecular Biology has an active funded research laboratory investigating alcohol and drug metabolism, and currently trains pre and postdoctoral students. He is course director for Concepts in Biotechnology and Scientific Writing and Communication. Dr. Sonal Sanghani, Associate Director, and Assistant Research Professor and Assistant Professor of Biochemistry and Molecular Biology, part-time, is an active researcher in cancer drug metabolism and in the cell biology of liver fibrosis. She is course director for the Cell Biology laboratory course. Dr. Paresh Sanghani, Assistant Research Professor and Assistant Professor of Biochemistry and Molecular Biology, part-time, has an active research laboratory investigating the structure and mechanism of zinc-dependent alcohol dehydrogenases. He is the Director of the INGEN Protein Expression Core and course director for the Proteomics lab course. Dr. David Allmann, Director of Admissions, has extensive experience with student recruiting and advising. Dr. Hiremagalur Jayaram, Professor of Biochemistry and Molecular Biology, has an active research laboratory investigating nucleic acid metabolism, drug resistance and chemotherapy. He is an expert in case development for Concepts in Biotechnology. Dr. Mark Lasbury, Assistant Scientist in Pathology and Laboratory Medicine, directs the laboratory course in Molecular Biology with Dr. Chao-Hung Lee.A list of participating core facilities and their directors is shown below.

Core Facility	Director
Biochemistry Biotechnology Facility	Robert Harris
Cell & Protein Expression	Paresh Sanghani
Flow Cytometry	Edward Srour
Ind. Center for Biological Microscopy	Kenneth Dunn
In vivo Imaging	Tim DeGrado
Proteomics	Mu Wang
Transgenic & Knockout Mouse	Loren Field
Zebrafish Knockdown Core	Jim Marrs

Impact on Undergraduate and Other Graduate Programs: As mentioned above, we have preliminary data to show that the Biotechnology Certificate program is a gateway for students to test graduate school before enrolling in M.S. programs. We believe that

the Biotechnology M.S. program will be a gateway for students interested in the research Ph.D. at IU or elsewhere. We believe that this M.S. track is unique at IUPUI and that it will not conflict with other M.S. programs on IU campuses (letters of support were provided with the initial application approved by IUPUI Graduate Affairs Committee).

Compatibility with University and Campus Missions: It is clear from statements by Chancellor Bantz that the development of Biotechnology Training programs is central to the mission of the IUPUI campus as articulated in his 2003 installation address 'IUPUI and the Power of Two'
http://www.iport.iupui.edu/performance_report/teach/pr_teach_provide.htm .

Implementation Plan: As indicated above, the Biotechnology Certificate Program has been in operation for 3 years. All of the core courses are in operation and the new INGEN Biotechnology Training facilities at the Biotechnology Research and Training Center. Most additional courses for the M.S. degree are already in operation except for the research and Scientific Writing courses. As indicated in the table above, we have support from 8 School of Medicine Core facilities to have students participate in faculty research under core director guidance.

Plan for Administering the Program: We have an existing administrative structure for the program: Dr. William Bosron, Director, Dr. Sonal Sanghani, Associate Director, Dr. David Allmann, Admissions Director. We have an existing advisory committee: Drs. Allmann, Bosron, Jayaram, Lasbury, P. Sanghani, S. Sanghani and Wang. The committee meets regularly to consider admissions strategies, perform program evaluations and review curricula. The Training Program Director reports directly to the Chair of Biochemistry and Molecular Biology, Dr. Thomas Hurley and to the Chair of the INGEN Steering Committee, Dr. Ora Pescovitz.

In collaboration with the IUPUI office of Institutional Improvement and Planning, we are designing a survey tool for the 29 students who matriculated into the Certificate program and their employers to assess the quality and utility of the program, and interest in the new M.S. degree. This should be available in the Fall of 2005 and a copy of the report will be forwarded to Deans Queener and Pescovitz and the INGEN Operations Committee.

Comparison with Similar Programs at other Universities and at other Campuses of Indiana University: There are several laboratory-oriented Biotechnology Training programs in the US and programs from major research institutions are listed below. The Biotechnology programs primarily oriented toward the business of biotechnology are not included. While some programs can be done part-time, we believe that our IUPUI Biotechnology MS program is the only one that was designed to be part time from the onset. Thirty graduate credits or about 10 courses (not counting research) seem to be the norm in the program. It should be pointed out that tuition for the Indiana University programs is far lower than other U.S. programs in this area.

University	Department	Effort	Credits	Duration	Fees
IUPUI (this proposal)	Biochemistry	Part	30	3 years	$6,506
Indiana Univ. Bloomington	Biol., Chem.	Full	30	1 year	$6,381
Penn State	Huck Institute	Full	30	1.5 years	$32,247
Johns Hopkins Univ.	Advanced Acad. Progs.	Full	10 courses	2 years	$20,750
Univ. Penn	Eng and Sci	Full	11 courses	2.5 years	~$41,652
Northwestern	Eng and Sci	Full/Part	5 quarters or ~1.5 years		$49,235
Univ Mass	Biology	Full	30		$11,145
Georgetown	Biochemistry	Full/Part	30	1 year	$23,595

Appendix 1: Proposed curriculum for full-time, 2 year M.S.

Title	Number	Credit	Type	Semester
Introductory Biochemistry	B500	3	Lecture	Fall, yr. 1
Concepts in Biotechnology	G828	2	PBL	Fall, yr. 1
Methods in Cell Biology	G823	3	Lab	Fall, yr. 1
Methods in Proteomics	G841	3	Lab	Spring, yr. 1
Concepts in Biotechnology	G828	2	PBL	Spring, yr. 1
Scientific Writing and Communication in Biotechnology	New	1	Tutorial	Spring, yr. 1
Research in Biotechnology	New	1	Research	Spring, yr. 1
Methods in Molecular Biology	G890	3	Lab	Summer, yr. 1
Research in Biotechnology	New	1	Research	Summer, yr. 1
Elective	Varies	3	Lecture/Lab	Fall, yr. 2
Responsible Conduct of Research	G505	1	PBL	Fall, yr. 2
Research in Biotechnology	New	3	Research	Fall, yr. 2
Research in Biotechnology	New	4	Research	Spring, yr. 2
Total		**30**		**2 Years**

Appendix 2: New Course Proposal for Scientific Writing and Communication in Biotechnology

Introduction and Justification of the course:

This course is designed to assist students in developing the research program and thesis for the Biotechnology track in the M.S. in Biochemistry and Molecular Biology at the School of Medicine (hereafter called the M.S. in Biotechnology). This new degree has been approved by the Department of Biochemistry and Molecular Biology and the IUPUI Graduate Affairs Committee. It is in the process of approval by the IU Graduate School.

This M.S. is designed for part-time students who have completed the 17 credit Certificate in Biotechnology. That is, the M.S. is a 13 credit addition to the Certificate program. Students will have taken an introductory biochemistry lecture course, three laboratory courses in proteomics, cell biology and molecular biology, a problem-based learning course in biotechnology and a course in research ethics in the Certificate program. The M.S. in Biotechnology has a relatively fixed curriculum like the Certificate. Students will start with an elective course in basic science, 9 credits of research in biotechnology with a faculty mentor and core research director and this scientific writing course. A time table for the three year Certificate and M.S. curriculum is shown below.

