

Proposal For A Program Leading To A Doctor of Philosophy Degree In Biomedical Sciences With A Specialization In Biological Communication

(Revision of a Formerly Approved Specialization in the Cell Biology of Aging)

**Centered in the Department of Biological Sciences
Oakland University Rochester, Michigan**

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I. INTRODUCTION

Traditional disciplines in biomedical research are merging at the interface of communication within specific signaling pathways that are common to many biological systems, ranging from single celled microbes to the complex human body. Scientific advances in this area have revolutionized the basic and medical sciences and have contributed significantly to the emergence of biotechnology as an important new industry. It is widely believed that many pathological conditions will be treated and/or eliminated by therapies based on genetic or pharmacological manipulation of these inter- and intra-cellular biochemical communication mechanisms.

The proposed revision of the previous doctoral program specialization centered in the Department of Biological Sciences will provide unique interdisciplinary training in basic and clinical aspects of biological communication. Graduates of the program will be prepared and trained for a broad range of employment opportunities in both the public and the private sector.

A. Program Overview

The program described below is designed to train doctoral-level scientists who will be capable of investigating research problems in the broad area of biological communication, using techniques in biochemistry, genetics, cellular and molecular biology. The successful Ph.D. candidate will complete a dissertation research project whose scope and depth is such that it will encompass publishable results and demonstrate mastery of the scientific process. In preparation for this tutorial-apprentice method of learning, the Ph.D. candidates will complete formal course work consisting of seven core courses plus electives recommended by members of their dissertation committees. Included among the core courses is a two-semester sequence (Biological Communication I & II) that will serve as a "capstone" course for the program. Seminar courses will be offered on specialized topics in which current literature and major developments in the field will be presented, discussed, and critiqued by the Ph.D. students. Interdisciplinary courses will also be offered in collaboration with faculty from participating departments and institutions to provide both basic science and clinical perspectives. Participation in the teaching of laboratories and/or lectures will be required to prepare students for a range of professional settings.

Since their inception, the departments of Biological Sciences and Chemistry have attracted scientists whose background, training and current interests lie in the area of biological and biochemical communication and who are well qualified to train doctoral students. Several faculty already participate in the interdisciplinary B.S. degree in Biochemistry and/or are members of the Center for Biomedical Research. The interdisciplinary nature and potential clinical application of the program will be further enhanced by the participation of faculty from the Eye Research Institute at Oakland University and the faculty from the many research programs at Henry Ford Hospital, a major biomedical research institution in Michigan.

II. RATIONALE

A. Need

Biological communication at the intercellular, intracellular, and molecular level is the focus of intensive research on almost every disease. Research on the fundamental mechanisms underlying human disease is the mission of the National Institutes of Health, the primary funding agency for biomedical research. Through funding by the National Institute of Health and other avenues, including collaborations with industry, faculty at Oakland University have made significant contributions to these studies in the major thrust areas of eye disease, cancer, cardiovascular disease, endocrine and reproductive disorders, and infectious diseases. Basic research topics at Oakland University also focus on biological communication, and the importance of this area is confirmed by funding from the National Science Foundation. The interdisciplinary focus of this proposal will prepare our graduate students for such applications as the Physiome Project, in which functions of the genes identified in the human (and other) Genome projects will be characterized to enable this knowledge to be translated into clinical treatments.

According to the Bureau of Labor Statistics, medical scientists and biological scientists are among the fastest growing professions for individuals holding doctoral degrees. These occupations were expected to experience one of the largest increases in employment from 1995 to the year 2005. Thus, even though the Commission on Life Science of the National Research Council recently issued a report stating that universities are producing a surplus of Ph.D.'s in the biomedical sciences, ongoing discussions clearly suggest that not all fields or career settings are equally affected.

It is clear that both basic and applied research in the public and private sectors require scientists that possess interdisciplinary training and who are trained to apply their expertise in biochemical and cellular communication to a wide range of problems. As for many other doctoral level occupations, it is necessary to evaluate national and international employment trends as well as local needs. Employment of biomedical scientists in pharmaceutical and biotechnology companies is expected to continue to increase relative to that of academia. There is a preponderance of pharmaceutical and biotechnology growth on the East and West coasts. In addition, Michigan is home to several not-for-profit institutions, with very large biomedical research programs (University of Michigan, Michigan State University, Wayne State University and its affiliated hospitals, Henry Ford Hospital, and William Beaumont Hospital), some major corporations with strong biomedical research programs (Pharmacia-Upjohn, Warner Lambert, Immuno U.S., a division of Baxter International, and a number of biotechnology companies at various stages of development i.e., Neogen Corp., Oxford Biomedical).

Oakland University and its collaborating institution, Henry Ford Hospital, are in a position to provide unique interdisciplinary training within the context of biological communication through extensive interdepartmental and inter-institutional dialogue, research collaboration, and teaching. Furthermore, Oakland University's strong history of, and continuing emphasis on, interaction and collaboration with industry by faculty in Biology, Chemistry, the Eye Research Institute, and other units, combined with the founding of the interdisciplinary Center for Biomedical Research will provide an important link in preparing students for careers in emerging areas of technology, in addition to traditional careers in biomedical sciences. In the proposed program, seminars and special topics courses will be designed to prepare students for many careers. Elective graduate courses are available at Oakland University in the Schools of Health Sciences, Business

Administration, and Education and Human Services that could also serve to prepare students for many areas in the private sector.

B. Oakland University's Strategic Plan

The proposed Ph.D. in Biomedical Sciences with a specialization in Biological Communication is consistent with the goals expressed in several strategies in *the Oakland University Strategic Plan, 1995-2005*. Most directly, the proposed program advances the goals of strategy 2, which states that "resources will be focused on creating and strengthening areas of graduate study in a manner that is responsive to regional and national needs." The intent of this strategy is to maintain excellence in graduate education through the development of innovative, non-duplicative programs at the doctoral level. The unique nature of the proposed Ph.D. program, as well as its response to a niche-oriented, market driven need underscores how well this proposal fulfills the goals of strategy 2. Additionally, the strong research dimension to the proposed program supports the goals of strategy 4, that "Research, scholarship, and creative activities are among Oakland University's greatest strengths and will be aggressively encouraged and supported." The partnership with Henry Ford Hospital supports the goals of strategy 5, which states that "Oakland University views community outreach as an integral component of its activities and will expand its efforts to serve the community, consistent with the university's mission and vision." Finally, the involvement of the Eye Research Institute, already considered a center of excellence on campus, illustrates how well the proposal responds to strategy 6, which states that "Oakland University will develop and fund areas of institutional excellence and distinction that contribute to local, regional, and national excellence."

In summary, the proposed Ph.D. in Biomedical Sciences is precisely the kind of niche-based, innovative, research oriented graduate program that the Strategic Plan urges the university to consider, one that enhances already established areas of excellence on campus and that will strengthen Oakland's relationship with its community through the partnership with Henry Ford Hospital.

C. Source of Expected Students

Oakland's existing undergraduate and graduate students provide a natural population of students interested in the proposed Ph.D. program, and we expect that the students who initially will enroll in the program to be master's students already enrolled at Oakland. At present, there are 15 M.S. students in Biology, several of whom might wish to continue for their Ph.D. Moreover, in the future we expect that students might be more inclined to begin a Masters program here at Oakland if they know that the opportunity to continue for a Ph.D. is available to them. Initially, the Department of Biological Sciences will advertise the program locally, through the Center for Biomedical Research and the College of Arts and Sciences. We will also look toward advertising the program in high profile national journals such as *Science* and *Nature*.

D. Advice and Consultation

The Department of Biological Sciences has been engaged in consultation from the outset with all of the units involved in the proposed Ph.D. program: the Department of Chemistry, the Center

for Biomedical Research, the Eye Research Institute, and Henry Ford Hospital. Indeed, the committee to formulate the program proposal included representatives from each of these areas (see below):

Fay Hansen-Smith (chair), Biology

Sitaramayya Ari, Eye Research Institute (term ended March 1998)

John Reddan, Biology (term ended March 1998)

Kathleen Moore, Chemistry

Jeffrey Garvin, Henry Ford Hospital

Jill Zeilstra-Ryalls, Biology (appointed May 1998)

Anne Hitt, Biology (appointed May 1998)

Janet Blanks, Eye Research Institute

As is evident from the list above, all units involved in the proposed program, in addition to the Department of Biological Sciences, have been represented on the proposal committee. Kathleen Moore, Chemistry, and Jeffrey Garvin, Henry Ford Hospital and the Center for Biomedical Research, have been committee members from the outset. Both continue to be strong supporters of it. In addition, under the leadership of Janet Blanks, the present director of the Eye Research Institute, the ERI has aggressively supported the development of this Ph.D. program and hopes to participate in it fully. Consultation has also taken place within the Department of Biological Sciences, and a significant majority (12 in favor) has voted in support of this program.

