

University of Hawai'i Code Request Form

I. REQUESTOR CONTACT INFORMATION

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 Title: Assoc. Dean for Academic Affairs

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Email Address: Fishere@hawaii.edu

Campus/Office/Department/Address: University of Hawai'i - Hilo
 College of Pharmacy
 200 West Kawili St.
 Hilo, HI 96720

Action Requested:

- NEW Program Code (new major/concentration, etc.)
 - NEW Subject Code
 - Change of existing code
- Type (subject, program, etc): _____

Old: _____
 New: _____
 OTHER: _____

II. CODE REQUEST

Academic program code preferences for consideration:

NEW Program Code Effective Term (semester/year): Fall 2011
 Major: PHD - PHRS Major Description: _____ Is this major financial aid eligible? YES NO
 Is the major code being used the same way at other UH campuses? YES NO Comment: _____
 Does the same or similar major code exist in Banner? YES NO If YES, please list code: _____

Concentration (if applicable): NA Concentration Description: _____
 Is the concentration code being used the same way at other UH campuses? YES NO
 Does the same or similar concentration code exist in Banner? YES NO If YES, please list code: _____
 Attach concentration to program code? YES NO

Level: Undergraduate Graduate First-Professional Other: _____
 Degree/Certificate: PHD
 College: College of Pharmacy Department: _____

If requesting a program name change, will current students be grandfathered in under the old program name? YES NO

If requesting a program name change, will the old code be available for:

Recruitment?	<input type="checkbox"/> YES	<input type="checkbox"/> NO	List the end term of old code:	_____
Admissions?	<input type="checkbox"/> YES	<input type="checkbox"/> NO	List the end term of old code:	_____
General Student?	<input type="checkbox"/> YES	<input type="checkbox"/> NO	List the end term of old code:	_____
Academic History?	<input type="checkbox"/> YES	<input type="checkbox"/> NO	List the end term of old code:	_____

NEW Subject Alpha/Code Effective Term (semester/year): _____
 Code: _____ Description: _____
 College: _____ Department: _____
 Does the same or similar subject code exist in Banner? YES NO If YES, please list code: _____
 Is the subject code being used the same way at other UH campuses? YES NO

**University of Hawai'i
Code Request Form**

OTHER: _____

Please briefly describe your request and explain why you are requesting the codes: _____

III. SUPPORTING DOCUMENTATION

Please attach the required supporting documentation. See *Guide to Academic Program Actions and Approval* at:
http://www.hawaii.edu/vpaa/cms/guide_to_acad_prog_121006.pdf

- BOR minutes from _____ (date) meeting with supporting documentation provided to BOR
- Memo from campus Chancellor
- Signed memo from UH President
- None required according to the Guide to Academic Program Actions and Approval

IV. CAMPUS VERIFICATION

The appropriate parties (faculty, administrators, registrar) have been consulted.

Edward Fisher
Name of Requestor (print or type)


Signature

Date

Send completed form with supporting documentation to:

Institutional Research Office (Attn: Lynn Inoshita or Christine Shaw) • 1633 Bachman Place • Sinclair Annex 2, Room 4 • Honolulu, HI 96822
Fax: 808-956-9870 Phone: 808-956-7532

For Internal Use Only:

Appropriate Documentation Received: YES NO
Approval Status:
Major code: YES NO
Concentr. code: YES NO
Program code: YES NO
Subject code: YES NO

NOTES:

Entered into SMAPRLE/SOACURR: _____
Entered into STVMAJR: _____
Entered into STVSUBJ: _____

Code processing completion date: _____
Copies sent to: _____

UNIVERSITY OF HAWAII AT HILO

UH Hilo Administration
Office of the ChancellorBOR APPROVED
2/24/11ec: J. Itano
P. Imada Iboshi
D. Mongold

February 14, 2011

UNIVERSITY OF HAWAII
BOARD OF REGENTSMEMORANDUM

11 FEB 14 P4:42

TO: Howard Karr
Chairperson, Board of RegentsVIA: M.R.C. Greenwood
President*M.R.C. Greenwood*FROM: *Donald O. Straney*
Donald O. Straney
Chancellor, University of Hawai'i at HiloSUBJECT: Authorization to Establish as a Provisional Program the Ph.D. in
Pharmaceutical Sciences at the University of Hawai'i at HiloSPECIFIC ACTION REQUESTED:

It is requested that the Board of Regents approve establishment of a provisional new degree program, the Ph.D. in Pharmaceutical Sciences, to be administered by the College of Pharmacy at the University of Hawai'i at Hilo (UH Hilo).

ADDITIONAL COST:

No additional cost. As described in the program proposal, there are absolutely no requests for any additional resources to implement this program. When the College of Pharmacy was started in 2007, implementation and phasing in of the Ph.D. program was taken into account. The existing faculty members who will participate in the program are listed in the document. In addition, three additional Ph.D.-level faculty members are currently being recruited in the Department of Pharmaceutical Sciences (over 75 applications have been received), and it is likely that at least three of the faculty members currently being recruited in the Department of Pharmacy Practice will either have a Ph.D. or a PharmD/Ph.D. The number of faculty listed in the revenue template provides an indication of the number involved in the didactic portion of the curriculum. Faculty members who have been involved in planning and preparation of course syllabi are now ready to deliver. Many additional faculty members will be involved in research training, but these individuals are already conducting active research programs so the new graduate students will simply be incorporated. All necessary equipment is in place and the new graduate students will have access. Further, all College of Pharmacy faculty members involved in research have postdoctoral associates working in their laboratories. In addition to faculty members, these postdoctoral associates will be supportive in providing practical training for

Howard Karr
February 14, 2011
Page 2

graduate students. In sum, due to cogent planning and success in meeting all benchmarks, the College of Pharmacy has full confidence in being able to launch a high quality graduate program without the necessity of requesting any additional internal resources.

RECOMMENDED EFFECTIVE DATE:

Fall 2011

PURPOSE:

At the present time, the College of Pharmacy provides training and experience leading to the Doctor of Pharmacy (PharmD) degree. The PharmD provides many career opportunities, largely centered on the profession of pharmacy. The PharmD program has been very successful; the first student pharmacists will graduate in May 2011.

In addition to offering curricula leading to the PharmD, all top-ranked and academically sound schools and colleges of pharmacy offer Ph.D. level programs. There is evidence these colleges have a distinct competitive advantage through research excellence, and this advantage is likely to enhance program stability and sustainability relative to programs that do not have this research capacity. The Ph.D. is viewed as the highest academic degree, and the Ph.D. in Pharmaceutical Sciences will provide our residents with a cadre of career opportunities never before available.

The degree will prepare graduates to be scientists with extensive skills in research design, techniques and methodologies. Graduates can serve the academy as faculty members. Alternatively, they will be well qualified to meet demand and make advances in a broad range of additional settings, including industrial, governmental, clinical, retail, marketing, and consultancy.

In addition to providing our residents an opportunity to obtain a Ph.D. in the Pharmaceutical Sciences without having to leave the State, this program will spawn a culture of pharmaceutical-based research here in Hawai'i that is entirely consistent with the vision of the UH system. As stated by President Greenwood "As the sole public institution of higher education, the University of Hawai'i plays a key role in building Hawai'i's educational and economic future... and this will be achieved by...Increasing the number of college graduates by 25 percent by 2015, contributing through research, innovation and technology transfer, and ensuring our campuses and facilities reflect our mission as a 21st-century university built on excellence."

At the present time, College of Pharmacy faculty members are actively engaged in high quality research programs. By adding the next tier of education and training to College, the Ph.D. in Pharmaceutical Sciences, we will be poised to help deliver on significant parts of the System goals alluded to above. The program will significantly elevate the culture of research, development and technology transfer in the pharmaceutical sciences. As the program grows and matures, further opportunities for extramural funding, collaboration, and growth will follow. Faculty success will be further assured.

Hawai'i, and the UH System in particular, is ideally positioned to become part of the anticipated future growth in the western use of Indian and Chinese Traditional Medicines, as well as the growth in the Asian pharmaceutical market place. Work in the area of new drug discovery and development will be incorporated into the Ph.D. program. The program will contribute to the development of young industries already taking root within the State.

The importance of implementing this Ph.D. program is widely recognized by community leaders, local entrepreneurs, academics within the UH system, and perspective students. No such program currently exists within the UH System, the State of Hawai'i, or the Pacific Region.

In sum, comprehensive planning is complete, no obstacles are apparent, all resources are available, and there is an obvious need for this new Ph.D. program. We seek Board approval to initiate the program of study.

BACKGROUND INFORMATION:

Pursuant to Board of Regents Policy 5-1, the Board of Regents has the authority to approve new degree programs upon recommendation by the President.