Title	Number	Credit	Type	Semester
Introductory Biochemistry	B500	3	Lecture	Fall, yr. 1
Concepts in Biotechnology	G828	2	PBL	Fall, yr. 1
Methods in Proteomics	G841	3	Lab	Spring, yr. 1
Concepts in Biotechnology	G828	2	PBL	Spring, yr. 1
Methods in Molecular Biology	G890	3	Lab	Summer, yr. 1
Methods in Cell Biology	G823	3	Lab	Fall, yr. 2
Responsible Conduct of Research	G505	1	PBL	Fall, yr. 2
Elective	Varies	3	Lecture/lab	Spring, yr. 2
Scientific Writing and Communication in Biotechnology	**New**	**1**	**Tutorial**	**Spring, yr. 2**
Research in Biotechnology	New	1	Research	Spring, yr. 2
Research in Biotechnology	New	2	Research	Summer, yr. 2
Research in Biotechnology	New	3	Research	Fall, yr. 3
Research in Biotechnology	New	3	Research	Spring, yr. 3
Total		**30**		**3 Years**

In this course, students will be introduced to the concept of the research thesis, selection of research advisors, construction of a research proposal and finally, the writing of the thesis. Students will register for this course in the first semester of their M.S. However, they will continue with the course throughout the 3 year program while they are doing their research project. The course will involve a series of group meetings with students covering the topics and at the times shown in the Syllabus document. The final part of the course will involve individualized meetings with students and the

course director on preparation of the thesis. We called the course a tutorial because of the flexibility in timing of the activities.

In summary, the rationale for this course is to guide the student through the research-based M.S. thesis in Biotechnology. We believe that a formalized course is much more beneficial to the part-time student rather than the informal guidance from advisors normally used with full-time students in graduate degree programs. Hence this course plays a key role in the overall curriculum of the research part of this M.S. degree. It is a graduate course because it is directly coupled to independent research for the M.S. degree.

Syllabus

Title: Scientific Writing and Communication in Biotechnology

Course Number: XXX

Instructor: William Bosron

Prerequisites: None

Course Description: Discussion and individualized instruction in the preparation of a research proposal and thesis in the Biotechnology track of the M.S. in Biochemistry and Molecular Biology.

Educational Objectives: The objective is to guide the student through the concept of independent research and thesis writing. There are specific goals for the course that are associated with the time line of the research thesis process including: the selection of research mentors and preparation of a time table, research proposal, thesis outline, first draft of the thesis and thesis defense. The student will read published information about the process and will be evaluated on ability to perform the tasks in a timely manner.

Course Content: The major objectives of the course are shown in the table below. Students will register for the 1 credit course in the Spring semester of year 2 of the part-time M.S. program when the students select a research mentor and project. However, the course will continue throughout the time in the research laboratory culminating in the thesis and defense. There will be 7 group lectures during the 2nd and 3rd years of the program that are based on literature readings on topics shown in the table below. There will be at least 8 one hour tutorial sessions involving individualized meetings with students and the course director concerning on the topics shown in the table below. Hence, a minimum of 15 one hour meetings with the student is consistent with one credit for the course.

Topic	Lecture/tutorial	Time
Introduction to a research thesis	1 lecture	Spring, yr. 2
Selection of research mentors	1 lecture, 1 tutorial	Spring, yr. 2
Preparation of a thesis time table	1 lecture, 1 tutorial	Spring, yr. 2
Preparation of a research proposal	1 lecture, 2 tutorial	Summer, yr. 2
Preparation of a thesis outline	1 lecture, 1 tutorial	Spring, yr. 3
Preparation of the first draft of the thesis	1 lecture, 2 tutorial	Spring, yr. 3
Preparation for the thesis defense	1 lecture, 1 tutorial	Spring, yr. 3

Texts: The main reading source for the course will be "Guide to the Successful Thesis and Dissertation: A Handbook for Students and Faculty" by Mauch and Birch, 1998. This text is available through the IUPUI library and NetLibary as an eBook. Students will be assigned chapters to read in this text on the 7 topics in the table above.

Secondary sources of assigned information will be "On Being a Scientist: Responsible Conduct in Research, Second Edition," 1995 and "Biotechnology: Science, Engineering, and Ethical Challenges for the 21st Century," 1996. Both of these texts are available on line from National Academic Press.

Evaluation and Grading: Students will be evaluated on the preparation of the following items: thesis time table, research proposal, thesis outline, first draft of the thesis and thesis seminar. This evaluation will be based on the content of documents relative to the examples given in texts. Students will be evaluated on their preparation for individual tutorial sessions dealing with the preparation of these documents. For the spring semester of the 2nd year when they register, students will receive an intermediate R grade until the requirements are completed in the spring of the 3rd year. The grading will be subjective by the course director who is experienced in preparation of thesis documents. The grading will be A (excellent), B (good), C (inadequate for graduate level work), F (not completed on time).

Bibliography: Reading materials will come from the on line tests that are described above. As an example, students will be given a model thesis time table described in "Guide to the Successful Thesis and Dissertation, …" in Figure 1-1. They will be asked to revise the step, action plan, time estimate and date for their own situation during the tutorial session.

Cheating and Plagiarism: Students will be asked to read the sections in the Academic Handbook dealing with cheating and plagiarism http://www.iupui.edu/~resgrad/grad/academic_misconduct_curriculum_subcommittee.rtf . We expect that students will work independently to produce the documents required in this course. The students will have taken a required course in responsible conduct of research that covers plagiarism and other ethical issues in research.

Appendix 3: New Course Proposal for Research in Biotechnology

Introduction and justification for the course:

The rationale for this course is that it is the primary research course for the thesis in the Biotechnology track for the newly proposed M.S. in Biochemistry and Molecular Biology degree. This is a fixed curriculum where the students will be asked to participate in 9 credits of research from the spring semester of their 2nd year to the spring semester of their 3rd year in the part-time program as shown in the curriculum table below.

Title	Number	Credit	Type	Semester
Introductory Biochemistry	B500	3	Lecture	Fall, yr. 1
Concepts in Biotechnology	G828	2	PBL	Fall, yr. 1
Methods in Proteomics	G841	3	Lab	Spring, yr. 1
Concepts in Biotechnology	G828	2	PBL	Spring, yr. 1
Methods in Molecular Biology	G890	3	Lab	Summer, yr. 1
Methods in Cell Biology	G823	3	Lab	Fall, yr. 2
Responsible Conduct of Research	G505	1	PBL	Fall, yr. 2
Elective	Varies	3	Lecture/lab	Spring, yr. 2
Scientific Writing and Communication in Biotechnology	New	1	Tutorial	Spring, yr. 2
Research in Biotechnology	**New**	**1**	**Research**	**Spring, yr. 2**
Research in Biotechnology	**New**	**2**	**Research**	**Summer, yr. 2**
Research in Biotechnology	**New**	**3**	**Research**	**Fall, yr. 3**
Research in Biotechnology	**New**	**3**	**Research**	**Spring, yr. 3**
Total		**30**		**3 Years**

This course is justified as a graduate level course because it represents the research that the student will perform for the thesis under the guidance of a faculty research mentor and a director of a School of Medicine core research facility (or their designee). It is very similar in requirements to the existing research course in Biochemistry and Molecular Biology (G855) that is used for M.S. and Ph.D. thesis preparation.

Syllabus:

Title: Research in Biotechnology

Course Number: XXX

Instructor: The instructor will be William Bosron, the Director of the Training Program.

Prerequisites: none

Course Description: Research for biotechnology track in M.S. thesis.

Educational Objectives: The objective of the course is for the student to conduct new research for the thesis under the direction of a faculty research mentor and a director of a School of Medicine Core research facility. The student will become experienced in

the biotechnology aspects of the research conducted in the core facility and apply this technology to the faculty mentor's specific research problem.