E. Summary

The program outlined below designed to train scientists in the area of biological communication, is a revision of a specialization in the existing Ph.D. program in the Biomedical Sciences which will replace the formerly approved Ph.D. program in the Cell Biology of Aging. Nationally recognized interdisciplinary research expertise in biological communication exists in the Departments of Biological Sciences, Chemistry, and the Eye Research Institute at Oakland University. The new specialization will also promote collaboration and interaction of faculty and students with research and clinical institutions in southeast Michigan, most notably Henry Ford Hospital. Within the State of Michigan we know of no departments that are currently offering Ph.D. programs selectively focused on biological communication. The program is thus unique in Michigan and is an area that should receive favorable consideration for funding from both the public and private sectors, as indicated by the recent award of funding from Howard Hughes Medical Institute for a parallel program in Biological Communication at the undergraduate level. The program capitalizes on the existing research interests and expertise within three units at Oakland (Biological Sciences, Chemistry, Eye Research Institute, including their collaborations with clinical researchers at William Beaumont Hospital in nearby Royal Oak) and the major

medical research institution, Henry Ford Hospital, in Detroit. This doctoral specialization will significantly enhance inter-departmental and inter-institutional collaboration, providing unique training opportunities in the graduate program. It is envisioned that the initiation of this specialization will add a critical mass to the already established Ph.D. Program in Biomedical Sciences with specializations centered in the Departments of Chemistry (Health and Environmental Chemistry) and Physics (Health Physics). Finally, development of this program will advance the *Strategic Plan* in the ways addressed above.

III. SELF-STUDY OF THE PARTICIPATING UNITS

This inter-disciplinary program will be administered by the Department of Biological Sciences. However, participation in the program will be open to faculty from other units, i.e. Chemistry, the Eye Research Institute, and possibly Physics and the School of Health Sciences at Oakland University, as well as faculty at Henry Ford Hospital. The present resources of the potential participants in departments and academic programs are outlined below.

A. Faculty and Staff

As summarized below and in the faculty vitae (see Appendix H), the main thrust of many research programs at Oakland University is directed toward using techniques in cell biology, biochemistry, genetics, and molecular biology to understand mechanisms of biological communication. These mechanisms regulate specific functions in normal and diseased cells and organisms, or are relevant to issues central to biotechnology. The interest and background of the participating faculty members encompasses several disciplines including biochemistry, genetics, microbiology, development, physiology, cell biology, immunology, and molecular biology. Thus there is a wide range of faculty expertise and ongoing research programs that provide a substantial base for the initiation and future development of the proposed program.

A1. The Department of Biological Sciences is staffed by 18 full-time and several part-time faculty members, two laboratory coordinators, and two secretaries. Four of the faculty with expertise in molecular biology were recently recruited to replace faculty members and a search for a faculty member with expertise in immunology and parasitology is in progress. Additional positions are being sought in botany and structural biology in order to restore the strength of our full-time faculty to an appropriate level in teaching and research expertise. Criteria for selection and hiring of faculty in the Department of Biological Sciences have always included evidence of excellence in both teaching and research. Minimum qualifications for the beginning assistant professor are a doctoral degree, at least two to three years of postdoctoral research experience, and several peer-reviewed publications. Many faculty members also have had significant research experience as an independent investigator before joining the department. The department has a strong record of publications and federal grant support. Many of the faculty in Biological Sciences have research programs which are integrally related to the biomedical doctoral program specialization proposed in this document. The research programs of many of these faculty members are currently, or have been, funded by grants from federal and national funding agencies. Areas of research specialization include clinical applications of biological communication such as cancer (Moudgil, Hitt, Wendell), cardiovascular disease (Hansen-Smith, Nag), and eye disease (Gordon, Reddan, Unakar) and biotechnological relevant areas such as

microbial biology and genetics (Zeilstra-Ryalls, Moudgil, Hitt, Walia, and Chaudhry). Basic processes in cellular and intracellular signaling (Zeilstra-Ryalls, Lindemann, Dvir) and inter-organismic communication (Berven, Gamboa, Grudzien, Hunter) are also emphasized in the Department's research program (see Appendix A).

A2. The Department of Chemistry is currently staffed by 15 full-time and several part-time faculty (Appendix A), as well as several professional and technical support staff. The department is also responsible for the operation of the University Instrument Shop. With teaching and research as its major priorities, the department has expertise in analytical, biological, environmental, inorganic, organic, and physical chemistry. The three biochemists (Bull, Callewaert, and Moore) have a long history of professional collaboration with the Department of Biological Sciences. Other faculty with biological directions to their research (Malinski, Sevilla, and Taylor) have also collaborated with the Department of Biological Sciences. A position in organic chemistry is currently available, and it is intended that the successful candidate will have a biomedically related research program. A search for an environmental chemist has just been initiated; it is probable that the research area of the successful candidate will have a biochemical or toxicological orientation. External support for faculty research is provided by the National Institutes of Health, the National Science Foundation, other governmental agencies, private foundations, local biotechnology companies, major research hospitals, and large pharmaceutical enterprises.

A3. The Eye Research Institute at Oakland University has eight full-time faculty (Appendix A), and a support staff of 25, six clinical appointees, and a support staff of 25, which includes postdoctoral fellows, undergraduate research students, technicians and secretaries. The institute is recognized nationally and internationally as a premier center for basic and clinical eye research. The principal source of support for the Eye Research Institute's research program is the National Institutes of Health.

Research in the Eye Research Institute addresses fundamental processes in ocular tissues and on diseases that cause blindness. Topics under investigation currently include the interplay of ions and molecules such as calcium, cyclic GMP (Ari), active species of oxygen and free radicals, and other signaling molecules (Hightower, Giblin, Winkler), the role of cytokines (Hartzer), neurotransmitters (Winkler) and metabolites such as adenosine (Riley), and other signaling molecules in cataractogenesis and vitreoretinal proliferative diseases. Studies of genetic defects leading to blindness (B. Shastri), and development of treatments for blindness based on gene therapy (Blanks) are currently in progress (see Appendix A).

A4. Henry Ford Hospital, our collaborating institution, is a nationally recognized biomedical research institution. Currently basic and clinical research brings in extensive governmental, industrial, and organizational support. Approximately two-thirds of this support comes from the National Institutes of Health. Pharmaceutical and other industrial sources and organizations such as the American Heart Association also provide significant funding. Major research programs are ongoing in Neurology, the Bone and Joint Center, Biostatistics, Hypertension and Vascular Research, Gastroenterology, the Sleep Center, Allergy, Endocrinology, and Metabolism and Diagnostic Radiology. Research at Henry Ford Hospital is conducted by M.D's and Ph.D's who are investigating both fundamental biological problems and issues that directly affect patient

care. Research occurs over a broad spectrum including outcome drug testing, molecular biology, physiology, and biochemistry. Most of the bench research occurs in the Benson Ford Education and Research Building and newly opened laboratories in One Ford Place. Henry Ford Hospital already has a strong academic link with Oakland University through the doctoral specialization in Medical Physics and other programs such as that in the School of Nursing. In addition, since the Center for Biomedical Sciences was established at Oakland University, five research faculty (Beierwaltes, Carretero, Garvin, Renehan, and Roth currently hold joint appointments with Oakland University through the Center for Biomedical Sciences (Appendix A).

In summary, the Department of Biological Sciences has a nationally competitive research program as well as a record of excellence in teaching. Combined with the research expertise available in the collaborating units at Oakland University (Chemistry, Eye Research Institute) and Henry Ford Hospital, the department will be able to operate a high quality doctoral program without adversely affecting the current undergraduate and M.S. programs in Biological Sciences, Biochemistry, and Chemistry. With the additional faculty and adequate support requested (see IV and V), we will continue to meet our obligations and commitment to undergraduate teaching in the basic sciences, nursing and the allied health programs and pre-professional studies. Moreover, undergraduate participation in research, which is historically a strength of the department, will be further augmented by the presence of pre-doctoral students in the laboratories.