The University of Hawai'i at Hilo College of Pharmacy currently offers a curriculum leading to the Doctor of Pharmacy (PharmD). The first class of student pharmacists will graduate in May 2011. The PharmD is required to gain licensure for professional practice as a pharmacist. The College is now perfectly positioned to offer a Ph.D. in the Pharmaceutical Sciences. This will be the first program of this type to be offered by the University of Hawai'i, and the only program of this type offered in the State of Hawai'i and in the Pacific region generally.

Implementation of the Ph.D. program is essential for the continued growth and development of the College. Since the program was premeditated since the time the College was founded, no additional funds or resources are required or being requested. Well-qualified mentors are in place and poised to accept graduate students. Extramural funding has been obtained from the National Institutes of Health. State-of-the-art

equipment is available for the conduct of world-class research. At the same time, the program nicely interfaces with related research programs that are in place at our flagship campus, and it is fully consonant with work force and technology development plans that have been spearheaded by the UH System.

Realization of the Ph.D. program forms an integral part of the College of Pharmacy overall mission. Active planning for the Ph.D. curriculum has been ongoing for about two years. Based on the present stage of development, the College of Pharmacy has the expertise, critical mass, and proven organizational skills for effective Ph.D. program implementation. We have established:

- The program has adequate resources available for success.
- There are no cross-program or departmental implications.
- The program reflects intellectual rigor and teaching excellence.
- Program coherence has been addressed.
- There is no impact on course and seat capacity.
- The program is consistent with the University Mission and Strategic Plan.
- The program will enhance the research output of faculty advising graduate students and so increase their ability to successfully secure extramural funding.
- The program will result in the development of new industry and business opportunities in the State.
- The program is unique within the UH System.
- The program leverages unique internal competence and a unique environmental setting.
- Within the State and throughout the Pacific, only the College of Pharmacy at UHH has the expertise and resources needed to launch this program.

This program will provide graduate training in the Pharmaceutical Sciences for students with a PharmD, MS or BS degree, and those currently working in the field. Studies will culminate with the award of a Ph.D. in Pharmaceutical Sciences, with an emphasis on natural products discovery and development and their importance in pharmacy and healthcare in general. The program will utilize the extraordinary intellectual, biological, physical and cultural diversity on the Island of Hawai'i, and within both the State and Asia-Pacific Region, as a focus of investigation and study. The program will prepare students for senior leadership positions in the pharmaceutical sciences in academia, research, education, government, industry and related fields. It will prepare leaders who can identify, research, and problem solve issues related to the pharmaceutical sciences. The program will foster the development of students as critical thinkers, team players, self-directed interdisciplinary scholars and communicators. The program will provide enhanced research opportunities for PharmD and post-doctoral fellows. As the program develops, the University of Hawai'i will increasingly be recognized as the center of excellence in pharmaceutical research, discovery, development and education in the Pacific Basin.

Housed in the College of Pharmacy, the Ph.D. in Pharmaceutical Sciences complements the PharmD degree. A graduate program exposes students to career prospects beyond the practice of pharmacy and creates new opportunities to enter into the pharmaceutical industry and academia. An active graduate program will give the professional student the chance to consider career options including drug discovery, pharmaceuticals, medicinal chemistry, pharmacology, or clinical research before committing to a particular career path.

Additionally, the program will greatly enhance the intellectual depth and breadth of the College and Campus community through seminar programs, discussion groups and campus lectures. The diverse scientific perspectives brought to the College, not just by the faculty but also by graduate students and postdoctoral fellows from a variety of backgrounds, will all contribute to the advancement of scholarship, which in turn will lead to an increase in the exposure of our programs to the scientific and industrial community and potential sources of funding.

To conclude, establishment of the Ph.D. in the Pharmaceutical Sciences within the College of Pharmacy at the University of Hawai'i at Hilo, will provide unique opportunities for residents of the State of Hawai'i. The program will ensure an adequate supply of scientists for future jobs, make a unique contribution to the multi-billion dollar healthcare industry within the State, and promote new research, development and technology transfer in an area that is critically lacking within the State. The program will serve as an important legacy for generations to come.

ACTION RECOMMENDED:

It is recommend that the Board of Regents approve establishment of a provisional new degree, the Ph.D. in Pharmaceutical Sciences, to be administered by the College of Pharmacy at the University of Hawai'i at Hilo, effective Fall 2011.

Attachment - Ph.D. in Pharmaceutical Sciences program proposal

N.B. A hard copy and an electronic copy of the full proposal (over 800 pages) will be available at the BOR office.

c: Keith Amemiya, Interim Executive Administrator and Secretary of the Board of Regents

Proposal for PhD in Pharmaceutical Science

UNIVERSITY of HAWAII[®]
HILO



February 10, 2011

**Proposal for Establishment of a
PhD
in Pharmaceutical Science**

College of Pharmacy

University of Hawaii at Hilo

Proposal for Establishment of a PhD Program in Pharmaceutical Science

Administrative Locus	College of Pharmacy, University of Hawaii at Hilo
Planning Committee	Robert P. Borris, Edward Fisher, Daniela Gündisch, Kenneth Morris, Karen Pellegrin, Anthony D. Wright (Chair)
Program Category	New (CoP-UHH)
Department/Program	College of Pharmacy
Degree Proposed	PhD in Pharmaceutical Science
Proposed Date of Implementation	Fall 2011

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Proposal for PhD in Pharmaceutical Science

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Proposal for PhD in Pharmaceutical Science

1. Executive Summary - Background

The University of Hawaii at Hilo College of Pharmacy (CoP) currently offers a curriculum leading to the Doctor of Pharmacy (PharmD). The first class of student pharmacists will graduate in May 2011. The PharmD is required to gain licensure for professional practice as a pharmacist. The College is now perfectly positioned to offer a PhD in Pharmaceutical Science. This will be the first program of this type to be offered by the University of Hawaii, and the only program of this type offered in the State of Hawaii and in the Pacific region in general. Implementation of the PhD program is essential for the continued growth and development of the College. Since the program has been planned from the time the College was founded, no additional funds or resources are being requested. Well-qualified mentors are in place and poised to accept graduate students. Extramural funding has been obtained from the National Institutes of Health. State-of-the-art equipment is available for the conduct of world-class research. At the same time, the program nicely interfaces with related research programs that are in place at our flagship campus, and is fully consonant with work force and technology development plans that have been spearheaded by the UH System. Details of the program are described herein.

Every school or college of pharmacy offers a curriculum leading to the PharmD. In addition, however, top-ranked and academically sound schools and colleges offer PhD level programs. In part, this is central to the success of the profession. The PharmD graduate can enter professional practice or meet the clinical needs of an academic pharmacy program; the PhD graduate can become a faculty member and meet the pharmaceutical science needs of an academic pharmacy program. In addition to educating PharmD students in areas of science and technology, the PhD faculty member assures the availability of well qualified academics in the pharmaceutical sciences who will continue to train and develop the generations of pharmacy educators and researchers that will follow. In addition to serving the academy, PhD graduates are well qualified to meet demand and make advances in a broad range of settings, including industrial, governmental, clinical, retail, marketing, and consultancy. Overall, implementation of this new PhD program will provide our residents with a cadre of career opportunities never before available.

As noted above, implementation of the PhD program forms an integral part of the College of Pharmacy mission. Based on the present stage of development, having the required expertise, critical mass, and proven organizational skills for implementation of an effective PhD program can be stated with confidence. We have established:

- The program has adequate resources available for success.
- There are no cross-program or departmental implications.
- The program reflects intellectual rigor and teaching excellence.
- Program coherence has been addressed.
- There is no impact on course and seat capacity.
- The program is consistent with the University Mission and Strategic Plan.
- The program will enhance the research output of faculty advising graduate students and so increase their ability to successfully secure extramural funding.
- The program will result in the development of new industry and business opportunities in the State.
- The program is unique within the UH System.
- The program leverages unique internal competence and a unique environmental setting.
- Within the State and throughout the Pacific, only the College of Pharmacy at UHH has the expertise and resources needed to launch this program.

This program will provide graduate training in the pharmaceutical sciences for students with a PharmD, MS, BA or BS degree, and perhaps others currently working in the field (e.g., MD, DVM, JD). Studies will culminate with the award of a PhD in Pharmaceutical Science, with an emphasis on natural products discovery and development and their importance in pharmacy and healthcare in general. The program will utilize the extraordinary intellectual, biological, physical and cultural diversity on the Island of Hawaii, and within both the State and Asia-Pacific Region, as a focus of investigation and study. The program will prepare students for senior leadership positions in the pharmaceutical sciences in academia, research, education, government, industry and related fields. The program will yield leaders who can identify, research, and problem solve issues related to the pharmaceutical sciences. The proposed PhD program is

Proposal for PhD in Pharmaceutical Science

designed to foster the development of a student as a critical thinker, team player, self-directed interdisciplinary scholar and communicator. The program will provide enhanced research opportunities for PharmD and post-doctoral fellows.