Course Content: The student will start with a research rotation in the core facility to learn the basic biotechnologies in the core. This is expected to occur in spring of the 2nd year (1 credit). The student will then perform new research in a faculty mentor's lab and the School of Medicine research core facility. It is expected that students will spend at least one half-day in the laboratory per week per fall or spring term for each credit of research. This should be viewed as a minimum commitment and the research time will likely be more depending on the individual research project. Students are encouraged to participate in organized research meetings of the students, technicians and postdocs in the mentor's laboratory or the core facility.

Required and recommended texts: There are no recommended texts. The student is expected to be familiar with the pertinent publications relating to research in the core and the mentor's laboratory.

Evaluating and grading: Grading will be performed each term of registration by the Chair of the thesis committee in consultation with the other members of the committee. Grading will be subjective but will follow the usual guidelines for research: A = excellent, B = good, C = unsatisfactory, F = did not participate.

Bibliography: The primary research readings will be selected by the faculty mentor and core director.

Cheating and Plagiarism: Students will be asked to read the sections in the Academic Handbook dealing with cheating and plagiarism http://www.iupui.edu/~resgrad/grad/academic_misconduct_curriculum_subcommittee.rtf . We expect that students will work independently to produce original research. The required course in Responsible Conduct of Research covers issues of data fabrication, plagiarism and ethical use of animals and human subjects.

Reviewer 3

May 22, 2005

Dr. Sherry F. Queener
Associate Dean, IU Graduate School
Director of the Graduate Office, IUPUI

Dear Dr. Queener,

As requested, I have reviewed the proposal for an M.S. degree in Biochemistry and Molecular Biology with a specialization in Biotechnology program. Overall, this is a well-defined and described proposal that will offer an advanced degree (M.S. degree) for Biotechnology on the Indianapolis Campus. This degree will serve in part as an enhancement of the Biotechnology certificate currently offered. The proposal is well written and appears to be supported by the Biotechnology and Biochemistry community. Of some concern is the differentiation between the M.S. programs in the IU School of Medicine that require a thesis for completion, and the certificate program. I suggest that perhaps additional didactic coursework be required that could then increase the classroom credit hours required (while keeping the credits required to 30). This would then separate this non-thesis option program from thesis option Master's programs. An additional concern is the long term source of potential applicants and students. While there appears to be an immediate source of interested and qualified students, whether this demand will be maintained through subsequent years is a concern

CHARGE QUESTIONS

With regard to the charge questions provided, my responses are as follows:

1. Is the curriculum appropriate to the campus and the area?

The proposed MS degree in Biotechnology is very timely and appropriate to the IUPUI campus. The need for individuals specifically trained in Biotechnology is great. Providing an opportunity for a M.S. degree in this field appears to be generally an excellent opportunity. An apparent need exists for M.S. training in the Biotechnology arena based on the responses cited in this proposal indicating the number of individuals that have recently completed the Biotechnology certificate program.

We agree and thank the reviewer for these comments.

2. Is the program sufficiently rigorous to be a master's program?

As described the new Biotechnology master's program proposal will be an extension of the Biotechnology certificate program. It differs from the current M.S. program in Biochemistry by not requiring 1) the GRE exam for admission, 2) providing more "hands on" technology related courses than required in the Biochemistry M.S. degree and 3) not requiring a MS thesis. The courses for the most part are similar if not the same as the requirements for the Biotechnology certificate. In addition, the final product for the new Biotechnology track will be a report of twenty pages or more in contrast to the thesis requirement for the M.S. in Biochemistry. The lack of more stringent requirements for the Masters degree in Biotechnology is a concern to this reviewer. While the writing of a twenty page technical report is admirable, I have a concern about the rigorousness of the requirements for this new M.S. program. While I support a non-thesis option for the M.S. program in Biotechnology, I recommend additional coursework be required. For example, several courses that could be added include a course discussing the overview of basic animal structure, function, and pathology as it relates to the Molecular Biology field. This could include toxicological aspects, disease related aspects, and animal handling techniques and approaches. Currently on campus, there are several laboratories devoted to development of animal models including the zebra fish, transgenic and knockout mouse studies; toxicology overviews: basic pathology, and tumor biology overviews. The development of an overview course covering these subjects would allow for a stronger foundation of the utilization of molecular techniques to disease states and whole animal studies. Colleagues of mine at senior leadership positions in Fortune 500 pharmaceutical and chemical industries frequently complain that there is a lack of understanding of the basic biological issues surrounding chronic disease states by many molecular biologists. This limits the integration of their work into overall approach of treating and curing human disease. The molecular Biology MS could take a lead in this area by providing for a basic foundation in understanding of disease states and the models used to study them.

In addition, perhaps one or two additional electives could be added, increasing the stringency of the MS in biotechnology, while still separating it from the certificate and the MS in biochemistry (which requires a thesis). A combination journal club/seminar series for one credit a semester could also be considered to increase the number of didactic credit hours.

Of concern is that without the additional course requirements this program would be effectively much less vigorous than that of the current Biochemistry M.S. degree program that requires a thesis.

We recognize the concern about rigor of the Biotechnology track vs. the traditional M.S. in Biochemistry and Molecular Biology and other M.S. degrees at the School of Medicine. However, we feel that additional lecture courses are not as beneficial to these students as laboratory courses, problem solving in PBL and the research writing experience. Hence, we decided to require a traditional thesis for this M.S. degree. We believe that the combination of 2 traditional lecture courses, 3 laboratory courses with substantial lecture content, 3 PBL courses (including Ethics), 2 seminar courses, a scientific writing tutorial and 9 credits of research with a thesis constitutes a M.S. degree of equal rigor to our traditional M.S. in Biochemistry and Molecular Biology. We do agree that a course that would deal with basic animal structure, function, pathology and humane experimentation would be a great addition to the School of Medicine graduate courses and would be very useful as the elective in the Biotechnology M.S. It should be noted that students are required to attend Biochemistry seminars at 4 PM on Mondays as part of the student seminar series. We would accept another seminar series for the Biotechnology students.

3. How does this program compare with similar programs nationally?

This program is comparable to other programs that I am aware of nationally. The main feature of the program is that it is usually oriented towards evening students and part time students that are working in the industry. The program is to provide them with the necessary skills to either advance within their organization or to seek employment in other organizations. This program would be extremely valuable to those with basic biological degrees that either have found or are seeking employment in the Life Sciences industry in Indiana.

One additional opportunity to consider is the possible utilization of an internship program in industry as an elective for those students not fully employed as a means to acquaint the student to the corporate or academic laboratory world. This option would provide hands on experience as well as linking the students with potential employers.

This program is designed for working technicians, so we decided that an internship in Industry of the type that is traditionally used with undergraduate or full-time programs is not appropriate for this predominately part-time program. We note that there is are full time B.S. and M.S. degrees at IU Bloomington that offer industrial opportunities. In the future, we would consider letting students do their research in local industries, if we could guarantee that students could publish their work and that industrial mentors will help the student with the thesis.

4. Are the faculty resources adequate?

As outlined the faculty resources appear to be adequate. The current faculty resources are also being used for the Biotechnology certificate program. In addition, if additional courses or teaching is required through additional coursework this can easily be provided by current faculty members in IU Medical School or on the IUPUI campus. The proposed MS program has the advantage of increasing the class size of the courses currently offered (many through the current biotechnology certificate program, by requiring similar courses), thus little increase in faculty commitment hours or lecture/ lab facilities will be needed for the MS program.

We agree and thank the reviewer for the comments.