B. Facilities

B1. Department of Biological Sciences: The facilities of the department are housed on the second and third floors of Dodge Hall and the third floor of the new Science and Engineering Building (SEB). The teaching laboratories are on the second floor of Dodge Hall and the third floor of the Science and Engineering Building. Offices, research labs, animal's facilities, and stock rooms are on the third floor of Dodge Hall and the Science and Engineering Building. A wide variety of specialized equipment is located in the laboratories of individual faculty. The department also has several multi-user laboratories (304A,B,C,D in Dodge Hall, Rooms 302, 306, 308, 309, and 324 in SEB) equipped for a range of analyses. Instrumentation includes several refrigerated super speed centrifuges, ultracentrifuges, other general centrifuges, an HPLC system, computerized imaging systems for analysis of electrophoretic separations, two spectrophotometers, a French Press with large and small cells, a DNA synthesizer, and an automated DNA sequencer. Two appropriately equipped radioisotope laboratories, including scintillation and gamma counters, (308 and 315 Dodge, 324 SEB) support radioisotopic work. Two multi-user cell culture facilities (304 Dodge Hall, 322 SEB) that supplement the facilities available for individual investigators are equipped with inverted microscopes for both fluorescence microscopy and video microscopy. One of the three laboratories in 322 SEB is designated for BS-3 level research. Image analysis capabilities are accommodated in a morphology core suite (321,331 Dodge). Major equipment includes a transmission electron microscope, a laser scanning microscope, several ultratomes, and a fully equipped darkroom, with additional smaller darkrooms. In addition, there are three common use cold rooms and two environmental warm rooms.

B2. Department of Chemistry: The department is located in the SEB and encompasses the entire second floor. The department also has space in Hannah Hall that consists primarily of teaching labs and graduate student offices in the south wing. Among the specialized facilities of the Chemistry Department are several laboratories which would directly support research in biological communication, including biochemical preparations, biochemical separations, electrochemistry and electrophysiology, immunochemistry, medicinal chemistry, and cell and tissue culture. Other potential sources of technological support would be the new facilities for chemical modeling and visualization, instrumental analysis, quantitative analysis, and inorganic and organic synthesis.

Major research equipment currently available in department laboratories include: a 300 MHz wide-bore NMR spectrometer, electron spin resonance spectrometers, a gas chromatograph/mass spectrometer, several spectrophotometers (visible and UV), several gas chromatography units, a capillary electrophoresis system, a liquid scintillation counter, centrifuges (ultra, high speed, clinical, micro), spectrofluorimeter, kinetic plate readers, several HPLC systems, a flow cytometer, laser Doppler and ultrasonic flowmeters, and a video microscope.

B3. Eye Research Institute: The Institute has laboratories on the third and fourth floors of Dodge Hall. The Eye Research Institute has multi-user facilities for studies using radioisotopes, a well equipped cell culture facility with several photomicroscopes, including fluorescence, and the electron microscopy electron microscopy lab houses both transmission and scanning electron microscopes. Among the shared and individual laboratories there is an extensive array of biochemical instruments that will be available for graduate student research.

B4. Center for Biomedical Research: Through funding from the Research Excellence Fund in Michigan, extensive research instrumentation has been acquired by the Center for Biomedical Research for inter-departmental, multi-user research applications. These research instruments collectively form a Biochemical Analysis Facility, a Radioisotope Facility, a Biochemical Separation Facility, a Cell and Molecular Biology Faculty, and a Biomedical Electrochemistry Laboratory. Equipment is housed in various laboratories in Biology, Chemistry and Physics. The Center for Biomedical Research provides internal funding for pilot studies by investigators as well as some graduate stipends.

B.5 Henry Ford Hospital: Henry Ford Hospital is a major research institution and as such, it has extensive facilities to conduct both basic and clinical research. Most laboratory research occurs in the Benson Ford Education and Research Building and the newly renovated laboratories at One Ford Place. Both buildings have animal care facilities. The hospital has a wide range of research programs and consequently has a broad range of major equipment. Techniques used by investigators at Henry Ford Hospital include many standard molecular biology techniques, as well as transgenic and knockout mice; patch clamping; intracellular and extracellular electrical recordings; ultramicro-analytical assays; electron microscopy, fluorescent microscopy and confocal microscopy; radio immunohistochemistry; histology; cell culture; measurements of cardiac output, heart rate and blood pressure; Doppler and electromagnetic measurement of blood flow; radioactive tracer studies of electrolyte, nonelectrolyte and metabolic fluxes.

B.6 Animal Facilities: All animal use at Oakland University and at Henry Ford Hospital is regulated through standing Institutional Animal Care and Use Committees (IACUC). All research involving animals must have approval of these committees to proceed. Animal facilities at Oakland University meet the guidelines of the National Institute of Health for animal care and use and are inspected by the U.S. Department of Agriculture at least twice annually. Animal rooms for rodents and rabbits are located on the third and fourth floors of Dodge Hall, and a Clinical Research Laboratory for animal surgery is located separately. All are maintained by a full-time technician. The facility is administered by the Office of Research Administration. A licensed veterinarian specializing in laboratory animal medicine provides veterinary care. Maintenance costs for this facility are largely funded through individual research grant funds. Through National Institutes of Health funding and matching funds from Oakland University, an additional animal facility is currently under construction and will be connected to the new Science and Engineering building. The new facility will be designed to be AALAC-accredited, will have isolation and surgical facilities, and will have additional support staff.

Bioresources at Henry Ford Hospital consist of an AALAC approved facility composed of two areas. The largest of these is located on the fourth floor of the Benson Ford Education and Research Building. This area includes animal housing, surgery suites, isolation rooms, and storage facilities. The second area, located in One Ford Place, also has animal housing, surgery suites and storage facilities. Veterinary support is provided to inspect the health status of housed animals, maintain a preventative medicine program, collect clinical samples and make diagnoses. Ancillary support is provided to assist investigators in their research. The staff consists of five veterinary technicians who hold the title of Bioresources Technologist. These individuals maintain animals on special diets and water, are responsible for the hygiene of the animals, exercise animals when appropriate, and assist the veterinarian.

B7. Library: The Kresge Library's holdings of journals in the area of cellular and molecular biology and biochemistry constitute a minimal core selection of the major journals needed for our proposed program. The Eye Research Institute has a collection of journals and books in its library, which will also be available for student and faculty reference. The extensive collection of basic science and medical journals and related references at Sladen Library (HFH) will be an additional valuable resource available to all participants in the program. Furthermore, the on-line capabilities for literature retrieval have made access to remote journals much more feasible. Expanding internet offerings will be increasingly important as resources for students and faculty extend the access to many scientific databases. A complete review of library holdings relevant to this degree proposal has been completed by Mildred Merz, Associate Professor of the Library. Her report can be found in Appendix F.

C. Present Curriculum and Programs

C1. Department of Biological Sciences:

The Department of Biological Sciences offers programs of study leading to the degrees of Bachelor of Arts, Bachelor of Science, Master of Science and Master of Arts. These programs prepare the student for further studies in life sciences, industrial biology, careers in the health professions and allied sciences, or science teaching, and a wide range of positions in the public

and private sector. The Bachelor of Arts in Biological Sciences degree requires 40 credits in at least three of five areas of biology plus training in chemistry, physics, and mathematics. The Bachelor of Science degree requires additional training in more mathematically oriented cognate courses plus an individual library or laboratory research project in biology. The department also participates in the interdepartmental Biochemistry Program.

The department's initial curricular emphasis was in the area of modern cell biology and this continues to be an area of current strength in both teaching and research. A diverse selection of courses is available, including biochemistry and molecular biology, physiology, structural biology, genetics, ecology, aquatic biology, invertebrate zoology, neurobiology, development, microbiology, immunology, evolution, botany, and animal behavior. Approximately 68 courses (lectures, laboratories, and independent studies) are now authorized and offered at least once a year. These include introductory courses, lecture-style intermediate-level courses, and advanced seminar courses in the specialties of the particular faculty. Laboratory courses are designed to introduce students to basic concepts relevant to the course, as well as to the techniques employed in the practice of biological sciences.

C1a: Undergraduate Curriculum: Enrollees in Biology courses are primarily majoring in biology, the nursing and allied health science programs, or pre-professional studies. Several of the introductory courses fulfill general education requirements in the natural sciences for students in other disciplines. Students may also choose to engage in faculty-guided research projects through independent study courses. Under one option for independent study, students author a paper based on library research (BIO 405), while the second option enables students to conduct a laboratory research project under the direction of a faculty member (BIO 490). Many such projects are ultimately published in scientific journals and/or presented at professional meetings. The new Howard Hughes Undergraduate Program in Biological Communication has expanded the quality and scope of opportunities for undergraduates. This competitive program provides for more extensive training of undergraduates through the Howard Hughes Summer Research Fellowships and subsequent two-year program of laboratory research and associated career mentoring and seminar programs.