The graduate program will open many doors for our students and faculty alike. As mentioned above, one of the primary duties of a university is to train the next generation of scientists and teachers; graduate students and post-doctoral fellows who will be pursuing research in the College under the supervision and mentoring of the College of Pharmacy faculty. Addition of these future professionals to the system will greatly enhance the intellectual depth and breadth of the college and campus community through seminar programs, discussion groups and campus lectures. The diverse scientific perspectives brought to the College, not just by the faculty but also by graduate students and post-doctoral fellows from a variety of backgrounds, will all contribute to the advancement of scholarship, which in turn will lead to an increase in the exposure of our programs to the scientific and industrial community and potential sources of funding. As the program develops, the University of Hawaii will increasingly be recognized as the center of excellence in pharmaceutical research, discovery, development and education in the Pacific Basin.

The PhD in Pharmaceutical Science complements the PharmD degree. The graduate program exposes PharmD students to career opportunities beyond the practice of pharmacy and creates new opportunities to enter into the pharmaceutical industry and academia. An active graduate program will give the professional student an opportunity to consider career options including drug discovery, pharmaceuticals, medicinal chemistry, pharmacology, or clinical research, before committing to a particular career path.

The PhD in Pharmaceutical Science prepares graduates to be scientists with extensive skills in research design, techniques and methodologies. Analysis of available faculty data nationwide reveals the demand for faculty members continues to grow as new pharmacy schools open and current schools expand their professional programs to address pharmacy workforce issues. It was estimated by an AACP (American Association of Colleges of Pharmacy) task force in 2006-2007 that over the following 10 years, faculty demand will increase by about 20%, as approximately 422 faculty will retire and 400 new positions will be created due to program expansion [1]. Further, this level of growth occurs in the face of a current vacancy rate of about 10% (427 positions are currently open). Three-fourths of the schools and colleges surveyed reported vacant or lost faculty positions in 2005-06. All of these data suggest there will be continuous need for PhD graduates over the long term.

It is not only academia that will require PhD graduates but also government and industry [2]. These findings argue well for the future of the profession of pharmacy and for graduates of the proposed PhD program, especially when one realizes the number of positions available for new graduates is greater than the actual number [2, 3]. The demographics of age and disease states in the nation generate significant pressure on all aspects of health care. This mandates the need for scientists to discover and develop new drugs for the public, and has particular relevance to the ever increasing expansion of the Asian market [4]. Our graduates will be well positioned to contribute in these areas.

All top American universities that have a College of Pharmacy offer a PhD in the pharmaceutical sciences [3, 5]. There is evidence these colleges have a distinct competitive advantage through research excellence, and this advantage is likely to enhance program stability and sustainability relative to programs that do not have this research capacity [5]. As well as serving to ensure the stability and continued success of our College, and providing our residents an opportunity to obtain a PhD in Pharmaceutical Science without having to leave the State, this program will spawn a culture of pharmaceutical-based research here in Hawaii that is entirely consistent with President Greenwood's vision for the UH system. President Greenwood states "As the sole public institution of higher education, the University of Hawai'i plays a key role in building Hawai'i's educational and economic future... and this will be achieved by us...increasing the number of college graduates by 25 percent by 2015, contributing through research, innovation and technology transfer, and ensuring our campuses and facilities reflect our mission as a 21st-century university built on excellence" [6].

The importance of having this nucleus of research and development expertise present within the University and the State is widely recognized by community leaders, local entrepreneurs, and academics within the UH system (see letters of support Appendix A). The value of the PhD program for the establishment and growth of a research, development and technology transfer culture within the College of Pharmacy is

Proposal for PhD in Pharmaceutical Science

apparent. At the present time, faculty members are actively engaged in high quality research programs. Of the 26 faculty involved in the program, 19 are actively involved in research on a day to day basis, in areas that cover all aspects of the pharmaceutical sciences. Some specific projects being undertaken involve: investigation of important drugs for their overall stability (Pharmaceutics); drug design and synthesis of compounds with nicotinic receptor inhibition or potentiation activity (Medicinal Chemistry); cancer chemoprevention (Pharmacology); screening and synthesis of compounds for their anticancer, anti-TB and antimalarial activities (Medicinal Chemistry, Pharmacology, Pharmacognosy); efficacy of short-term vitamin D supplementation in metabolic syndrome patients (Clinical); Advanced characterization of pharmaceutically relevant natural products with hyperspectral imaging and chemometrics (Pharmaceutics, Pharmacognosy); and, invasion activity of breast cancer cell lines and its regulation by phenazines (Pharmacology). Together with the faculty, the CoP is currently populated with 20 post-doctoral associates, four visiting scholars, seven research assistants, and four to eight regular volunteers, who are supported by funds from various sources including; \$9 million over the next five years from an INBRE NCCR/NIH grant; \$669,875 for the period 2009-2014 from a National Science Foundation-EPSCOR-III grant; \$30,000 from UHH starter grants; and, \$50,000 from the Hawaii Community Foundation (HCF).

By adding the the next tier of education and training to College, the PhD in Pharmaceutical Science, faculty success will be further assured. We will be poised to help deliver on significant parts of the University System goals for the 21st Century, as articulated by President Greenwood [6]. As the program grows and matures, further opportunities for extramural funding, collaboration, and growth will follow. Hawaii, and the UH System in particular, is ideally positioned to become part of the future anticipated growth in the western use of Indian and Chinese Traditional Medicines [7-9], growth in the Asian pharmaceutical market place [4], as well as to contribute to the next stage of development of young industries already taking root within the State (see Appendix A, letters of support).

To conclude, establishment of the PhD in Pharmaceutical Science within the College of Pharmacy at the University of Hawaii at Hilo will provide opportunities for residents of the State of Hawaii that currently do not exist. The program will ensure an adequate supply of scientists for future jobs, make a unique contribution to the multi-billion dollar healthcare industry within the State [10], and promote new research, development and technology transfer in an area that is critically lacking within the State. The program will serve as an important legacy for generations to come.

2. Program Objectives

This program will provide graduate training in the pharmaceutical sciences for students with a PharmD, MS or Baccalaureate Degree, and those currently working in the field with advanced degrees. Studies will culminate with the award of a PhD in Pharmaceutical Science, with an emphasis on natural products and their importance in pharmacy. The program will utilize the extraordinary intellectual, biological, physical and cultural diversity on the Island of Hawaii, and within both the State and Asia-Pacific Region, as a focus of investigation and study. The program will prepare students for senior leadership positions in the pharmaceutical sciences in academia, research, education, government, industry and any related fields - leaders who can identify, research, and problem solve issues related to the pharmaceutical sciences. The proposed PhD program is designed to foster the development of students as critical thinkers, team players, self-directed interdisciplinary scholars and communicators. The program will provide enhanced research opportunities for PharmD and post-doctoral students. The program will capitalize on the wealth of knowledge and experience of the faculty and in so doing potentiate their knowledge and skills to ensure the College is seen as a center of excellence in pharmaceutical-based research. The program will develop capacity to attract investors and promote technology transfer.

Specific objectives:

- To provide a meaningful and important course of study available nowhere else within the State of Hawaii and to some extent nowhere else within the US.
- To ensure places exist within the program to train as many local students as is practicable.
- To enhance academic rigor and scholarship within the CoP and UH Hilo in general.
- To leverage the research expertise of CoP faculty.
- To develop a community research partnership, process, and protocol for understanding the diversity of natural products originating in Hawaii, the Pacific, and around the world and their applications to healing in a culturally respectful way.
- To advance the science of pharmacy and pharmaceutical sciences on the international stage.
- To create a pharmaceutical technology research center for dosage form design and characterization based on the precepts of Quality by Design.
- To foster knowledge of and help direct current trends and issues in pharmaceutical sciences including basic and applied research and natural resource issues.
- To provide participants with specific experiences in conceptual and technical research areas in the pharmaceutical sciences, e.g., Pharmaceutics, Pharmacognosy, Medicinal Chemistry, Pharmacology, as well as in exploring the natural environment, marine and terrestrial, for potentially economical important natural products.
- To promote research and scholarly activities that will enable participants to successfully develop a resume suited to successfully pursue a career in the pharmaceutical and related industries.
- To offer new career training options to undergraduate and pharmacy students within the UH System, Statewide and throughout the Asia-Pacific Basin.
- To develop methods and/or innovations in analytical processes and technologies relevant to natural product research and discovery and drug safety.
- Develop a center of biotechnological expertise that will foster new business development within the State.
- Create opportunities for businesses to locate in Hawaii that have traditionally been mainland based.
- Create a culture of excellence in research, development and translational science.
- Provide opportunities for residents of the State of Hawaii that currently do not exist.
- Ensure the College's potential to become the driving force for new industrial and business investment is realized by the creation of direct links with potential industrial and business partners.
- Establish from its inception the culture of excellence at all levels within the program is maintained at bench mark levels of other UH PhD programs.
- To support President Greenwood's vision for building Hawaii's educational and economic future as outlined in her document available at <http://www.hawaii.edu/offices/op/2010/initiatives-brochure.pdf> entitled, "The University of Hawaii for the 21st Century."