5. Is the equipment and physical plant adequate?

The physical plant for the proposal provided appears to be adequate for the proposed studies. The training will occur at the Biotechnology Research and Training Center (BRTC).

We agree and thank the reviewer for the comments.

6. Is the business model realistic?

The business model as outlined appears to be realistic and well thought out. One area of concern is the long term source of potential applicants and students. While there appears to be an immediate source of interested and qualified students, whether this demand will be maintained through subsequent years is a concern. Marketing of the program will be important to insure long term interest and application for the program by qualified students. To the credit of this proposal, the linkage of the Biotechnology M.S. program and the Biotechnology certificate program should provide enough students to maintain a relatively good class size and need.

We agree with the reviewer that the demand for this program in Central Indiana is not altogether clear at this point. We do feel confident that we can recruit ~14 students per year based on the response in 2003 and 2004. We are designing survey tools with the IUPUI office of Planning and Institutional Improvement to evaluate the quality of the program so far by surveying our students and their employers. We plan an additional survey to local employers. We are getting some interest from students outside of Indiana from the information on the IU, BioCrossroads and other sites. We have not developed strategies to recruit beyond Central Indiana for a part-time program. Perhaps we could partner with IUPUI Human Resources and local industries to jointly recruit good candidates.

Reviewer 2

Dear Sherry,

Thank you for asking me to evaluate the proposal for the M.S. in Biochemistry and Molecular Biology with a Specialization in Biotechnology.

I think that this is a very good program with lots of potential, including the following strengths:

1. The proposed M.S. program builds upon the certificate program that is already in place. Therefore, most of the courses, teaching faculty, and research facilities are already in place.

2. Pedagogical aspects of the program are innovative, such as the problem-based-learning course in biotechnology. I also think that a technical report instead of a formal thesis is appropriate for this degree, which is both applied and research oriented.

3. There will be a need for this M.S. degree program, especially among the students completing the certificate in biotechnology program. It offers an excellent opportunity to students who are already employed or want to return to the work force.

4. The proposed M.S. program complements B.S. and M.S. degree programs at IU Bloomington and other Universities. There is really not much overlap in mission or program format. The IUPUI M.S. program will serve mainly part-time students, who are already employed in the Indianapolis area. In contrast, the M.S. degree program in biotechnology at IU Bloomington will be a full-time, intensive one-year program, mainly for resident students, many of whom will have earned their B.S. biotechnology degree here.

5. The faculty and facilities are excellent. I have toured these facilities, and they will serve this curriculum well. There has been good communication between Dr. Bosron and me about our respective programs, and I expect this communication to continue in the future.

There are a couple of issues that the course organizers may want to consider and incorporate into long-term plans for this M.S. program.

1. The number of students proposed seems fairly limited. This is fine for the start, but how will the program accommodate more students if there is demand?

At the present time, we do not have a operational model to accommodate more than ~14 students per year in the Certificate and ~6 per year that go on to M.S. There are two major factors dictating the size of the program: the numbers of Central Indiana students interested in the program and the available faculty to support the program. We are confident that these numbers are OK for now and we are designing surveys

to evaluate the growth potential for this program. As research at IUPUI grows, we hope that the interest and support for the program grows proportionally

2. The length of the program is a bit long and requires completion of the certificate program, which might be redundant for some students with previous background or degrees in biotechnology. How will the program accommodate these students?

With respect to length of program (3 years for M.S.) about 5-6 credits or two courses per term seems reasonable for a part-time student based on our initial experiences with the Certificate program. With regard to different student backgrounds, we have allowed students to place out of B500 and G890 so far if they have an equivalent course. However, we do not let students place out of a laboratory course simply because they have research laboratory experience.

3. The electives listed sound fine. But will most of the students have the prerequisites needed to take these graduate-level courses?

We do check prerequisites for all courses. We made the following revisions to the proposal for admission to the M.S. degree program: 1) students must have an undergraduate degree in science with organic chemistry and a biology laboratory course. 2) students must have a grade of B- or greater in B500 and the 3 lab courses to go on to the M.S. If not, they must take an additional elective course to rectify deficiencies as directed by the faculty advisory committee.

4. The emphasis on laboratory instruction for the M.S. biotechnology track might be consolidated somewhat with the instructional courses. Twelve hours are devoted to laboratory courses, and the Concepts in Biotechnology course is required twice. Will the students have the appropriate course background to really understand the laboratory courses? Perhaps the Fundamental Molecular Biology course should be included as a requirement, with a corresponding reduction in some of the laboratory courses. Would two credit courses serve the purposes of the program and allow more lecture courses to obtain some depth and background?

There are 9 credit hours of laboratory courses and 4 credit hours of PBL in the Certificate program. It should be noted that the laboratory courses contain a significant amount of lecture material relating to the basic science issues demonstrated in experiments (about 1/3 of the course content is lecture). Moreover, students are tested on this lecture material. Hence, the only requirement for the 3 laboratory courses is B500. We believe that G895, Fundamental Molecular Biology would be an excellent course for the M.S. degree but we would like to give the students the choice of taking it as an elective. In the current curriculum, the students will take 2 lecture courses, 3 laboratory courses, 3 PBL courses, 2 seminar courses, a scientific writing tutorial and 9 credits of research. We acknowledge that the emphasis on PBL and lab courses is more than the traditional M.S. in

Biochemistry and Molecular Biology but this seems consistent with a more experimental and problem solving approach to Biotechnology.

In summary, I think that the proposed M.S. degree program is well-conceived, feasible, and important for the training of the work force in Indiana. The program has numerous strengths and few overt weaknesses. Some additional issues need to be considered, but these are more long-term and to expand the base of the program. I strongly endorse the proposed M.S. degree program.

We agree and thank the reviewer for support.

Review – M.S. in Biochemistry and Molecular Biology with a Specialization in Biotechnology

Reviewer 1:
Curriculum: The proposed Biotechnology M.S. curriculum is based upon the approved 17 cr. Lecture and laboratory Biotechnology Certificate curriculum, with additional graduate lecture courses, research, and a research report. The utilization of the Biotech certificate curriculum is a strength of the proposed M.S. degree program in that students can use all courses earned in the certificate for the M.S. degree. The curriculum is an excellent compilation of fundamental lecture courses in modern biochemistry, molecular biology, and cell biology; laboratory courses in key areas of proteomics, molecular biology, and cell biology; and an individual research project. The depth and breadth of the curriculum is highly appropriate to an M.S. program in biotechnology, and graduates are likely to be in high demand in life science laboratories in academia and in the biotechnology industry. For these reasons, the proposed degree program is ideally suited to IUPUI campus priorities of life science and community service.

Comparison to national programs: The proposed program is very affordable in comparison to other national programs. The structure of the program with late afternoon classes offers an advantage over other programs in that students can complete the program while working full time. The Biotechnology certificate program successfully attracts employees of local biotechnology companies such as Eli Lilly & Co. and Roche Diagnostics.

Faculty resources: The faculty who will direct the courses and research projects of the Biotechnology students are already engaged in teaching the certificate program courses, and thus have demonstrated commitment to this program. All faculty are very well qualified to lead their respective courses and projects, and all areas of the program are covered.

Physical resources: The Biotechnology facilities and resources available at the Biochemistry Research Technology Complex (BRTC) and elsewhere in the IU School of Medicine are state of the art and very well suited to the proposed program.

Business model: The proposed program can easily accommodate the expected number of students. Students in the approved Biotechnology certificate program often seek M.S. degrees, and thus this program will fulfill an unmet need at IUPUI.