C1b: Graduate Curriculum: The Master of Science program in Biological Sciences is composed of two tracks: a) the Cellular and Molecular Biology track requires courses in genetics, biochemistry, physiology, and structural and developmental biology; and b) the Ecology, Evolution, and Behavior track requires that students complete course work in physiological ecology, population and community biology, applied ecology, and evolutionary biology. Students are also required to take a graduate seminar course and complete a thesis. Thesis research is carried out under the supervision of the student's mentor and is also normally presented at national scientific meetings and/or published in peer-reviewed journals. The department has recently reviewed approval for a non-thesis M.A. program, with course work and research experiences designed to serve the needs of middle school and high school teachers and other professionals who require additional training for their professional advancement.

In the past, the Department of Biological Sciences has participated in the Biomedical Sciences Doctoral Program through the Health and Environmental Chemistry Specialization and has graduated three Ph.D.'s since the program's inception. A fourth Ph.D. candidate is currently

enrolled in the program. While this specialization has contributed significantly to graduate training in the Department of Biological Sciences, it does not currently serve the needs of most prospective graduate students in Biological Sciences due to the extensive concentration on non-biological aspects of chemistry and insufficient concentration in biological areas.

C1c. Summary: In summary, there are courses available that can be used in the proposed program. The strong research-oriented basis of our ongoing M.S. program as well as the department's ongoing participation in the Health and Environmental Chemistry specialization of the Doctoral Program in Biomedical Sciences will provide a base of experience for teaching and administering a doctoral-level graduate program.

C2. Department of Chemistry

C2a) Undergraduate Curriculum: At the undergraduate level, the department's primary degree is the Bachelor of Science in Chemistry which requires a minimum of 48 credits in core and advanced chemistry courses; with proper course selection, the B.S. recipient may also receive professional certification from the American Chemical Society. The liberal arts Bachelor of Arts in Chemistry requires 41 credits or core and advanced courses. In addition, the department participates in the interdepartmental Biochemistry Program (see next section) with the Department of Biological Sciences, and cooperates with the School of Engineering and Computer Science in offering a B.S. in Engineering Chemistry. The department also houses the Environmental Health Program, which offers a B.S. degree. Like the Department of Biological Sciences, the Department of Chemistry has a long history of significant undergraduate research. The most recent recognition of this tradition was a three-year National Science Foundation "Research Experiences for Undergraduates" grant centered around the general theme of "Chemical Studies on Problems of Biological Interest." The Howard Hughes Program in Biological Communication has expanded research opportunities in Chemistry for undergraduates and provided for more extensive training through Howard Hughes Summer Research Fellowships.

C2b. Graduate Curriculum: At the graduate level, the department offers a Master of Science in Chemistry, which requires 32 credits of graduate course work and research, as well as completion of a research thesis. The department also participates in the Ph.D. in Biomedical Sciences by offering a specialization in Health and Environmental Chemistry that requires 90 credits beyond the baccalaureate degree, including at least 30 credits of dissertation research. The department offers twenty 400-level courses and twelve 500-level courses, some of which may be applicable to the Biological Communication doctoral program as proficiency or elective courses (e.g. 453/454 Biochemistry I and II; 553 Advanced Biochemistry; 554 Topics in Biochemistry and 581 Biochemical Toxicology).

C3. Biochemistry

The department of Biological Sciences and Chemistry have cooperated in offering an interdepartmental Bachelor of Science in Biochemistry since 1980. This strong undergraduate curriculum requires 60 major credits, including 32 in chemistry plus lab, analytical chemistry and two semesters of physical chemistry), 16 in biology (most at the 300 level), and 12 in

biochemistry (at the 400 and 500 level), as well as two semesters of calculus and 2 semesters of calculus-based physics. The required biochemistry credits include the comprehensive two-semester biochemistry lecture sequence (BCM 453/454) and the 2-credit biochemistry laboratory course (BCM 457). For elective biochemistry credit, students are encouraged to do research (BCM 490) and/or select an approved upper level chemistry or biology lecture course.

C4. Eye Research Institute

The Eye Research Institute is a research unit with no mandated teaching. Nevertheless, the faculty in the Eye Research Institute have regularly participated in selected undergraduate teaching in the form of full upper level courses (i.e. Dr. Winkler's Neurobiology class, BIO 351), guest lecturing in upper level undergraduate and graduate seminar-style courses, and by mentoring student research projects (BIO 490, BCM 390). The Eye Research Institute has extended the research opportunities for undergraduates by providing competitive summer fellowships. In addition, the Eye Research Institute has joined the departments of Biological Sciences and Chemistry in the teaching and research components of the Howard Hughes Program in Biological Communication.

C5. Henry Ford Hospital

Several faculty members of Henry Ford Hospital are also fellows of Oakland University's Center for Biomedical Research. In the Medical Physics specialization of the Doctorate in Biomedical Sciences there is a strong record of doctoral training and several faculty hold joint appointments at Oakland University and Henry Ford Hospital. The hospital's summer undergraduate fellowships have traditionally provided excellent research experiences for many of Oakland University's students.

D. Impact on Current Programs

We anticipate that the proposed program will have a strong positive impact on the current programs. The present undergraduate (B.S.) and graduate (M.S.) curricula in Biological Sciences, Chemistry (B.S., Ph.D.), and Biochemistry (B.S.) have a solid base in research. From their inception, the departments of Biological Sciences and Chemistry have had an extensive undergraduate research program in each discipline. This was extended by the development of the inter-departmental Biochemistry Program, and the Department of Chemistry currently offers a doctoral specialty in Health and Environmental Chemistry in which the Department of Biological Sciences participates. The departments each have subsequently developed a masters level program. Both undergraduate and graduate programs have mutually benefited because in many faculty research laboratories, undergraduates and graduate students work together in research groups. The Annual Student Research Conference in Biological Sciences includes presentations by both undergraduate and graduate students. This environment has led to close interaction between undergraduates, graduates postdoctoral fellows, and faculty. We believe this has had a strong positive effect on our undergraduate program and has helped fulfill student career goals. This contrasts with many medically oriented Ph.D. programs which are usually administered by medical schools and tend to be physically separated from undergraduate training.

We believe that doctoral students specializing in biological communication will add a critical link to strengthen our current undergraduate and master-level programs. Our previous experience at the master's level indicates that active participation of doctoral students in the ongoing research programs in faculty laboratories will have a positive effect on the productivity and equality of research of our undergraduate and master's students and will broaden the types of mentoring available to these students. Along with the implementation of the Howard Hughes Undergraduate Program in Biological Communications, the proposed revised Ph.D. specialization in biological communication is a unique inter-departmental program of research at Oakland University which complements the other two ongoing specializations of the Ph.D. program in Biomedical Sciences, i.e., Health and Environmental Chemistry and Medical Physics.

IV. THE PROGRAM

A. Admission Requirements

Admission to the program requires a bachelor's degree or its equivalent from an accredited institution with an undergraduate grade point average of 3.0 or higher on a 4.0 scale. The applicant should have a strong record in science with a background in biology, chemistry, physics and mathematics. It is recognized that students with a diverse range of undergraduate training may be appropriate candidates for this interdisciplinary program. The student with deficiencies in any of these areas may be provisionally admitted if evidence of exceptional potential in research is provided, but preliminary courses may be required (see C-2 below). A complete application will include all academic records, results from the Graduate Record Examination (including a Biology or Biochemistry component), letters of recommendation from three scientists or other faculty indicating scholarly achievements and promise of the candidate, and a personal statement of no more than 500 words. Personal interviews will be required of the applicant prior to final admission.

B. Program Administration

B1. Doctoral Program Committee: The Doctoral Program committee for the specialization in biological communication will be appointed on the recommendations of the Doctoral Program in Biomedical Research, the chairperson of the Department of Biological Sciences, and Chairs/Directors of the participating units. The committee will consist of at least one member from each of the participating departments and institutions with a majority from Biological Sciences, including a representative of the Department of Biological Science's graduate committee. In addition, the chairperson of the Biomedical Sciences Doctoral Program committee will serve in an *ex officio* and non-voting capacity. Terms of the doctoral program committee members will be three years and will be staggered. The chairperson will be a full-time Oakland University faculty member, will be elected by the committee, and will serve on the Advisory Committee of the Doctoral Program in Biomedical Sciences. The committee will be charged with the general administration of the program, student admissions, determination of student proficiency, approval of student dissertation committees, and final approval of candidates having fulfilled all degree requirements including the dissertation. The Doctoral Program Committee will advise each incoming student until the student's dissertation committee is established.