To accomplish these objectives the program will ensure that Graduate Students within the program will:

Proposal for PhD in Pharmaceutical Science

- Complete the seven stages for a successful PhD in any technical discipline:
 1. Identify a problem/question.
 2. Form a hypothesis.
 3. Develop a model.
 4. Design an experimental strategy to test the hypothesis.
 5. Execute experimental plan.
 6. Interpret the data against the hypothesis.
 7. Report the results in a dissertation and peer reviewed publications.
- Develop state-of-the-art skills in the pharmaceutical sciences.
- Perform scientific research that will advance knowledge in the interdisciplinary field of pharmaceutical sciences.
- Be educated and trained to use advanced technological equipment in order to perform quantitative analysis and be able to interpret complex data.
- Learn how to apply research findings.
- Present research findings at local, national and international forums.
- Learn how to prepare scientific publications and proposals.
- Interpret and critique professional scientific literature.
- Undertake an original individual research project leading to a PhD dissertation.
- Develop an understanding of the importance of the concept of translation research.
- Be able to identify what aspects of their individual program may be usefully transferred to some applied research program.
- Pass qualifying exams by the end of their third academic year.
- Write and successfully defend their dissertation.
- Learn the importance of basic and applied research for underpinning future growth and development of pharmaceutical-related industries and business in Hawaii.

From the faculty standpoint, program objectives will be accomplished, further extended and developed, through the collective expertise of those individuals involved directly with delivering the courses and guiding the research within the College of Pharmacy. The faculty will be assisted by a graduate program director and will be responsible for maintaining the quality of admission requirements, curricular and program requirements, candidacy, comprehensive exams, and dissertation research that is original, independent, and a significant contribution to the field. It is also anticipated that these same faculty will be the ones who will ensure that their own didactic and research programs, and hence the program in general, becomes so competitive that the College as a whole will become recognized as a leader in selected areas of pharmaceutical research and development.

3. Relationship of the Program to BOR criteria

The relationship of the PhD program to the seven BOR criteria for establishment of new programs are given in the form of references to specific sections and references within the planning document below each criterion.

1. The direct relevance of the contribution of the field of study to the professional, economic, social, occupational and general educational needs of Hawai'i.

This is a totally unique program that fills an important niche in the State of Hawaii. The specific ways in which the program contributes to the professional, economic, social, occupational and general educational needs of Hawai'i are described in Sections 2, 6 and 7 as well as in letters of support and interest (Appendices A and B).

2. A "national needs factor" that emphasizes the direct relevance of the contributions of the field of study to national needs and where Hawai'i and the University have unique or outstanding resources to respond with quality.

The UH Hilo College of Pharmacy was started in 2006. The discipline of pharmaceutical science is

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now well established. Together with state-of-the-art equipment and the natural resources of the Big Island, the State of Hawaii and the Pacific as-a-whole, there is no better place to start this new program. Additional details are presented in 2, 6 and 7 as well as in letters of support and interest (Appendices A and B).

3. An "international needs factor" that emphasizes the direct relevance of the contributions of the field of study to international needs and where Hawai'i and the University have unique or outstanding resources to respond with quality.

Pharmaceutical science is an international discipline that will meet unique needs throughout Asia, the Pacific Region, and the rest of the world. The UH Hilo College of Pharmacy is well positioned to become one of the top programs of its type in the world. Further details are given in Sections 2, 6 and 7 as well as in letters of support and interest (Appendices A and B).

4. An educational needs factor that indicates the direct relevance of a field of study to basic educational needs for which there is a demand by Hawai'i's population.

This will be the first and only program of this type in Hawaii. We have established a need for the program and there is demand in Hawaii as described in Sections 2, 6, and 7 as well as in the letters of support and interest (Appendices A and B).

5. The relevance of a field of study as a necessary supporting discipline for quality programs identified by the above criteria.

The PhD program in pharmaceutical sciences is critical for the success of the development of the College of Pharmacy. All high quality colleges of pharmacy have graduate programs that complement the professional program. We are ready to launch the program now. Further details are presented in Sections 2, 6, and 7 as well as in letters of support and interest (Appendices A and B).

6. A qualitative assessment of the program in relation to competing demands for resources by new programs and continuing programs. Such assessment will include among other information, program reviews, student performance and placement, accreditation reports, and faculty resources.

This is a new program that has been in premeditated since the creation of the College of Pharmacy, and undergoing active planning for about two years. There are no competing demands and the program will enhance existing activities. All necessary resources are available. Firm plans are in place for assessment. A more detailed description is given in Sections 8, 9, 10, and 11.

7. An assessment of productivity and cost/benefit considerations within the overall context of campus and University "mission" and planning priorities.

The College of Pharmacy was founded based on the premise of striving for excellence, and thereby it was anticipated the PhD in Pharmaceutical Science would be introduced at the appropriate time. As a result, the cost/benefit ratio is very favorable and implementation of the program will increase productivity. Fostering development of the College of Pharmacy is a high priority that conforms perfectly to the UH mission and all strategic plans. More information is provided in Section 10.

4. Relationship to Other Programs

It is expected that the PhD in Pharmaceutical Science will both assist with retention of students within the UH System by providing them with an option for post graduate studies here within the State and make UH an even more attractive option for study for those students who in the past would not have considered coming to Hawaii or staying in Hawaii for their continued education.

It is anticipated that for the first year or two, the program will be "stand alone" within the College of Pharmacy and, as such, will have a minimal effect on other programs within UH System as it will have no direct relationship. In the medium to long term, however, other programs may contribute to and benefit

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from the development of this program. Indeed, it is hoped that the UH System as a whole will benefit greatly from having a PhD program in the pharmaceutical sciences. Logical contributors in the future would be from any of the scientific disciplines on the UHH campus and from JABSOM and UH Cancer Center. As stated by Dr. Vogel in his letter of support: "A PhD program in Pharmaceutical Sciences will not only provide additional PhD-level opportunities for students from Guam but would also strengthen the overall breadths and depth of cancer research at UH as well as our long-term partnership with the University of Guam." As the program grows and becomes firmly established, other such collaborations and relationships are anticipated to develop over time.

Many tangible examples of meaningful interactions of the College of Pharmacy with the flagship campus are currently available. Six clinical faculty members are currently based in Honolulu (full-time), and this will grow to approximately 10 in the future. At some time in the future, these faculty members may participate in the PhD program if clinical expertise is required. In addition, the CoP serves as the administrative center of a federally-funded \$16 M Beacon Community. Seven investigators in the CoP serve as Principal Investigators of the University of Hawaii's INBRE II: Hawaii Statewide Research and Education Partnership (HSREP), and a research core within the CoP is supported by this grant. Several CoP faculty members are members of the UH Cancer Center (Bachmann, Boris, Chang, Guendisch, Jacobs, Konorev, Pezzuto, Wright). Drs. Bachmann, Pellegrin and Pezzuto hold joint appointments in JABSOM. The CoP supports initiatives such as the Queen's COBRE application "Molecular Targets and Health Disparities in Cancer" and other programmatic initiatives based in JABSOM. The CoP has served as a partner in a HRSA-supported Geriatrics Center. Clearly, a synergistic relationship has been developed, and we look forward to strengthening the partnership once the PhD program is established.

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5. Comparison with Similar Programs at Comparable Institutions

The PhD in the Pharmaceutical Science at the College of Pharmacy, UH Hilo will focus on the four main areas that come under the heading of the pharmaceutical sciences with an emphasis on Hawaii as a natural laboratory and natural products and a scientific natural resources in general. The main topic areas will be:

- Medicinal Chemistry
- Pharmaceutics
- Pharmacology
- Pharmacognosy

The Core subjects of the program will be completed in year one followed by a minimum of another three years of electives and research that will be grounded in the four main topic areas listed above. The elective and research offerings will enable all candidates to gain not only an overall graduate education in the pharmaceutical sciences generally but also to focus on an area of specialization. A potential typical course outline for our PhD program is given in the first column below, and this is compared with four other programs from around the country. Credit hours are given in parentheses, e.g., (3).