We agree and thank the reviewer for the comments.

New Course Proposal for Scientific Writing and Communication in Biotechnology

Introduction and Justification of the course:

This course is designed to assist students in developing the research program and thesis for the Biotechnology track in the M.S. in Biochemistry and Molecular Biology at the School of Medicine (hereafter called the M.S. in Biotechnology). This new degree has been approved by the Department of Biochemistry and Molecular Biology and the IUPUI Graduate Affairs Committee. It is in the process of approval by the IU Graduate School.

This M.S. is designed for part-time students who have completed the 17 credit Certificate in Biotechnology. That is, the M.S. is a 13 credit addition to the Certificate program. Students will have taken an introductory biochemistry lecture course, three laboratory courses in proteomics, cell biology and molecular biology, a problem-based learning course in biotechnology and a course in research ethics in the Certificate program. The M.S. in Biotechnology has a relatively fixed curriculum like the Certificate. Students will start with an elective course in basic science, 9 credits of research in biotechnology with a faculty mentor and core research director and this scientific writing course. A time table for the three year Certificate and M.S. curriculum is shown below.

Title	Number	Credit	Type	Semester
Introductory Biochemistry	B500	3	Lecture	Fall, yr. 1
Concepts in Biotechnology	G828	2	PBL	Fall, yr. 1
Methods in Proteomics	G841	3	Lab	Spring, yr. 1
Concepts in Biotechnology	G828	2	PBL	Spring, yr. 1
Methods in Molecular Biology	G890	3	Lab	Summer, yr. 1
Methods in Cell Biology	G823	3	Lab	Fall, yr. 2
Responsible Conduct of Research	G505	1	PBL	Fall, yr. 2
Elective	Varies	3	Lecture/lab	Spring, yr. 2
Scientific Writing and Communication in Biotechnology	**New**	**1**	**Tutorial**	**Spring, yr. 2**
Research in Biotechnology	New	1	Research	Spring, yr. 2
Research in Biotechnology	New	2	Research	Summer, yr. 2
Research in Biotechnology	New	3	Research	Fall, yr. 3
Research in Biotechnology	New	3	Research	Spring, yr. 3
Total		**30**		**3 Years**

In this course, students will be introduced to the concept of the research thesis, selection of research advisors, construction of a research proposal and finally, the writing of the thesis. Students will register for this course in the first semester of their M.S. However, they will continue with the course throughout the 3 year program while they are doing their research project. The course will involve a series of group meetings with students covering the topics and at the times shown in the Syllabus document. The final part of the course will involve individualized meetings with students and the course director on preparation of the thesis. We called the course a tutorial because of the flexibility in timing of the activities.

In summary, the rationale for this course is to guide the student through the research-based M.S. thesis in Biotechnology. We believe that a formalized course is much more beneficial to the part-time student rather than the informal guidance from advisors normally used with full-time students in graduate degree programs. Hence this course plays a key role in the overall curriculum of the research part of this M.S. degree. It is a graduate course because it is directly coupled to independent research for the M.S. degree.

Syllabus

Title: Scientific Writing and Communication in Biotechnology

Course Number: B821

Instructor: William Bosron

Prerequisites: None

Course Description: Discussion and individualized instruction in the preparation of a research proposal and thesis in the Biotechnology track of the M.S. in Biochemistry and Molecular Biology.

Educational Objectives: The objective is to guide the student through the concept of independent research and thesis writing. There are specific goals for the course that are associated with the time line of the research thesis process including: the selection of research mentors and preparation of a time table, research proposal, thesis outline, first draft of the thesis and thesis defense. The student will read published information about the process and will be evaluated on ability to perform the tasks in a timely manner.

Course Content: The major objectives of the course are shown in the table below. Students will register for the 1 credit course in the Spring semester of year 2 of the part-time M.S. program when the students select a research mentor and project. However, the course will continue throughout the time in the research laboratory culminating in the thesis and defense. There will be 7 group lectures during the 2nd and 3rd years of the program that are based on literature readings on topics shown in the table below. There will be at least 8 one hour tutorial sessions involving individualized meetings with students and the course director concerning on the topics shown in the table below. Hence, a minimum of 15 one hour meetings with the student is consistent with one credit for the course.

Topic	Lecture/tutorial	Time
Introduction to a research thesis	1 lecture	Spring, yr. 2
Selection of research mentors	1 lecture, 1 tutorial	Spring, yr. 2
Preparation of a thesis time table	1 lecture, 1 tutorial	Spring, yr. 2
Preparation of a research proposal	1 lecture, 2 tutorial	Summer, yr. 2
Preparation of a thesis outline	1 lecture, 1 tutorial	Spring, yr. 3
Preparation of the first draft of the thesis	1 lecture, 2 tutorial	Spring, yr. 3
Preparation for the thesis defense	1 lecture, 1 tutorial	Spring, yr. 3

Texts: The main reading source for the course will be "Guide to the Successful Thesis and Dissertation: A Handbook for Students and Faculty" by Mauch and Birch, 1998. This text is available through the IUPUI library and NetLibary as an eBook. Students will be assigned chapters to read in this text on the 7 topics in the table above.

Secondary sources of assigned information will be "On Being a Scientist: Responsible Conduct in Research, Second Edition," 1995 and "Biotechnology: Science, Engineering, and Ethical Challenges for the 21st Century," 1996. Both of these texts are available on line from National Academic Press.

Evaluation and Grading: Students will be evaluated on the preparation of the following items: thesis time table, research proposal, thesis outline, first draft of the thesis and thesis seminar. This evaluation will be based on the content of documents relative to the examples given in texts. Students will be evaluated on their preparation for individual tutorial sessions dealing with the preparation of these documents. For the spring semester of the 2nd year when they register, students will receive an intermediate R grade until the requirements are completed in the spring of the 3rd year. The grading will be subjective by the course director who is experienced in preparation of thesis documents. The grading will be A (excellent), B (good), C (inadequate for graduate level work), F (not completed on time).

Bibliography: Reading materials will come from the on line tests that are described above. As an example, students will be given a model thesis time table described in "Guide to the Successful Thesis and Dissertation, …" in Figure 1-1. They will be asked to revise the step, action plan, time estimate and date for their own situation during the tutorial session.

Cheating and Plagiarism: Students will be asked to read the sections in the Academic Handbook dealing with cheating and plagiarism http://www.iupui.edu/~resgrad/grad/academic_misconduct_curriculum_subcommittee.rtf . We expect that students will work independently to produce the documents required in this course. The students will have taken a required course in responsible conduct of research that covers plagiarism and other ethical issues in research.

Revised Curriculum for Medical Neurobiology Graduate Program
6/15/05

The Graduate Program in Medical Neurobiology is a formally recognized, degree-granting (MS, PhD, and MD/PhD) program based in the Indiana University School of Medicine. It constitutes one of the largest graduate programs in the School in terms of both student matriculants and participating faculty. The vast majority of the participating faculty have primary appointments in departments of the School of Medicine while other faculty in the IUPUI School of Science have secondary appointments in the School of Medicine.