B2. Dissertation Committee: The Dissertation Committee will be a five-member committee mutually agreed to by the student and the dissertation adviser by the end of the second year, with approval by the administrator of the graduate school. The Dissertation Committee is charged with the preliminary approval of students' completion of requirements and guidance in course selection, in addition to counseling on scientific matters and ultimately, giving preliminary approval of the dissertation research plan and the approval of the dissertation itself. A faculty member other than the student's dissertation adviser will be the chairperson of the Dissertation Committee. Faculty from any of the participating units may be appointed to the Dissertation Committee, but each Dissertation Committee must include a member from the Department of Biological Sciences and must have a minimum of three full-time faculty members from Oakland University.

C. Degree Requirements

The basic requirements for the Ph.D. are successful completion of the preliminary and qualifying examinations (years one and two), completion of a program of formal course work, and independent research directed and approved by the candidate's dissertation committee and the Doctoral Program Committee, and completion of a written dissertation.

C1. Credit Requirements: A minimum of 90 credits beyond the baccalaureate degree are required, which would include at least 40 credits of preliminary, core, and elective courses and at least 30 doctoral research credits. A limited number of transfer credits may be acceptable under some circumstances (to be decided on a case by case basis) but they must meet graduate level requirements and receive approval by the Doctoral Program Committee and the Vice Provost for Graduate Study. Students admitted as transfer students or those entering with a master's degree must take the required core courses in this program at Oakland University. *A student receiving a master's degree at Oakland University may petition to apply up to 32 credits toward the degree. This petition must be approved by the Doctoral Program Committee and the Vice Provost for Graduate Study.*

C2. Proficiency and Preliminary Courses: A background in physiology, biochemistry, genetics, cell biology, and statistics is required before the student can enter into the core program. The proficiency of the student in particular areas will be determined from the applicant's academic record. Proficiency exams such as the graduate record exam and the Biology or Biochemistry subject exams also will be used in decisions for admission. Preliminary courses may be recommended prior to enrollment in certain core courses to accommodate deficiencies in training that are to be expected among a student population with varying backgrounds. Up to 12 credits of preliminary courses may be applied toward the total of 90 credits. These preliminary courses must be at the 400 level or above unless otherwise recommended by the Doctoral Program Committee and approved by the Vice Provost for Graduate Study.

C3. Core Program: All students must complete the courses listed in the core program in Appendix B. A one-credit seminar course must be taken for at least four semesters. Additional electives are required to fulfill the minimal requirement of 40 course credits. A schedule of proposed core course offerings, as well as exams, is listed in Appendix C.

C4. Elective Courses: Graduate level courses listed in the Oakland University graduate catalog are available as electives (Appendix B). The choice will depend on student interest and need as mutually determined by the student's adviser, dissertation committee, and the student.

C5. Qualifier and Preliminary Examinations: Evaluation of candidacy for the doctorate degree will consist of two examinations. The *qualifier examination* will determine whether or not the student's background knowledge in the core areas is sufficient to become a candidate for the doctoral degree, and the *preliminary examination* will evaluate oral and written skills, as well as reasoning ability. The qualifier examination will be designed and evaluated by the Doctoral Program Committee in consultation with participating faculty. The preliminary examination will consist of a written proposal on a topic that is distinct from the student's thesis topic. The proposal then will be presented orally and defended to an examining committee. A member of the student's Dissertation Committee other than the dissertation adviser will chair the examining committee. Record of the results of the qualifier and preliminary examinations will also be forwarded to the Vice Provost of Graduate Study. The student must pass both qualifier and preliminary examinations within two years after admission into the program, at which point they become doctoral candidates. Should a student fail the preliminary examination, the administration will determine on a case by case basis if a re-examination will be permitted and in no instance will more than one additional examination be given.

C6. Research Training: During the first year, students must rotate through three or more different research labs to become familiar with a range of research technology and research topics (BIO 690). The rotation is intended to introduce the students to the faculty in participating units and to function as an introduction to research training. The laboratory rotations will be assigned by the Doctoral Program Committee after consultation among the students and participating faculty.

C7. Research Dissertation: The major component of the program is the successful completion of an original laboratory project, including a written dissertation. The project should be comprised of work that is publishable in a refereed journal. Prior to beginning the dissertation project, the student should present to his/her dissertation committee a research proposal outlining the problem to be studied, a survey of the appropriate literature, a description of the appropriate techniques, and an outline of the experiments to be performed. The dissertation committee evaluation and recommendation will be forwarded to the Doctoral Program Committee together with the proposal. The student must successfully complete at least 30 credits of BIO 799, Doctoral Research. Upon completion of the written dissertation, the student will present the results in a seminar open to the public, immediately followed by a defense of his/her dissertation before the Dissertation Committee. A majority of the members of the Dissertation Committee must approve the candidate's defense of his/her dissertation for it to be deemed successful. The results of the defense will be forwarded to the Doctoral Program Committee. A student must be first author on at least one manuscript worthy of acceptance in a peer-reviewed journal reporting dissertation work in order to fulfill the degree requirement.

C8. Teaching: Teaching skills are regarded as important for employment in both academic and industrial sectors of science. All Ph.D. students are required to make a major teaching contribution to a minimum of three undergraduate courses or laboratories to fulfill the degree

requirements. The teaching may be used either to fulfill credit requirements (BIO 697) or to fulfill the terms of a teaching assistantship.

C9. Communication Skills: Proficiency in communication, both in written and spoken English, must be demonstrated in the student's course work, formal and informal presentations, examinations, and dissertation writings for successful completion of the degree. The Doctoral Program Committee may require additional training in written and/or spoken English to fulfill degree requirements for students whose communication skills in English are determined to be inadequate

C10. Residency: All students are required to fulfill a residency requirement as specified by the Office of Graduate Study, and students are strongly encouraged to complete the program by continuous full-time enrollment.

C11. Time Limit: All requirements, including the dissertation, must be completed within seven years after admission to the program. Under exceptional circumstances, an extension may be granted with the approval of the Doctoral Program Committee and the Vice Provost for Graduate Study.

V. PROGRAM IMPLEMENTATION

Implementation of the doctoral specialization in Biological Communication will proceed according to the schedule outlined below. The components built into this implementation plan are designed to provide a strong, high quality program, which will be competitive with other nationally, recognized interdisciplinary programs in the Biomedical Sciences. Preparation and optimization of the program before students are admitted. This is pivotal to the success of the program, for without it the students will not be able to achieve the necessary goals required to complete the degree. Self-evaluation and external assessment of the program. A key strength of this implementation plan is a built-in mechanism which provides quality assurance to the students and to Oakland University. Application for external support. By incorporating into the implementation plan the preparation and submission for pre-doctoral training grant proposals as well as faculty development, the program has the potential to be self-sustaining, provided that it is deemed to be of sufficiently high quality to merit awarding of the training grant. The input of the review process of the proposal will provide guidelines for future modifications of the program, with the goal of obtaining such an award.

STAGE 1: Appointment of Doctoral Program Committee:

Following approval of the revised program at all levels of the review process a Doctoral Program Committee will be appointed to oversee the subsequent stages of program implementation.

STAGE 2: Program Development:

A. Resources

A-1. Development of core course syllabi and materials, including library resources, and development of an extended list of potential speakers for the program seminar series by qualified faculty in conjunction with the Doctoral Program Committee.

A-2. Approval of course syllabi and proposed library resources by the Doctoral Program Committee.

A-3. Presentation to, and Review of Program by Participating Units: Department of Biological Sciences, Department of Chemistry, Eye Research Institute, and Henry Ford Hospital.

B. Faculty

Recruitment and hiring of at least four faculty members required to provide the full range of expertise critical to the successful implementation of the program. The areas of expertise not currently available to the program as designed are:

1. Neurobiology
2. Cell biology, focus on intra and intercellular signaling
3. Plant biology, molecular emphasis
4. Development and gene regulation

In addition to hiring additional faculty members, an opportunity for "re-tooling" by current faculty will be created, whereby one faculty member per year will be able to learn an important new technique which would make his/her research program more competitive and also offer more state-of-the-art training for graduate students. This in turn brings more expertise to the formal instruction and prepares faculty for expanded roles in the curricular offerings.