Semester and Year	Pharmaceutical Sciences University of Hawaii at Hilo Course	Drug Discovery Sequence Nova Southeastern University Course (Data from four year program)	Medicinal Chemistry University of Utah Course (This data is extracted from a seven year PharmD / PhD course)	Pharmacognosy University of Illinois at Chicago (The actual timing of courses listed is an abstraction for ease of comparison. Actual semester course timing might be different from that presented)	Pharmacology and Toxicology University of Arizona Course
P1 Fall	PhD Advanced Introduction to the Pharmaceutical Sciences (3)	Bioethics (3)	Basics Pharm Sci (3)	Advanced Pharmacognosy (4)	Biostatistics, or Statistics or Biochemistry Deficiency (3)
	Advanced Pharmaceutics I with Dosage form Design and Processing (3)	Clinical Pharmacy or Elective (3)	Physiol Chem i (4)	Pharmacognosy Research Methods (3)	General and Systems Toxicology (3)
	PhD Biochemistry – Biomolecules (4)	Biostatistics I (3)	Electives (3)		Genomics and Proteomics (2)
	Graduate Seminar and visit each research lab and interview with lab	Graduate Research (2)		Pharmacognosy Rotation (2)	Advanced Toxicology (1)

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	leader (1)	Graduate Seminar (1)	10	11	Graduate Seminar (2)	Graduate Seminar (1)	12	10	11	12-15	Graduate Seminar (1) Lab Rotation (1) Required Minor or Scientific Writing Strategies and Ethics, or Research (1-4)
Total Credits	11	12	10	11							
P1 Spring	Start research with Primary Advisor (1)	Clinical Drug Development (3)	Physiol Chem II (3)	Drug Discovery (3)							Required Minor or Research or Statistics, or Biochemistry Deficiency (2-3)
	PhD Biochemistry – Metabolism (4)	Molecular and Cellular Pharmacodynamics (3)	Pharmaceutics (4)	Biochemistry (3)							Systems Physiology (5)
	Advanced Pharmaceutics II with Dosage form Design and Processing (3)	Graduate Research (2)	Drug Literature Evaluation I (2)	Pharmacognosy Rotation (2)							Student Seminar (1)
	Electives and Graduate Seminar (2)	Biostatistics II (3)		Special Projects (3)							Cell Communication and Signal Transduction (3)
		Scientific Writing (1)									Lab Rotation (1)
		Graduate Seminar (1)									
Total Credits	10	13	9	11							12-13
P1-P2 Summer	Research with Primary Advisor (8)	Research (3)	Research Rotations(6)	Research (Credits Undefined)							Research (1)
Total Credits	8	3	6	Undefined							1
P2 Fall	Electives, Graduate Seminar and Research with Primary Advisor (8)	Research Techniques and Instrumentation (3)	Med Chem I (2)	Structure Elucidation I (2)							Pharmacology I (4)
		Elective (3)	Research Ethics (1)	Spectroscopy (3)							Cell Communication and Signal Transduction (3)
		Graduate Research (2)	Genetic Engineering (2)	Stereochemistry (1)							Biostatistics or Required

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		Graduate Seminar (1)	Drug Literature Evaluation II (3)	Statistics (2)	Minor (3)
Total Credits	Minimum 8	9	8	8	Scientific Writing Strategies and Ethics (2) Research (1) 12-14
P2 Spring	Electives, Graduate Seminar and Research with Primary Advisor (8)	Applied Pharmacology (3)	Med Chem II (2)	Structure Elucidation II (3)	Pharmacology II (3)
		Elective (3) Graduate Research (2)	Research Clerkship (6)	Microscopy (3) Taxonomy (3)	Required Minor (3) Drug Metabolism and Disposition (2)
		Graduate Seminar (1)			Student Seminar (1) Research (2) Science, Society, and Ethics (1)
Total Credits	Minimum 8	9	8	9	12
P2-P3 Summer	Research with Primary Advisor (8)	Research Funding and Proposal Development (1) Research Design (3)	Research Rotations (3)	Research (Credits Undefined)	Research (1)
Total Credits	8	4	3	Undefined	1
P3 Fall	Electives, Graduate Seminar and Research with Primary Advisor (8)	Dissertation Research (8)	Physical Organic (2)	Research (Credits Undefined)	Required Minor (if needed) (3)
		Graduate Seminar (1)	Protein Chemistry (2) Research (6)		Dissertation (8) Student Seminar (1)
Total Credits	8	9	10	Undefined	12
P3 Spring	Electives, Graduate Seminar and Research	Dissertation Research (8)	Structural Methods (3)	Research (Credits Undefined)	Required Minor (if needed) (3)

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	with Primary Advisor (8)	Graduate Seminar (1)	Research Seminar (1) Research (6)	Dissertation (8) Student Seminar (1)
Total Credits	8	9	10	12
P3 Summer	Research with Primary Advisor (8)	Dissertation Research (8)	Research (6)	Dissertation (1)
Total Credits	8	8	6	1
P4 Fall	Graduate Seminar and Research with Primary Advisor (8)	Dissertation Research (8)	Research (9)	Dissertation (11)
Total Credits	8	9	9	12
P4 Spring	Graduate Seminar and Research with Primary Advisor (8)	Dissertation Research (8)	Research (9)	Dissertation (11)
Total Credits	8	9	9	12
P4 Summer	Research with Primary Advisor (8)	Dissertation Research (8)	Research (9)	Dissertation (1)
Total Credits	8	8	9	1
P5 up to P7 (Fifth and	Research with Primary Advisor	Course Complete after Dissertation Defense in Spring	Research	Course Complete after Dissertation Defense in Spring or before

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<i>further years as required)</i>	24 per year as required	24 per year as required	24 per year as required	Undefined	24 per year as required
Total Credits					
Course Complete after Dissertation Defense in Spring or Summer of any year after the end of year four					
Minimum Total Credits	96 (40)¹	60 (36)²	97 (49)³	96 (26)⁴	67 (40)⁵

¹Students are required to take a minimum of 96 credit hours, at least 40 of which are recommended to be in didactic course work.
²Students are required to take a minimum of 60 credit hours, at least 36 of which must be in didactic course work.
³From this course it is not exactly clear the number of hours required for the PhD program alone but it is roughly comparable to the ones proposed for the other programs listed, an abstraction suggests a minimum of 97, at least 49 of which must be in didactic course work.
⁴Students are required to take a minimum of 96 credit hours, at least 26 of which must be in didactic course work.
⁵Students are required to take a minimum of 67 credit hours, at least 40 of which must be major course work, 9 units of minor coursework, and 18 units of dissertation.

6. Program Justification

The creation of a graduate program offering the PhD degree is a next logical step in the academic development of the UH Hilo CoP. Any ranking program in any academic field has the PhD as a benchmark for excellence, and every high ranking and well respected College of Pharmacy in the US has a PhD program [3, 5]. The PhD in Pharmaceutical Science is recognized as the necessary degree to assure graduates are competitive in the current job market for scientists able to develop, lead, and direct independent research in industrial, academic, educational and government settings, at the local, national and international level. Offering this degree is an essential step toward fulfilling the mission of the CoP, which is to educate pharmacy practitioners and leaders, to serve as a catalyst for much needed innovations and discoveries in pharmaceutical sciences and practice for promoting health and well-being, and to deliver quality patient care, as it solidifies our intentions of enhancing the research capabilities of UH Hilo [11]. Only through an active graduate program will the CoP and its faculty be able to fulfill their obligations to expand the essential knowledge base of the local, national and global medical community and produce highly skilled researchers, practitioners, and teachers who continue the advance of biomedical science. It should also be noted that in current nationwide PharmD programs, pharmacists are no longer being trained to be researchers in the pharmaceutical sciences [2]. Thus, there is already a projected need for the people who will graduate from this program.

A graduate program in the CoP will open many doors for our students and faculty. One of the primary duties of a university is to train the next generation of scientists and teachers; graduate students and post-doctoral fellows [2] who will be pursuing research in the College under the supervision and mentoring of the academic faculty. Addition of these future professionals to the System will greatly enhance the intellectual depth and breadth of the College and Campus community through seminar programs, discussion groups and campus lectures. The diverse scientific perspectives brought to the College, not just by the faculty but also by graduate students and postdoctoral fellows from a variety of backgrounds, will all contribute to the advancement of scholarship, which in turn will lead to an increase in the exposure of our programs to the scientific community and potential sources of funding. As the program develops, the University of Hawaii will increasingly be recognized as the center of excellence in pharmaceutical research and education in the Pacific Basin and become an attractive option for investment once it is realized that there is a vibrant research culture in this area that is producing world class scientists and results that can be translated in products that are locally derived. Without the PhD program, advances of this type cannot be made and new investment and development in these areas will not be attracted to the State.