Administrative responsibility for this program has recently been transferred to the Stark Neurosciences Research Institute (SNRI). As a part of this administrative change the Medical Neurobiology graduate program has undergone an extensive self-study involving discussions among faculty in two new appointed committees (Curriculum and Admissions & Recruitment) and a survey of student views of the current curriculum. One outcome of this self-study has been the development of an improved and refreshed curriculum incorporating new course structures and offerings and expanded opportunities for laboratory research. The central goals of a new curriculum are:

- Interactive and efficient instruction of a selected set of core fundamentals of neuroscience.
- To reduce redundancy of content among existing course offerings.
- To expand faculty participation in the graduate program.
- To reduce total formal time commitment per individual faculty member by distribution of effort and elimination of content redundancy.
- Transition to a student-centric model of learning from a faculty-centric model of teaching.
- Early and pervasive development of critical reading and data interpretation skills for all students.
- Implementation of evaluations (exams) that challenge student skills rather than their accumulated knowledge.
- Diversity of laboratory experience and lab selection opportunities for students.
- Reduction of didactic experiences to move students toward dissertation research in a more timely manner.

This document outlines the structure of the revised curriculum that was discussed and approved at a faculty meeting on 12/02/2004 and further revised in March 2005. The new curriculum involves a gradual and progressive transition to a new structure for the Medical Neurobiology graduate courses. The curriculum is intended for Ph.D. track students. How MS degree students will fit into the structure is being discussed date. The proposal involves creation of two new “modular” courses on fundamentals of cellular, molecular, and integrative neuroscience to be integrated with existing but revised course offerings in other areas. In addition, it is proposed that the curriculum incorporates required research rotations in different laboratories for entering students.

The outline of this proposal is divided into the following sections for your consideration:

A. Course requirements
B. Model schedules for Ph.D. and MD/PhD trainees
C. Description of new courses in cellular & molecular neuroscience and in translational neuroscience
D. Structure and scheduling of laboratory rotations
E. Approved elective courses
F. Timing and structure of qualifying examination

A. Proposed Course **Requirements**: Approval has been granted to reduce didactic course requirements from the current 45 hours to 36 hours. Under this new structure the following courses and their general content would be required of all students entering the Medical Neurobiology graduate program. Completion of the required courses would occur during the first two years in the Ph.D. program. Note that some of these courses exist in some format now and that others are new offerings as indicated below.

Course	*Status/Format*	*Credit*	*Overview*
Graduate Neuroanatomy	Exists/Lecture	3	A comprehensive course in functional neuroanatomy for graduate students.
Fundamental Neuroscience I (N611)	New / Lecture & discussion	1	Cell biology and basic signaling mechanisms of neurons; basics of molecular neurobiology
Fundamental Neuroscience II (N613)	New / Lecture & discussion	2	Membrane potentials and voltage-gated ion channels and their contribution to signaling in the nervous system.
Fundamental Neuroscience III (N615)	New / Lecture & discussion	2	Neuropharmacology of synaptic transmission; postsynaptic receptor biology.
Fundamental Neuroscience IV (N617)	New / Lecture & discussion	2	Signal transduction in neurons; G-proteins, post-translational events; growth factors; lipid signaling
Fundamental Neuroscience V (N612)	New / Lecture & discussion	2	Neurotransmitter dynamics and synaptic plasticity; neurotransmitter transporters; dendritic signaling.
Fundamental Neuroscience VI (N614)	New / Lecture & discussion	2	Special senses and integrative neurophysiology; sensory receptors; simple reflex circuits and analysis.
Fundamental Neuroscience VII (N616)	New / Lecture & discussion	2	Developmental neurobiology; axon guidance; neuronal stem cell biology; patterning in the nervous system.
Behavioral Neuroscience (I615)	Exists / Lecture (revision)	3	Learning & memory, cognitive neuroscience, addiction, emotion, motivation, stress, sleep & circadian rhythms
Translational Neuroscience & Neurogenetics	New / Lecture & discussion	3	Consideration of the basic neuroscience underlying various disorders from clinical, historical and contemporary genetic views. Significant clinical faculty involvement.
Student Seminar	Exists / to be revised and expanded	1	Course will be revised to provide more instruction and real-time critique of student presentations and serve as a forum for discussion of broader career issues.
Research	Exists	Var	Laboratory rotations during first year. Now will become required. Structure outlined below.

* Hours depend upon number of modules offered/taken. Med Neuro students would take all modules

With two semesters of the seminar course in year 1, this would put required didactic course hours at 24 for the first two years without electives, but likely with more actual time for students to work in labs during their rotations due to the structure of the proposed modular courses. Electives will be chosen to satisfy the required minor (12 hours), thus the total didactic require hours (program + minor) equals 36.

Both Graduate Neuroanatomy (D527) and Behavioral Neuroscience (I615) must serve the needs of several different university constituencies and therefore will not be dramatically altered. Graduate Neuroanatomy is currently required and will be modestly revised to avoid unnecessary content overlap with other courses. Behavioral Neuroscience covers several areas of fundamental cellular and systems neuroscience in its first few weeks, while the primary "behavioral" content outlined above will become a "virtual module" for Medical Neurobiology graduate students who will enroll for only that component. The new Fundamental Neuroscience modules will replace the existing Neurochemistry course, components of

the Behavioral Neuroscience course, the Developmental Neurobiology course and reinstate the content of a previously offered Neuropharmacology course.

B. Model Schedule for First Two Years of Matriculation. Below is a model for how these courses and rotations could be sequenced for the Medical Neurobiology Ph.D. students during the first two years. While other models are possible due to unforeseen conflicts, this model represents the optimum structure in the opinion of the curriculum committee. Importantly, this model would not require that any existing course would move between fall and spring semesters. This, of course, is negotiable. Shaded time blocks represent required activities.

Fall Semester	Spring Semester	Summer Sessions

Year 1 of Training Program (Medical Neurobiology Student)

Fundamental Neuroscience I-IV (N611, 613, 615, 617) 7 credits	Fundamental Neuroscience V-VII (N612, 614, 616) 6 credits	Lab Rotation #3 (Thesis Research Focused) 4 credits (research)
Elective (e.g. Biochemistry) 3 credits	Graduate Neuroanatomy (D527) 3 credits	*Off-site course (opt.)*
Lab Rotation #1 1-3 credits (research)	Lab Rotation #2 2 credits (research)	Elective
Seminar Course (revised to instruct presentation skills) 1 credit	Seminar Course (revised) 1 credit	Methods in Neuroscience

Year 2 of Training Program (Medical Neurobiology Student)

Translational Neuroscience & Neurogenetics 3 credits	Behavioral Module (I615) 2 credits	Neuroscience Elective (e.g. Ion Channels, Psychopharmacology) 2-3 credits	*Qualifying Exam*
Elective		Thesis Research	Thesis Research
Grant Writing Skills (N802)		Elective	
Seminar Course (revised)		Seminar Course (revised)	

Year 1 of Training Program (MD/PhD Student - Year 3 of their matriculation)

Fundamental Neuroscience I-IV (N611, 613, 615, 617) 7 credits	Fundamental Neuroscience V-VII (N612, 614, 616) 6 credits	Thesis Research
Elective	Elective	*Off-site course (opt.)*
Thesis Research or Lab Rotation	Thesis Research or Lab Rotation	Elective
Seminar Course (revised to instruct presentation skills) 1 credit	Seminar Course (revised) 1 credit	Methods in Neuroscience

This model is designed to sequence students through didactic courses in a logical and content progressive manner, to provide more time for lab work, and to permit time for desired exposure or remediation in fundamental areas such as biochemistry, statistics, molecular biology, or cell biology.