C. Funding of Training Program and Admission

C-1. Preparation, submission, and funding of a Graduate Training Grant Proposal to the Oakland University Research Foundation.

C-2. Preparation of publicity materials in conjunction with the other two units of the Doctoral Program and the Center for Biomedical Research.

C-3. Recruitment and review of applicants and identification of those deemed qualified for admission to the program.

STAGE 3: Program Initiation

A. Upon completion of all items indicated in STAGE 2, implementation will proceed to the first year of program operation, with the admission of up to 3 students. Up to three new students will be admitted each subsequent year. Completion of the proposed doctoral program is expected to take five years. Therefore, at a steady state-level the program will have an enrollment of up to 15 students (see Appendix D).

B. A series of program seminars will be scheduled to afford a maximum attendance of faculty and students at all levels, as well as opportunities for professional interactions/mentoring afterwards.

STAGE 4: Faculty Development

Preparation, submission, and funding of a Faculty Development Grant Proposal to the Oakland University Research Foundation to enable participating faculty members to "re-tool" in the context of their research program, take specialized training in areas deemed essential for the program, and to prepare new course materials, thereby assuring updated, innovative, and state-of-the-art training for the graduate fellows.

STAGE 5: Assessment and Preparation of Extramural Training Grant Proposal

Upon the graduation of six students from the program, the Doctoral Program Committee will evaluate the program, identify strengths and weaknesses, and develop a course of action to correct deficiencies. The guidelines for this evaluation will be those indicated in the Guide for NIH/NSF Training Grant. The resulting document from this evaluation will be an application for a pre-doctoral training grant. This serves the purpose of providing an opportunity for external review of the program, with the potential benefit of securing extramural funds to support the program.

Stage 1: No costs.

Stage 2A: Core course and library resource needs development will have a one-time cost of 3/9 annual salary for the four faculty charged with completing this portion of the program implementation: Total cost: \$80,000. Library resources will be identified in this stage and are expected to be in the range of \$25,000 annually.

Stage 2B: Recruitment: \$20,000 per position; Start-up funds: \$150,000 per position. An office and at least 400 sq. ft. laboratory space must be allocated per position. Laboratory renovation: \$50,000 per position; Salary and Fringe Benefits: \$60,000 per position. Total cost: \$1,120,000.

Stage 2C: Publicity materials (in conjunction with the Center for Biomedical Research), \$5000; Recruitment \$5000 annually.

Stage 3: Stipends, \$18,000; fringes, housing allowance, \$5000; tuition \$8000 per student. Seminar series, \$12,500/year. Total first year cost: \$105,500, with \$31,000 per student added subsequently.

Stage 4: Faculty development, 3/9 salary; \$3000 materials/tuition. Total annual cost: \$23,000.

Stage 5: 3/9 annual salary for two faculty. Total cost \$40,000.

Additional costs: Initiation of this program and expansion of the faculty size will result in an increased annual administrative cost to the Department of Biological Sciences (i.e., phone,

photocopying, computer supplies, student assistantships) estimated at \$9000 annually. Instructional costs (part-time teaching appointments for non-faculty course directors, laboratory, and computer/audiovisual supplies) are estimated at \$14,000/year. The proposed seminar series, with some of the seminar speakers invited from nationally and internationally recognized research laboratories, will require \$6000 annually for honoraria, travel, and lodging.

VII. PLANS FOR EVALUATION

The Vice Provost of Graduate Study will formally review the program every fifth year. In addition, the Doctoral Program Committee will undergo a biannual self-evaluation to evaluate the students' progress and to identify areas of weakness in the instructional and research components of the program. We will benchmark this new program against the "best" of other comparable interdisciplinary programs in the state, as well as those at institutions of comparable size at the international level. After graduating 10 students, the submission and subsequent review of a Training Grant application will serve as an external review which will be based on competitive standards. Data concerning the post-doctoral placement and employment status of our graduates will be essential for successful competition for funds at the national level.

APPENDIX A

FACULTY RESEARCH SPECIALIZATIONS

Department of Biological Sciences (complete faculty listing)

Berven, Keith Amphibian population biology and evolution of life history patterns

Chaudhry, Rasul Gene expression and genetic engineering

Cowlshaw, John Systems theory in biology; energy and information processing

Dvir, Arik Regulation of DNA-associated protein kinase; transcription

Gamboa, George Kin recognition of social insects and amphibians

Gordon, Sheldon Role of cytoskeleton and extracellular matrix in wound repair

Grudzien, Thad Evolutionary genetics; biochemical systematics of ranid frogs

Hansen-Smith, Fay Inter- and intra-cellular communication during angiogenesis

Hitt, Anne Cytoskeleton-membrane interactions; protein structure/function

Hunter, R. Douglas Aquatic ecology; zebra mussel ecology; impacts on ecosystems

Lindemann, Charles Mechanisms of sperm motility; workings of flagellar axoneme

Moudgil, Virinder Molecular mechanisms of steroid hormone action

Nag, Asish Differentiation and growth of cardiac muscle cells

Reddan, John Regulation of lens epithelial cell proliferation; causes of cataract

Unaker, Nalin Cataract induction and inhibition

Walia, Satish Molecular mechanisms of detoxification; antibiotic resistance

Wendell, Douglas Genetic Mapping and molecular cloning of tumor genes

Zeilstra-Ryalls, Jill Regulation of gene expression in photosynthetic bacteria

Department of Chemistry (partial faculty listing, relevent to Ph.D. specilization)

Bull, Arthur Enzymatic and non-enzymatic lipid oxidation as cell regulators

Callewaert, Denis Molecular basis of psychoneuroimmunological phenomena

Malinski, Tadeusz Biosensors for redox reactions; nitric oxide chemistry

Moore, Kathleen Xenobiotics and fatty acid metabolism; gangliosides

Sevilla, Michael Free radicals and radiation damage to biomolecules

Taylor, Craig Inorganic complexes as antiviral and antitumor agents

Eye Research Institute (complete faculty listing)

Ari, Sitaramaya Calcium binding proteins and cyclic GMP synthesis in retina

Blanks, Janet Molecular techniques for restoration of photoreceptor functions

Giblin, Frank Oxidative and free-radical processing in cataract development

Hartzer, Michael Mechanisms underlying vitreoretinal disease

Hightower, Kenneth Role of calcium in lens physiology and cataract development

Riley, Michael Intracellular signaling in maintenance of lens transparency

Shatry, Barkur Genetic studies of vitreoretinal degeneration

Winkler, Barry Metabolic function of retinal neurons, glia, and pigment epithelium

Henry Ford Hospital Faculty

(Adjunct appointments in the Center for Biomedical Research at Oakland University)

Beierwaltes, William Interactions between vasoactive hormones and renal function

Carretero, Oscar Mechanisms of hypertension

Garvin, Jeffrey Vasoactive hormones, renal function, and hypertension

Renehan, William Central nervous system and gastrointestinal development

Roth, Thomas Physiology of sleep and sleep disorders

APPENDIX B

SCHEDULE OF COURSE OFFERINGS

B-I. CORE COURSES REQUIRED FOR ALL STUDENTS

BIO 554 Biochemistry

BIO 517 Mechanisms of Microbial Genes Regulation, 4 credits

BIO 515 Mechanisms of Development and Multicellular Gene Regulation, 4 credits

BIO 563 Cell Biology, 4 Credits

BIO 6XX Biological Communication I: Extracellular and Intercellular Mechanisms, 4 credits

BIO 6XX Biological Communication II: Intercellular Signaling Pathways, 4 credits

BIO 6XX Ethics in Science and Medicine, 1 credit

BIO 6XX Seminars in Biological Communication, 1 credit

BIO 690 Graduate Research

BIO 6XX Special Topics in Scientific Communication, credits TBA

BIO 697 Apprentice Graduate Teaching, 2 credits

BIO 799 Doctoral Research

B-II. ADDITIONAL COURSE OFFERINGS ACCEPTABLE FOR ELECTIVES

BIO 511 Advanced Topics in Cellular Biochemistry and Biophysics

BIO 513 Advanced Topics in Cell Physiology

BIO 521 Medical Microbiology

BIO 565 Medical Parasitology and Mycology

BIO 581 Topics in Physiological Ecology

BIO 584 Topics in Behavioral Biology

BIO 585 Topics in Behavioral Communication

BIO 601 Advanced Human Physiology

CHM 553 Advance Biochemistry

CHM 581 Biochemical Toxicology
EXS 620 Muscle Physiology
HIS 503 Industrial Toxicology
PSY 552 Sensation and Perception
STA 513-14 Introduction to Mathematical Statistics

TABLE C

SAMPLE CURRICULUM

YEAR 1

Fall

BIO 554 Biochemistry
BIO 517 Mechanisms of Microbial Gene Regulation
BIO 690 Graduate Research
BIO 691 Special Topics

Winter

BIO 515 Mechanisms of Development and Multicellular Gene Regulation
BIO 563 Cell Biology
BIO 690 Graduate Research
BIO 691 Special Topics

Spring

BIO 690 Graduate Research
MAY: COMPREHENSIVE WRITTEN EXAMINATION (QUALIFIERS)

Summer

BIO 690 Graduate Research

YEAR 2

Fall

BIO 6XX Biological Communication I
BIO XXX Elective
BIO XXX Ethics
BIO 691 Special Topics
BIO 690 Graduate Research/Apprentice Teaching
DECEMBER: COMPREHENSIVE WRITTEN EXAM (retake if necessary)

Winter

BIO 6XX Biological Communication II|
BIO XXX Elective
BIO 691 Special Topics
BIO 690 Graduate Research/Apprentice Teaching

Spring/Summer

BIO 690 Graduate Research
AUGUST: ORAL EXAMINATION (PRELIMINARY EXAM)
If successfully completed, the student becomes a doctoral candidate.