The program will also be of great benefit for our professional students. A graduate program exposes students to career opportunities in addition to the practice of pharmacy and creates additional opportunities to enter into the pharmaceutical industry and academia. An active graduate program will give the professional student the opportunity to enter into potential career options like drug discovery, pharmaceuticals, medicinal chemistry, pharmacology, or clinical research before committing to a particular career path. Professional students will closely interact with graduate students and post-doctoral fellows who have already decided to pursue one of these fields, and they will receive the guidance and mentoring of a faculty member working at the forefront of their particular field. Students completing their PharmD program at the UH Hilo CoP will gain an understanding and appreciation of the real breadth of opportunities through which pharmacists can contribute to modern healthcare.

Considerable research funding from the NIH, NCI, NSF and similar agencies is focused on drugs, from their discovery to ensuring that they are beneficial to human health [12]. The enhanced depth and quality of students offered by a PhD program in the pharmaceutical sciences would greatly assist UHH researchers in competing for these funds and assist them with becoming involved in more translational and developmental areas of research. The proposed PhD will also provide an interdisciplinary, team-approach philosophy to problem solving needed by professionals today, by providing collaborations among students and faculty from all of the disciplines that are encompassed by the pharmaceutical sciences. Such diversity in student interactions can create a dynamic intellectual environment and improve the quality of research, research ideas, and information generated from such a program.

This program will be unique in the Pacific Islands. Our location in Hilo will serve to make the program accessible to students from Hawaii, as well as those from other nations in the Pacific, who are considered under-represented minorities in the scientific community. It is expected that the research and scholarly

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activities of this program will help to spawn a local pharmaceutical/biotechnology industry in Hawaii, as similar programs have done in numerous other locations around the country, thereby creating a vibrant job market for our students upon graduation, while bolstering employment and the economy.

Since a PhD in Pharmaceutical Science has never been offered within the University of Hawaii System, residents of Hawaii, current pharmacy students and those undertaking BS and MS degrees in Hawaii and the Asia-Pacific region, and prospective mainland students, have not had the opportunity to obtain advanced training in the pharmaceutical sciences within this State. These prospective students have no choice but to leave or not return to the State to continue their studies. Since there no PhD programs of this type in the Asia-Pacific Region, students from the Asia-Pacific region must also go somewhere other than Hawaii for training in this scientific area. All of the top American universities that have a College of Pharmacy offer a PhD in the pharmaceutical sciences. According to American Association of Colleges of Pharmacy (AACP) Surveys [3], 450 students graduate annually from these programs. Hawaii is losing students to these mainland schools and in so doing is losing a significant investment already made in such individuals, their intellectual capacity to help the State develop centers of tertiary industry/business, the ability to potentiate the intellectual capacity of its faculty, and the chance to develop programs that will lead to extramural funding and translational research. We propose to fill this academic gap within the UH System and better serve the needs of the people of Hawaii and the Asia-Pacific region by providing a PhD program that can address the unique characteristics of our region. The program will serve as a center of excellence to promote opportunities for citizens and economic development for the State. We will train highly marketable students who will be eagerly sought after by future employers. The program will significantly enhance awareness that the State of Hawaii is a natural products mecca.

Once the PhD in Pharmaceutical Science is initiated there will be significant interest from local, national and international students who will want to participate in such a unique program in a truly unique location that offers such unique opportunities. Currently, over 20 external students have expressed interest in applying to join our program to pursue a PhD even before we entered the approval to plan stage. Once the program commences it is anticipated that we will have an initial cohort of 5 and 10 students per year leading to a total of 25-30 graduate students in the College, as a whole, within 5 years.

7. Needs Assessment

According to data available from the American Association of Colleges of Pharmacy (AACP) [3], as of fall 2009, there were 5349 full time and 553 part time faculty in the 114 Colleges and Schools of Pharmacy across the US. Of these colleges and schools, 66, including all high ranking colleges and schools, offer postgraduate programs. Data from Surveys of Earned Doctorates (SED) sponsored by NSF, NIH, DOE, NEH and NASA [13] indicate that the top colleges and schools award around 160 doctoral degrees in pharmacy annually, while overall the actual number is around 450 [3]. Analysis of available faculty data nationwide revealed the demand for faculty members continues to grow as new pharmacy schools open and current schools expand their professional programs to address pharmacy workforce issues. It was estimated by an AACP task force in 2006-2007 [1] that over the following 10 years, faculty demand will increase by about 20% as approximately 422 faculty will retire and 400 new positions will be created due to program expansion. This level of growth occurs in the face of a current vacancy rate of about 10% (427 positions are currently open). Some of the vacancies will be filled by clinical pharmacists, but it is reasonable to expect about half will be filled by individuals holding a PhD in Pharmaceutical Science. Accordingly, it is logical to project there will be a continuous need for our graduates in academia, as well as the ongoing demand in government and industry.

If one assumes a turn over of around 5% per year within all systems where graduates of this program might be likely to find employment, through career changes, retirement, and death, it can be seen that the number of PhD graduates currently entering the workforce is inadequate to fulfill the projected need. So, these numbers not only attest to the demand/need for training in this discipline and an academic gap in graduate program offerings in the UH System, but also show that the number of PhD graduates is not satisfying the demand of the US generally and certainly not for any developments in Hawaii. Currently, 100% of the UHH CoP Department of Pharmaceutical Sciences faculty were trained outside the State and most had no relation to the State before moving here. All leading US universities, including many on the west coast such as Oregon State, University of Washington, UC Davis, UC Berkeley, as well as Colorado

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State, and Utah State, compete with Hawaii for students. Indeed, most major land-grant universities across the nation offer a doctoral degree in the Pharmaceutical Sciences including University of Michigan, University of California San Francisco, University of Texas, University of Kentucky, University of Michigan, Purdue University, University of Minnesota, Ohio State University, University of Arizona, University of Florida, University of Maryland Baltimore, University of North Carolina Chapel Hill, University of Tennessee, University of Illinois Chicago, University of Washington, University of Utah, University of Wisconsin, University of Southern California, and University of Iowa. As we are a new College we cannot say at this stage where our students will go if they want to pursue a PhD, but it is clear that if we do not offer such a program here they will not be staying in Hawaii to assist with the growth and development of pharmaceutical science related ventures so the State will not just be losing students but also their intellectual and creative capacities. Without establishment of this program, students who chose to remain in Hawaii for family reasons will not have the opportunity to enroll in such a program in their State. At this stage it is reasonable to assume that the demand for a PhD program in the pharmaceutical sciences in Hawaii could easily result in the acceptance of 2-4 highly qualified resident students per year.

For letters of interest from students for the establishment of the program here in the CoP at UHH see Appendix B. As can be seen from these letters, interest in developing this program is considerable from people who are most likely to be the ones who will be the first participants.

Statewide and Local Need for a PhD in Pharmaceutical Science

The College of Pharmacy embraces the concepts put forth by President Greenwood [6]: UH should contribute to Hawaii's overall economic future through research, innovation and technology transfer, and we should enhance our ability to compete for extramural funding and pursue activities and discoveries that benefit the community. In the world of academic pharmacy, industry and business is attracted by research and graduate education. The proposed program is an ideal vehicle given the current and projected dramatic need for pharmaceutical-based health care, the demographics of the State population, and the unique environment of the Big Island.

Currently, the College of Pharmacy generates around \$10 million in tuition revenue for the University, and over \$1 million in donations have been received [14]. An independent economic survey determined that College activities were projected to have an economic impact of over \$50 million per year throughout the State [15]. However, this is certainly an under estimate, since the CoP now serves as the administrative center for a \$16 M Beacon Community. On the basis of its current and projected success and economic value to the State, the College should be encouraged to realize its full potential by completing its original mission of offering the full range of academic programs currently being offered by all of the well ranked Colleges of Pharmacy across the US. In so doing, the College will be well positioned to compete for the extramural and industrial funding. This means offering a PhD program to well qualified applicants. Establishment of this program will not only support academic learning and discovery but will also provide a foundation for the development of a pharmaceutical industry within the State and facilitate much needed translation research.

At the present time, any residents interested in graduate level education in pharmaceutical science will need to leave the State to be trained in colleges of pharmacy on the mainland US or elsewhere. A graduate program in the CoP will help resolve many of the issues associated with having to leave the State for education purposes and open many doors for our students and faculty alike as it will provide opportunities that are currently not available within the State. This in itself is probably the single most important driving force for this program. We have already witnessed the huge effect the CoP has had on training our residents as pharmacists. There is little doubt the PhD will have the same impact. Added to this is the fact that pharmacists are no longer being trained to be researchers in the pharmaceutical sciences where there is a general shortage in many areas of research, quality control, production, development, marketing, administration and sales, meaning there is already a projected need for the people who will graduate from this program.