C. Development and implementation two new *modular* courses. As is common in many institutions, course structures usually adapt to registration structures (e.g. semesters or quarters) in an "undergraduate model" where credit and faculty effort are apportioned in lengthy (e.g. 16 weeks) and often intellectually disengaging lecture/exam paradigms. In a discipline as broad and expanding as neuroscience, such a structure can result in overly long periods of didactic instruction (required courses beyond the first two years of matriculation) to cover fundamentals. Furthermore, semester-long courses often support several student groups and are inherently redundant with other offerings leading to content "holes" in neuroscience education. Finally, these instructional paradigms can be at the expense of more "Socratic" approaches to learning (seminars, journal clubs). The proposed new courses are designed to address these issues by (1) teaching selected neuroscience fundamentals in smaller "modules" requiring less time, (2) constantly engaging students in discussions and presentations of original literature focused on the topic at hand, and (3) assessing student problem solving skills as well as knowledge in exams.

A series of "modular" courses will be taught during the first year (Fundamental Neuroscience I-VII) focusing on core principles of neuroscience at the cellular and molecular level, including consideration of simple neuronal circuits and sensory receptors. As indicated in the schedule above, these courses would run in parallel with another semester-long course in Functional Neuroanatomy (revised D527).

Each course module will cover a specific topic area and will be team-taught by a limited number of faculty (3-5) per module to provide instructional continuity. The goal will be to combine didactic teaching (lectures) and formal discussion of original literature in as many sessions as possible. It is suggested that each session be 2 hours in length and that two faculty must be present for each session. If there are 3 sessions per week, 6 total credit hours can be issued per semester with fractional credit hours per module (e.g. 2/module).

A common text book (*Fundamental Neuroscience,* 2nd edition, Academic Press) has been chosen to serve as reference reading material for all blocks and original papers and/or review articles and simulation programs will be supplied on CD-ROM for each block. The text material is intended to provide context for class discussions, but the focus will be upon scientific articles and reviews. Student participation will include group presentations of the paper for the day and discussion of the content. Faculty lectures will be meant to highlight and supplement key points embodied in the reading. No typical lecture outlines (syllabus style) will be required of faculty, rather a set of study questions will be provided for each discussion session.

Each module will have an independent evaluation instrument, a take-home exam to be completed in a total continuous effort of 5-6 hours. The exam will focus on experimental problems, even some that may not have been specifically covered in class, rather than be comprehensive and repetitive. The goal is to assess fundamentals of data interpretation and design related to a given topic area rather than comprehension of textbook/lecture content in the course.

An important feature of this structure is that while Medical Neurobiology students would take all modules (as part of their requirement), students from other programs (e.g. Physiology, Pharmacology, Biochemistry, Cell Biology, Psychology) could elect to take selected modules according to their departmental/personal requirements and have a quality "emersion" experience in the module of interest without having to take an entire semester course.

It is important to note that an "introductory" module (Module 1, N611) is designed to help "normalize" all students given their diverse entry backgrounds and ensure they are minimally prepared to wrestle with the technical concepts in methods sections of research papers. This module would be valued at 1 credit hour and represents a "bootcamp" on very elementary principles of neuronal cell biology, electrical and chemical signaling, and general anatomy. In addition, we will include a tutorial workshop of molecular biology principles taught by postdocs and senior students to "demystify" the terminology of modern molecular neuroscience.

An outline of each module and general topics to be covered is shown below. The topics represent clearly incomplete sets, reflecting oversights as well as the need to focus on fundamentals, which will evolve and be refined.

Module	Central Theme	General Topics
N611 Fall 1 credit	Cell Biology and Molecular Biology of Neurons (2-3 weeks)	• Cell types and architecture • General neuroanatomy overview (definitions, locations, tracts) • Membrane potentials and synaptic transmission • Molecular biology / biochemistry principles (tutorial workshop)
N613 Fall 2 credits	Electrical Excitability and Voltage-Gated Ion Channels (4-5 weeks)	• Basic bioelectricity and membrane potentials • Action potentials and their conduction • Sodium channels and their roles • Potassium channels and their roles • Calcium channels and their roles • Ion channel pharmacology (drugs, toxins) and post-translational modifications
N615 Fall 2 credits	Neurotransmitters and post-synaptic receptors. (3-4 weeks)	• General pharmacokinetics; binding, potency, efficacy; ternary models for receptor activation. • Glutamate receptors (ionotropic) • G-protein signaling I • Glutamate receptors (metabotropic) • GABA receptors (both A and B) • Monoamine receptors • Peptide receptors (e.g. opioid, NPY, SOM)
N617 Fall 2 credits	Signal transduction in neurons (3-4 weeks)	• General mechanisms of post-translational regulation (phosphorylation, methylation, ribosylation) • G-protein signaling II • Receptor tyrosine kinase pathways • Integrin signaling pathways • Intracellular calcium signaling pathways • Lipid signaling
N612 Spring 2 credits	Neurotransmitter synthesis, release, and synaptic plasticity (3-4 weeks)	• Neurotransmitter and peptide synthesis • Quantal basis of neurotransmitter release • Neurotransmitter transporters • Facilitation and depression • Molecular mechanisms of synaptic plasticity
N614 Spring 2 credits	Special senses, integrative and computational neuroscience (4-5 weeks)	• Sensory receptors (photoreceptors) • Sensory receptors (hair cells) • Spinal reflex circuits as general models • Visual system as a model
N616 Spring 2 credits	Developmental Neurobiology (4-5 weeks)	• Basic neuroembryology • Molecular cues for axial patterning • Axonal pathfinding and guidance • Developmental regulation of gene transcription • Neuronal stem cells and glial cell precursors • Regionalization of nervous system functionl

Additional new course for Fall of 2nd year in program (new in 2006)

Fall 3 credits	Translational Neuroscience & Neurogenetics (10 weeks) *This could include a "shadowing" rotation in a clinical setting and attendance at Grand Rounds.*	• Neurodegenerative (Alzheimer's) • Neurodegenerative (Parkinson's) • Cognitive/developmental (Schizophrenia) • Affective (Autism) • Affective (Depression, bipolar) • Demyelinating (MS) • Addiction • Epilepsy • Stroke • Animal models

D. Laboratory Rotations. Presently there are no required laboratory rotations in the Medical Neurobiology graduate program. While students have the option to engage in laboratory rotations, the actual practice is not common. Lab rotations have become a prominent and nearly ubiquitous feature of nationally prominent neuroscience graduate programs and will be required in the new curriculum. While students may enter the program with a strong preference for a specific research mentor or laboratory, it is

felt that exposure to other options and a broader range of approaches to neuroscience is vital to the quality of their educational experience. Furthermore, faculty gain from the process by having students commit to their labs not only having a firm experience with them, but also by their bringing new perspectives with them. In particular, it is felt that research projects that may stem from "cross-fertilization" of labs by student rotations is highly desirable and has thus been encouraged by the specific structure proposed for the rotations.

Students will be required to engage in three rotations, two of which will be "traditional" and the third will be a novel thesis-centric experience with a formal co-mentor. Students will choose their rotations only from laboratories of full graduate faculty status prepared to support the research of an eventual thesis project. The rotations should be in labs that have distinctly different technical approaches to research (e.g. imaging vs behavior, molecular biology vs electrophysiology). Each rotation will last a complete semester with a 20 hours/week commitment on the part of the student. The two rotations will be taken in the first year of graduate school and the student will ordinarily be prepared to choose a thesis lab by the end of the spring semester of that year. Under no circumstances will a student be permitted to waive the first two rotations.

In addition to a primary mentor, each student (in consultation with their primary mentor and their advisory committee) will choose a secondary mentor from among the faculty. This individual will be chosen to provide a complementary technical approach to those available in the primary mentor lab to be incorporated into the thesis research. A formal rotation in the secondary mentors lab will then be scheduled as early as the summer following the first year and no later than the summer following the second year of the program. Examples of complementary research would be confocal imaging for a student doing primarily microdialysis, or biochemistry for a student doing primarily electrophysiology, or receptor binding for a student doing primarily molecular genetics.