YEAR 3

Fall

BIO XXX Elective, if necessary, to complete course credit requirements.
BIO 799 Doctoral Research

Winter

BIO 799 Doctoral Research

Spring/Summer

BIO 799 Doctoral Research

YEAR 4

Fall

BIO 799 Doctoral Research

Winter

BIO 799 Doctoral Research

Spring/Summer

BIO 799 Doctoral Research

APPENDIX D

EXPECTED ENROLLMENT

Students per Year

Year					Total
1999	3	0	0	0	3
2000	3	3	0	0	6
2001	3	3	3	0	9
2002	3	3	3	3	12
2003	3	3	3	3	15

Appendix E

Proposed 5 year budget

	<u>Preliminary</u>	<u>Year 1</u>	<u>Year 2</u>	<u>Year 3</u>	<u>Year 4</u>	<u>Year 5</u>
<u>Faculty</u>						
Planning, Stage 2A	80K					
Recruitment, Stage 2B	40K					
Start-up costs, Stage 2B	1120K					
New Faculty Salary		280K	288K	297K	306K	315K
Faculty Development		23K	24K	25K	26K	26K
Instructional Salary		14K	14K	15K	15K	16K
Travel		5K	5K	5K	5K	6K
<u>Students</u>						
Recruitment	10K	10K	10K	11K	11K	12K
Stipend, benefits		93K	186K	279K	372K	465K
<u>Library</u>						
		25K	26K	26K	27K	28K
<u>Seminar Speakers</u>						
		12K	12K	13K	13K	14K
<u>Administrative</u>						
		9K	9K	10K	10K	10K
TOTAL	1265K	471K	574K	682K	785K	892K

*3% annual increase

-

Budget Justification

1. Faculty

One-time costs:

- a. Stage 2A: \$80K
Sp/Su salary @ \$20K x 4 for detailed core course curriculum and library resource development
- b. Stage 2B: Recruitment of four new faculty members: \$10K per position = \$40K
Advertisement @ \$5,500 each:
Cost per candidate interview: airfare @ \$800, meals with faculty @ \$500, lodging @ \$200
(4 positions x 3 candidates = 12 total);
Equipment/start-up @ \$200K x 4
Laboratory renovation: \$80,000 per position
400 sq. feet new space per position @ \$200/sq. ft.
- c. Stage 5: \$40K
Sp/Su salary \$20K x 2 for assessment, training grant proposal

Annual costs:

- a. Stage 2B: New Faculty: Salaries, fringes @ \$70K x 4 = \$280K
- b. Stage 4: Faculty Development: Sp/Su salary @ \$20K: materials/tuition @ \$3K

2. Students

Annual costs:

- a. Recruitment: \$10K
Publicity: \$5K
Interviews with potential candidates prior to admission: \$5K
- b. Costs per student \$31K
Annual Stipend: \$18K (basis: WSU offers \$17.5K in '99 for comparable program in biomedical sciences-need to be competitive)
Benefits: health insurance, housing allowance for on-campus residence: \$5K
Tuition: \$8K annually

3. Library

Annual costs: (estimate in absence of library evaluation - \$25K annually)

- a. Books (topics, methods, texts): 20 @ \$200
- b. New journals (emphasis on range of review journals i.e., "topics in...", "with other key journals): 10 @ \$1,000
- c. Continuation of key journals previously identified for cuts: \$11,000

4. Instruction, Administration

Annual costs:

a. Faculty salary: \$14K (Instructional salary for research/grant-funded investigators who teach up to 50% of a class; as needed, 2 @ \$7K)

b. Seminar speakers: \$12K: Travel, lodging, board, honorarium for internationally recognized speakers: 3 @ \$2K; 4 @ \$1K, 4 @ \$500

c. Travel: \$5K:

Faculty travel to special symposia and workshops: \$2.5K x 2

d. Administrative: \$9K

Additional supplies and services (phone, copiers, computer, A-V, etc.) \$6K

Student clerical/laboratory assistance for faculty teaching/administering graduate program \$3K

5. Benefits of Indirect Costs

In the past three years, the Department of Biological Sciences has hired four new faculty members, all of whom are engaged in research related to Biological Communication, the theme of the proposed Ph.D. program. All have federally funded research programs which generate considerable indirect costs for Oakland University. Therefore, the recruitment of additional faculty is not entirely at the university's expense, since the candidates that will be selected are those most likely to be fundable to federal agencies. The indirect costs generated by new faculty are more than expected to offset the budgetary expense of their hiring. Moreover, research students trained in faculty funded programs benefit from the research equipment and supplies of their mentor. Indeed, many costs of training graduate students are borne by the research grants. Thus, portions of faculty grants are funneled back to the students who work with them on research projects in their laboratories.

DRAFT

Oakland University/Henry Ford Hospital Agreement Financial Support for Collaborative Biomedical Research and Education

1. Henry Ford Hospital (HFH) will be represented on all appropriate committees and oversight boards, including the Executive Committee of the Center for Biomedical Research (CBR) and the Specialization Committee for the doctoral program in Biochemical and Cellular Communication. The HFH representative on such committees will be chosen by HFH with the approval of Oakland University.

2. Henry Ford Hospital will provide financial support for pre doctoral students in approximate proportion to its representation and participation in the Ph.D. specialization in Biochemical and

Cellular Communication. The expenses to be covered will include stipend, tuition, and ancillary costs associated with students' enrollment in the program, including medical coverage. The current cost of support for each student is estimated to be approximately \$20,000 per year.

3. Henry Ford Hospital will support a total of:

zero students for the first two admitted to this specialization.

one student for the third through seventh students admitted to the program.

two students if more than seven students are enrolled in the program.

4. HFH will be allowed to name the fellowships for students that it supports. A suggested name is "Henry Ford Health Sciences Fellowship."

5. Students will generally be supported for up to the first two years of their enrollment in the doctoral program. Once a student has chosen a laboratory, the student's advisor is responsible for his or her support. Exceptions may be made to this rule in unusual circumstances.

6. HFH will also allocate funds to support approximately twenty percent of the advertising, instructional, and administration costs for the specialization in biochemical and cellular communication. The balance of these costs will be borne by the College of Arts and Sciences at Oakland University and/or (in the case of advertising, promotion and general administrative costs) by the departments of Biology, Chemistry, and Physics, and the Eye Research Institute. Projected estimates for calendar 1997 are as follows:

Incremental instructional costs \$14,000

Advertising and recruiting expenses 15,000

Travel 9,000

Seminar program 12,000

Total \$50,000

Based upon these projections, Henry Ford Hospital will allocate up to \$10,000 for support of the general educational and administrative expenses for this program. These funds shall be committed to the College of Arts and Sciences at Oakland University to be dispensed by the dean as appropriate.

7. HFH staff will receive appointments as "Investigators" in the Center for Biomedical Research at Oakland University. The criteria for appointments to be determined by the Executive Committee of the Center for Biomedical Research. Appointments will have a three-year term with renewal subject to review.

8. The relationship between Oakland University and Henry Ford Hospital regarding Henry Ford Hospital's participation in and financial support of the doctoral specialization in biochemical and cellular communication shall be reviewed every three years for renewal and for adjustments in levels of financial support.