To assess if this perceived need was genuine, a survey of the current students enrolled in the UHH CoP was undertaken. The results of this survey showed that from our current four classes, 2011 (8), 2012 (11), 2013 (38) and 2014 (42), a total of 99 students would be interested in participating in this program when it becomes available (see Appendix C). This survey was then extended to include a limited number of other

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potentially interested applicants locally, nationally and internationally. The results of this survey showed that there was interest from 42 local, two national, and eight international individuals [16].

With interest and need established at the student level, the next step was to establish need for these individuals once they have graduated. In general, many of the graduates from a program of this type will go on to postdoctoral studies, i.e., further research training, residency, MBA and the like, either within the State, nationally or internationally, so as to expand their options and broaden their skills. Others may go directly into industry or government.

The need for post-doctoral fellows trained in the pharmaceutical sciences locally and nationally is expanding, with many of these positions currently being occupied by international applicants. In any one year, nationally there are literally hundreds of postdoctoral and related positions available in areas directly related to the PhD degree the candidates from this program will have obtained. Any *ad hoc* evaluation will demonstrate these positions are being filled by international students. The demand for resident students is unequivocal.

Once an individual has completed a term as a post-doctoral fellow there are a variety of career paths that may be undertaken. The two most obvious paths are into academia or industry. According to an AACP report [Report of the 2006/2007, COF (Council of Faculty)/COD (Council of Deans) Task Force on, Faculty Workforce, June 15, 2007] [1] it was estimated that the demand for Academic Pharmacy Faculty will increase by about 20% over the next few years as 422 faculty retire and up to 400 new vacancies will be created. The rate of retirement will remain fairly constant for the foreseeable future as about 30% of all faculty are over 50 years of age. At the time of this AACP report there were 427 positions still vacant. Of all of these positions about 40% will be in the pharmaceutical sciences, meaning that in this area alone some hundreds of PhD or equivalently qualified individuals will be required each year for the foreseeable future. Of course colleges and universities beyond pharmacy greatly expand these opportunities. Graduates of the program would be well positioned for employment in departments of pharmacology, for example.

In the industrial pharmacy sector, even though there has been rationalizations and some contractions over the past ten years or so, there will always be a demand for well qualified and trained PhD graduates simply because of attrition (e.g., retirement), and the like, and the fact that this industry will again have to expand if it is to raise to the challenge of providing new drugs to deal with current and emerging healthcare issues. According to the US Department of Labor, Bureau of Labor Statistics, Occupational Outlook Quarterly [17], nationwide between 2008 and 2018 there will be an average growth of employment opportunities of at least 3% in all industries related to the production of pharmaceuticals. In their Career Guide to Industries, 2010-11 Edition [18], Pharmaceutical and Medicine Manufacturing section, it was pointed out that this industry alone in 2008 employed 289,800 wage and salary earners. About 87% of these jobs were in establishments that employed more than 100 workers. They go on to state that, "The number of wage and salary jobs in pharmaceutical and medicine manufacturing is expected to increase by 6 percent over the 2008-18 period, compared with 11% projected for all industries combined. Even during fluctuating economic conditions, demand is expected to remain strong for this industry's products." Under job prospects the report states, "Prospects should be favorable, particularly for life scientists with a doctoral degree. Unlike many other manufacturing industries, the pharmaceutical and medicine manufacturing industry is not highly sensitive to changes in economic conditions. Even during periods of high unemployment, work is likely to be relatively stable in this industry, because consumption of medicine does not vary greatly with economic conditions. Additional openings will arise from the need to replace workers who transfer to other industries, retire, or leave the workforce for other reasons." Even at this level, it is not difficult to calculate that the anticipated percentage growth will translate into hundreds of opportunities for new graduates. Further support for this comes from the article by Hartzema and Perfetto, in the journal *Pharmaceutical Research* [19], where they show that even though the supply of pharmaceutical scientists has increased, the increases have been outpaced by increases in demand. More recently, Augsburger, in his article in the journal *AAPS Pharm. Sci. Tech.* [2] stated, "The 2004 PT Section Education Committee took the first steps in addressing the charge: "How can the supply of highly qualified pharmaceutical scientist specialists in product development and related technologies that meet current and future needs be ensured?" This charge was borne out of earlier reports and current experience that suggest that: (1) graduate programs in colleges of pharmacy are increasingly failing to produce sufficient numbers of appropriately qualified specialists in product development and related pharmaceutical technologies, and (2)

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the pharmaceutical industry has been forced to recruit and train scientists from other disciplines. Surveys conducted by this committee of the membership (PT, PDD and BT sections) and a representative group of pharmaceutical executives validated this concern and provided insight into its nature and depth. As an example, the executives reported that 50% or less of product development staff have undergraduate degrees in pharmacy and that 50% or less have advanced degrees in pharmaceuticals/Industrial pharmacy/pharmaceutical technology, yet entry-level PhDs in these specialties bring a better mix of skills to product development than their counterparts from other scientific disciplines, and that this advantage persist even after 4-6 years experience on the job. And the great difficulty in finding candidates with the right mix of experience and education was also made clear by the surveys," further demonstrating not just the need but in some case a dire need for individuals trained to the PhD level in the pharmaceutical sciences.

The dramatic growth of the biopharmaceutical, dietary supplement, nutraceutical, alternative medicine, and alternative health care and related industries over the last 15-20 years has also seen an increase in demand for individuals who have been trained to the PhD level with an emphasis in the pharmaceutical sciences to provide advice as expert consultants, managers, quality controllers and to generally guide the industry through the mine field of regulatory affairs and controls.

Aside from the academic and industrial pharmacy routes, qualified individuals will also be able to find employment opportunities in government, particularly in dealing with regulatory issues, in the food, nutraceutical or dietary supplement arena, as well as in related but diverse areas like the cosmetic, agricultural, fine chemical and veterinary product industries, as well as in future areas that are yet to be defined. The emerging area of biofuels and green industry must also be seen as an industrial opportunity for graduates of our program. Some individuals will opt to become self employed or use their education and training to take them into unrelated areas. In essence, any area where natural materials are used and require analysis, preparation, formulation, marketing and/or synthesis, could be employers of our doctoral graduates.

Direct Benefits to the State of Hawaii

The PhD program will:

1. Provide residents of Hawaii the opportunity for the first time to undertake a PhD in Pharmaceutical Sciences within their own State.
2. Significantly help strengthen, stabilize, and sustain the CoP and in so doing ensure both student and faculty retention and potentiation and, as stated by the Mayor of Hawai'i, Billy Kenoi, in his letter of support for the establishment of the PhD program, "The addition of the PhD program will open many doors for graduates, enhance the standard of education at the University and improve the quality of life throughout our County, the State of Hawai'i, and the greater Pacific Region."
3. Create opportunities, both educational and technological, that do not exist within the State. In particular, the PhD program has the potential to greatly contribute to the technology transfer initiative launched by President Greenwood.[6]. An example of this is eluded to by Mr. B. Jacobson, President of the Hawaiian Tea Growers Association, when he says, in his letter of support for the establishment of the PhD program, "Internationally, research on tea and tea compounds are part of the cutting edge work in the Pharmaceutical Sciences. I feel that research undertaken locally on Hawai'i grown teas and other nutraceuticals will not only benefit our local industries and residents but also promote the standing of our local institutions and our knowledge base from UHH research. Hopefully this work can also help the health of our residents. Hawai'i is unique in that here we have the ability to grow almost any crop in the world because of our diverse microclimates. Hawai'i's farmers can produce agricultural research materials in controlled settings that can be of great use to researchers. This is a very exciting aspect of the establishment of a PhD program in the Pharmaceutical Sciences, within the College of Pharmacy, at the University of Hawai'i Hilo because it fits so well into the purposes of the Hawai'i Tea Society."

Another example of the possibilities for technology transfer are with organisations like those represented by Dr. G. Cysewski of Cyanotech, see letters of support Appendix A. Organisations like

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Cyanotech are based purely on natural products isolated from micro-algae grown here on the Big Island. Faculty within the College have already had discussions with this company and Cellana LLC concerning possible collaborative research that could be mutually beneficial when the College is better placed to deal with more and varied projects that the PhD program would be offering.