Finally, while the secondary co-mentor can be at any faculty rank and from any department participating in the program, primary mentors of thesis research must be full graduate faculty with endorsement with their primary appointment in an academic department of the IU School of Medicine.

E. Elective Coursework Students can choose from a number of new and existing (see below for examples) courses in order to remediate deficiencies or pursue specific interests. The faculty are encouraged to develop new "journal club" like courses to expand our offerings.

PSY I544	Psychobiology of Motivation and Reward (alternate years)
PSY I545	Psychopharmacology (every year)
PSY 590	Behavior Genetics & Animal Models (alternate years)
PSY 590	Drugs of Abuse (alternate years)
PSY I675	Human Neuropsychology (alternate years)
BME595	Experimental Methods in Biomedical Engineering
D526	Methods in Cell and Neurobiology
D875	Topics in Advanced Neuroanatomy
D876	Neurotransmitter and Neuroendocrine Cytology (alternate years)
F592	Introduction to Biomolecular Imaging
G613	Advanced Cellular Imaging
G614	Advanced Molecular Imaging
Math537	Applied Mathmatics for Scientists and Engineers1
Math526	Principals of Mathematical Modeling
Chem675	Chemical Kinetics
G865	Fundamentals of Molecular Biology
B500	Biochemistry
N802	Techniques of Effective Grant writing

F. Minor. Students will select a minor from among those listed in the University Graduate School Bulletin. In general, this will consist of 12 credit hours in a particular discipline, or 6 credit hours in one discipline and 6 credits distributed among other life science disciplines (life science minor). As stated in the University Graduate School Bulletin, the determination of the minimum requirements for the minor is entirely at the discretion of the minor department or program. Since Graduate Neuroanatomy

(Department of Anatomy) and Behavioral Neuroscience (Department of Psychology) are required courses, any other 3 credit course in either of these departments, plus 6 credits in the other electives, would satisfy the life science minor without adding excess credit hours to the course of study. Students in other departments should be able to obtain a minor in Medical Neurobiology by satisfying similar requirements as set forth by their departmental curriculum. With the acceptance of the new proposed courses, there will be ample opportunity for students to obtain the necessary credits for a minor in Medical Neurobiology.

G. Qualifying Examination The qualifying examination of the Medical Neurobiology graduate program presently consists of several options, but students tend to choose the least desirable option of an in-class, closed-note examination. We have now developed an extended take-home examination exercise (written component) followed by an oral examination by a common advisory committee for all students in a given class (oral component). The written component will consisit of 4 extended questions each with supporting literature focusing on a problem in experimental design and interpretation. The questions will come from different areas of neuroscience, be submitted by teaching faculty, and vetted by an examination committee. The students will choose 3 of the 4 questions and answer them in a 3-week period in an open literature format with a 5 page single spaced limit for each question. The answers to each question will be graded by 3 independent faculty members. If the student fails to answer satisfactorily one of three questions, an additional question, along with the question that was not chosen, will be re-administered, and the student must answer one of these satisfactorily. Failure to satisfactorily answer 2 or more questions constitutes failure of the written component. A student portfolio will be maintained and will contain all pertinent information and material on the student's performance preceding the exam, as well as the results of the written qualifying exam component. Upon passing the written component, an oral exam will be given by the same committee, but would be open to all faculty who want to participate, but only as spectators, not as examiners. The student must pass the written in order to take the oral. The committee will decide on whether each student passes the qualifying examination and is then admitted to candidacy. This examination (both written and oral) will continue to be administered in the summer following the second year of the program.

COMPARISON OF OLD AND NEW REQUIREMENTS FOR THE PH.D. DEGREE IN MEDICAL NEUROBIOLOGY

	OLD REQUIREMENT	NEW REQUIREMENT
Total credits	90	90
Total course credits	45	36
Total minor credits	12	12
Core courses required	D527, B835, D533, I615, I545 (see below)	N801, N802, N611, N612, N613, N614, N615, N616, N617, I615 (see page 2)
Laboratory rotations	Not required, but recommended	Required to do at least 2 rotations (see page 5)
Qualifying Examination	Choice of (i) in-house closed book, (ii) take home open book, or (iii) grant proposal. Written and oral components are mandatory	Mandatory take home open book (see page 6). Written and oral components are mandatory

D527 Graduate Neuroanatomy (3 credits)
B835 Neurochemistry (3 credits)
D533 Neural Substrate for Sensory Motor Control (3 credit)
I545 Psychopharmacology (3 credits)
I615 Behavioral Neuroscience (3 credits)

Kelley School of Business Indianapolis
Dual MBA/MPA Degree
(Master of Business Administration / Master of Professional Accountancy)

After an Accounting Major for the MBA (Master of Business Administration) program was recently approved, the Kelley School of Business faculty then approved a dual MBA/MPA (Master of Professional Accountancy) degree program for the Indianapolis campus. The recommendation follows the template that has been used by the Kelley School of Business on the Indianapolis campus for other dual degree programs with Medicine, Law, Science, and Engineering and Technology. Students who choose this option would have to be admitted to both MBA and MPA programs independently. Students who might be interested in the dual degree would be those without undergraduate degrees in business (or accounting) who would possibly be interested in pursuing a career in accounting and being prepared to take the CPA exam. As shown below, the template for the dual degree calls for a 66 hour program, 42 MBA and 24 MPA, and it eliminates 9 hours of MBA electives and 6 hours of MPA electives.

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DUAL MBA/MPA DEGREE PROGRAM	
Prerequisites (equivalent of A201, E270)	***6***
MBA Core	33.0
MBA Electives	9.0
Subtotal, MBA Coursework	42.0
MPA	24.0
Total, dual degree	66.0
Total MBA and MPA separately (51 + 30)	81.0

Assuming that a student completed an undergraduate degree with 124 hours (most students graduate with more than 124 hours), a student in the dual MBA/MPA degree program would take 124 undergraduate hours, 42 MBA hours, and 24 MPA hours 190 hours (196 hours if accounting principles and statistics are needed prior to admission) in order to meet the requirements for the three degrees. For Kelley School of Business Indianapolis graduate students working full-time and taking classes part-time (the MBA program model and a model that applies to many MPA students), the dual program of study takes between 3 and 4 years if the student averages 15.5-22.0 hours per year.

MBA Core Courses:

A524 – Managing Accounting Information For Decision Making (3)
G502 – Managerial Economics (1.5)
F523 – Financial Management (3)
J501 – Developing Strategic Capabilities (3)
G511 – Microeconomics for Managers (1.5)
G512 - Macroeconomics for Managers (1.5)
X522 – Business Enterprise Experience (1.5)
L512 – Law & Ethics in Business (3)
S555/6 – Info Technology for Managers (3)
M501 – Strategic Marketing Management (3)
P501 – Operations Management (3)
J506 – Leadership and Ethics in Business (3)
D594 – Competitive Strategies in Global Industries (3)

Electives – (9 hours)
Total MBA hours = 42

MPA Core Courses:

A510 – Financial Accounting Theory and Practice I (3)
A511 - Financial Accounting Theory and Practice II (3)
A514 – Auditing Theory & Practice (3)
A515 – Federal Income Taxes (3)
A551 – Tax Research (1.5)
A562 – Advanced Financial Accounting (3)
A539 – Advanced Taxation (3)
L503 – Advanced Business Law (3)

Electives (1.5 hours)
Total MPA hours = 24