REPORT ON LIBRARY HOLDINGS FOR PH.D. IN BIOMEDICAL SCIENCES WITH A SPECIALIZATION ON BIOLOGICAL COMMUNICATION

MEMORANDUM

TO: Fay Hansen-Smith
Chair, Ad Hoc Committee for Ph.D. in Biological Communication

FROM: Mildred H. Merz
Coordinator for Collection Development
Richard L. Pettengill
Librarian Liaison for Biological Sciences
Library

SUBJECT: Collection Evaluation for Proposed Ph.D.

DATE: March 31, 1999

It was hard to know how to begin doing a report of the library's ability to support the proposed Ph.D. in Biological Communication. Many of the journal titles that would seem to be relevant to the program are quite expensive. Several of these titles to which the library currently subscribes show low documented use and thus are being considered for cancellation. Other titles not held have costs up to \$15,000 per year. (While this high cost is unusual, costs of over \$2,000 per title are not uncommon.) Another matter to consider is the fact that most all of the relevant titles to which the library does not have current subscriptions are available at area libraries--usually Wayne State University's Science/Engineering or Medical libraries. Articles from most of these "not held" titles are also available for faxing within a day through UNCOVER (cost paid by the library). It is difficult to know what titles are essential to have on site and which titles it is sufficient to have only area or within one day access to specific articles. While electronic access to the journals would seem to be the solution to this dilemma, this is not a cost saving solution. Full text electronic subscriptions to scientific titles usually require a print subscription plus often even a surcharge for the online version.

Appendix A Journals Relevant to Program to Which Library Currently Subscribes

AMERICAN JOURNAL OF BACTERIOLOGY
AMERICAN JOURNAL OF HUMAN GENETICS
AMERICAN JOURNAL OF PHYSIOLOGY

ANALYTICAL BIOCHEMISTRY
ANATOMICAL RECORD
ANNUAL REVIEW OF BIOCHEMISTRY
ANNUAL REVIEW OF CELL AND DEVELOPMENTAL BIOLOGY
ANNUAL REVIEW OF MICROBIOLOGY
APPLIED AND ENVIRONMENTAL MICROBIOLOGY
ARCHIVES OF BIOCHEMISTRY AND BIOPHYSICS
ARCHIVES OF MICROBIOLOGY
BEHAVIORAL NEUROSCIENCE
BIOCHEMICAL AND BIOPHYSICAL RESEARCH COMMUNICATIONS
BIOCHEMICAL JOURNAL
BIOCHEMISTRY
BIOCHEMISTRY AND CELL BIOLOGY
BIOCHIMICA ET BIOPHYSICA ACTA (most but not all parts)
BIOLOGICAL BULLETIN
BIOPHYSICAL JOURNAL
CANADIAN JOURNAL OF MICROBIOLOGY
CANCER RESEARCH
CELL
COMPARATIVE BIOCHEMISTRY AND PHYSIOLOGY--A, B, C
DEVELOPMENT
DEVELOPMENTAL BIOLOGY
EMBO JOURNAL
EXPERIMENTAL CELL RESEARCH
FASEB JOURNAL
GENETICS
GENOME
JOURNAL OF BACTERIOLOGY
JOURNAL OF BIOCHEMISTRY
JOURNAL OF BIOLOGICAL CHEMISTRY
JOURNAL OF CELL BIOLOGY
JOURNAL OF CELL SCIENCE
JOURNAL OF CELLULAR PHYSIOLOGY
JOURNAL OF EUKARYOTIC MICROBIOLOGY
JOURNAL OF IMMUNOLOGY
JOURNAL OF PHYSIOLOGY
JOURNAL OF VIROLOGY
MICROBIOLOGY (was JOURNAL OF GENERAL MICROBIOLOGY)
MICROBIOLOGY AND MOLECULAR BIOLOGY REVIEWS (was MICROBIOLOGICAL REVIEWS)
MOLECULAR AND CELLULAR BIOLOGY
NATURE
PLANT PHYSIOLOGY
PROCEEDINGS OF THE SOCIETY FOR EXPERIMENTAL BIOLOGY & MEDICINE
PROGRESS IN BIOPHYSICS AND MOLECULAR BIOLOGY

TISSUE AND CELL
VIROLOGY

Appendix B
Possibly Needed Journals for Biology Ph.D.

AMERICAN JOURNAL OF MEDICAL GENETICS \$6,495
BIOCHIMIE 92 cut published indicates "price on request"
BIOESSAYS \$495
BIOLOGICAL SIGNALS AND RECEPTORS (was BIOLOGICAL SIGNALS) \$391
BRAIN RESEARCH \$15,203 (includes at least 2 other titles)
CELL AND TISSUE RESEARCH \$4,564
CELL GROWTH AND DIFFERENTIATION \$360
CELL STRUCTURE AND FUNCTION \$124
CELLULAR AND MOLECULAR LIFE SCIENCES (was EXPERIENTIA 92 cut) \$1064
CURRENT MICROBIOLOGY \$507
DEVELOPMENTAL DYNAMICS 99 cut \$2,195
DNA AND CELL BIOLOGY \$748
EUROPEAN JOURNAL OF BIOCHEMISTRY 92 cut \$2,550
EUROPEAN JOURNAL OF CELL BIOLOGY \$1,077
FEBS LETTERS 92 cut \$4,252
FEMS MICROBIOLOGY LETTERS \$3,265
GENE 92 cut \$6,487
GENES AND DEVELOPMENT \$729
GENETICA 98 cut \$1,268
HORMONE AND METABOLIC RESEARCH 92 cut \$329
HORMONES AND BEHAVIOR 92 cut \$450
HUMAN MOLECULAR GENETICS \$795
INTERNATIONAL JOURNAL OF SYSTEMATIC BACTERIOLOGY \$145
JOURNAL OF BIOTECHNOLOGY \$2,404
JOURNAL OF COMPARATIVE NEUROLOGY \$13,900
JOURNAL OF ELECTRON MICROSCOPY 92 cut \$295
JOURNAL OF MICROSCOPY 92 cut \$969
JOURNAL OF MOLECULAR BIOLOGY 92 cut \$2,675
JOURNAL OF NEUROBIOLOGY \$2,495
JOURNAL OF NEUROSCIENCE \$1,285
LIFE SCIENCES 92 cut \$3,750
MOLECULAR AND CELLULAR ENDOCRINOLOGY 92 cut \$2,986
MOLECULAR AND GENERAL GENETICS 92 cut \$3,166
MOLECULAR BIOLOGY 92 CUT \$1,885
MOLECULAR BIOLOGY OF THE CELL \$425
MOLECULAR BIOTECHNOLOGY \$270
MOLECULAR BRAIN RESEARCH \$3,285 separately (included with BRAIN RESEARCH)
MOLECULAR CARCINOGENESIS \$1,250

MOLECULAR MICROBIOLOGY \$2,196
 NATURE GENETICS \$595
 NATURE BIOTECHNOLOGY \$595
 NEUROENDOCRINOLOGY \$1,572
 NEURON \$545
 NEUROSCIENCE \$5,365
 NEUROSCIENCE LETTERS \$4,662
 NUCLEIC ACIDS RESEARCH 98 CUT \$1,725
 ONCOGENE \$2,805
 PHOTOCHEMISTRY AND PHOTOBIOLOGY \$575
 SYSTEMATIC AND APPLIED MICROBIOLOGY \$584
 THEORETICAL AND APPLIED GENETICS 92 cut \$3,579
 TRANSGENIC RESEARCH could not locate price
 TRENDS IN MICROBIOLOGY \$844
 TRENDS IN NEUROSCIENCES \$844

Appendix C

Budget for Library Needs

		Year 1	Year 2	Year 3	Year 4	Year 5
New Journals*		\$25,000	\$27,000	\$30,250	\$33,275	\$36,600
Preservation of targeted journals		2,500	2,750	3,025	3,328	3,660
Current Contents-Life Sciences		2,000	2,000	2,000	2,000	2,000
Biosis searching for grad students		850	850	850	850	850
Uncover subsidy		2,000	2,000	2,000	2,000	2,000
TOTALS		\$ 32,350	\$ 35,100	\$ 38,125	\$ 41,453	\$ 45,110

*Obviously the amount here could vary from \$0 to \$100,000. We just picked \$25,000 as an amount that would allow definite strengthening of the journal collection. We have budgeted the \$25,000 for new journal subscriptions during the first year and have then presumed that these titles will inflate at 10% a year. No additional new subscriptions are built in after year 1. No costs for backfiles are budgeted. If these were to be needed, cost for one year backfile would be approximately cost of a one year subscription.