4. Improve links within Pacific Basin Countries and with Asia through collaborative educational and technological research projects. Currently, members of the College have long term collaborations with Pacific Basin and Asian colleagues. The College of Pharmacy is in an ideal situation to further develop these strong ties particularly with Pacific Basin countries and other Asian neighbors who are preparing for the economic recovery as stated in a recent channelnewsasia.com article; "But Asia's biomedical and pharmaceutical sector is using this period to gear itself up in preparation for an eventual recovery. The global pharmaceutical sector is expected to see growth of between four and five per cent this year. But pill processing and other pharmaceutical and biomedical activities are expected to see double-digit growth in Asia" [4].
5. Provide an intellectual resource that is becoming extremely difficult to find. The pharmaceutical, and related industries, are often looking to academia to take a lead in the discovery and initial development of natural products. A PhD program provides an environment well suited to produce results and new ideas, many of which would be very attractive to industry and other similar partners. Examples of this are discoveries made by L. Dwoskin of the University of Kentucky's College of Pharmacy [20], H. Luesch of the University of Florida's College of Pharmacy [21], and A. D. Kinghom of Ohio State University's College of Pharmacy [22].
6. Sustain, extend and enhance the economic and positive healthcare impact the College is already having on the State.
7. Add a degree to the healthcare related professions that is offered nowhere else within Hawaii and so perfectly complement and potentiate those being offered elsewhere throughout the System. This will also ensure that UH is being nationally competitive in an important healthcare area.
8. Attract new industry in the form of new pharmaceutical companies, training organizations, NGOs and governmental agency support for UHH-CoP based technologies.
9. Leveraging the significant investment the State has made and will continue to make in establishing the CoP insures that the program will have a small resource "footprint", i.e., much of the infrastructure is already in place to begin the program.
10. Support and enhance relationships that have been established with the flagship campus, such as CoP participation in the INBRE award.
11. Establishment of an important legacy for generations to come.

Conclusion of Need

Based on the discussion presented in the previous section, it is evident that there is a very clear need for a PhD in Pharmaceutical Science within the College of Pharmacy at the University of Hawaii at Hilo. Establishment of the PhD program within the College of Pharmacy will significantly help strengthen, stabilize, and sustain the CoP in its mission of becoming a highly ranked college, and in so doing, become a foundation for the creation and development of pharmaceutical related business and industry within the State that in the medium to long term can be maintained and expanded by graduates of the program itself.

It is also apparent from this discussion that establishment of a PhD program is going to be essential for successful hiring of further highly qualified faculty and staff as well as for current faculty career development, retention, and leverage of their skills to enable the College to help accomplish significant parts of the stated mission of President Greenwood [6] as well as its own [11].

Appendices A and B contain letters of support for this program from the Mayor of Hawaii, University of Guam administrators and academics, local academics, individuals from the pharmaceutical and related

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industries, the private sector, government authorities here in Hawaii, and many potential PhD candidates commenting on the need for a PhD in Pharmaceutical Science in general and specifically within the UH System. A poll of the members of the current Faculty also indicated strong and unequivocal support of this proposal.

8a. Resources: Faculty

At the present time, the College of Pharmacy offers and administers a professional degree in pharmacy (PharmD). However, from the time the the College of Pharmacy was started, the ultimate implementation of a PhD program was taken into account. As a result, current faculty members are qualified and capable of teaching, mentoring and supporting PhD students. Therefore, no additional human resources will be needed to begin a PhD program. The addition of a new PhD program will result in the College having a PharmD and a PhD which ideally complement each other. It is also expected that no additional support staff or administrative resources will be required. Existing support staff, the Planning Director of the Graduate Program, the Admissions and Graduate Program Committees, and the Assessment Coordinator, will be able to deal with correspondence, admissions, and administration of the PhD program.

Existing faculty regularly teach significant parts of many of the courses required for the proposed PhD degree within the PharmD program. In addition, all the courses that support core pharmaceutical sciences knowledge as well as the new courses that will be required can all be offered by existing CoP faculty. This means no additional FTEs are needed to support the proposed curriculum (see Appendix D and references to Appendices E and F). Courses marked with an asterisk (*) in the course description part of Appendix D indicates some of the lecture materials also form part of the PharmD program.

There are sufficient faculty members to chair PhD dissertation committees (see below for a list of current faculty). Current faculty members who will participate in the PhD program all have appointments in the College of Pharmacy. These individuals can provide adequate research infrastructure, laboratory space, and graduate research assistantships for PhD students in the pharmaceutical sciences. The expectation is that faculty will draw PhD students directly from our program, form within the State, nationally and internationally.

It is anticipated that the College will be able to provide a limited teaching assistantships to PhD students. It is expected that initially the PhD program will be composed of 5-10 students all of whom can be supported from current levels of funding within the College.

It is also expected that the availability of PhD level students will greatly increase their attractiveness as graduate research assistants for faculty with funded research programs. With the potential for high research productivity from PhD students, the number of research assistantships should increase to help support the target of 25-30 PhD students. Furthermore, as co-operations and collaboration develop, and the program evolves, new faculty, assistantships, and instructional FTEs could be brought into the program to facilitate further growth. Interdisciplinary proposals for PhD training grants and higher education challenge grants will become possible. The increased potential to develop these kinds of institutional grants as well as interdisciplinary research grants aimed at major funding agencies have the potential to add new resources to the program and the university.

Proposed Faculty for PhD Program in the Pharmaceutical Sciences (See Appendix G for faculty CVs)

Alphabetical Listing of PhD Program Faculty in the College of Pharmacy:

Name and Title	Topic Area	Institution	Year	Email
Julie Adrian DVM Assistant Professor	Small Animal Medicine	Oklahoma State	2004	jluiz@hawaii.edu
Andre Bachmann PhD	Biology	University of Zurich	1998	andre@hawaii.edu

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Associate Professor

Forrest Batz PharmD Assistant Professor	Clinical Pharmacy	UC San Francisco	1989	fbatz@hawaii.edu
Robert P. Borris PhD Associate Professor	Pharmacognosy	University of Illinois at Chicago	1981	borris@hawaii.edu
Leng Chee Chang PhD Assistant Professor	Pharmacognosy	University of Illinois at Chicago	1998	lengchee@hawaii.edu
Mahavir Chougule PhD Assistant Professor	Pharmacy	Maharaja Sayajirao University of Baroda, Vadodara, India	2007	mahavir@hawaii.edu
Linda Connelly PhD Assistant Professor	Molecular Pharmacology	University of London, England	2002	lindacon@hawaii.edu
Edward Fisher PhD Professor	Pharmacology and Toxicology	Temple University	1987	fishere@hawaii.edu
Daniela Guendisch PhD Assistant Professor	Pharmaceutical Chemistry	Eberhard-Karis University, Germany	1992	danielag@hawaii.edu
Aaron Jacobs PhD Assistant Professor	Pharmacology	University of California at Los Angeles	2003	jacobsa@hawaii.edu
Susan I. Jarvi PhD Associate Professor	Biology	Northern Illinois University	1989	jarvi@hawaii.edu
Tamara Kondratyuk PhD Research Scientist	Biochemistry	Moscow State University	1992	kondraty@hawaii.edu
Eugene Konorev MD, PhD Assistant Professor	Pharmacology	Kursk Medical University	1988	ekonorev@hawaii.edu
Russ J. Molyneux PhD Affiliate Faculty	Organic Chemistry	University of Nottingham, England	1964	molyneux@hawaii.edu
Kenneth Morris PhD Professor	Pharmaceutics	University of Arizona	1988	krmorris@hawaii.edu
Anthony Otsuka PhD Affiliate Faculty	Chemistry	University of California at San Diego	1979	ajotsuka@hawaii.edu
Karen Pellegrin PhD, MBA Director of Strategic Planning	Psychology, Business Administration	University of South Florida and The Citadel	1991 1996	karen3@hawaii.edu
John M. Pezzuto PhD, Professor and Dean	Biochemistry	University of Medicine and Dentistry of New Jersey	1977	pezzuto@hawaii.edu
Dianqing Sun PhD Assistant Professor	Organic Chemistry	University of Memphis	2004	dianqing@hawaii.edu

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Ghee Tan PhD Assistant Professor	Biochemistry and Molecular Pharmacology	University of Illinois at Chicago	1992	gheetan@hawaii.edu
Gary R. Ten Eyck PhD Assistant Professor	Biological Sciences	University of South Dakota	1997	gte4@hawaii.edu
Supakit Wongwiwatthananutit PharmD, PhD Assistant Professor	Pharmacy Practice	Purdue University	1998	supakit@hawaii.edu
Anthony D. Wright PhD Associate Professor	Organic Chemistry	James Cook University, Australia	1988	adwright@hawaii.edu
Pharmaceutics Assistant Professor	To start Fall 2011	NA	NA	NA
Medicinal Chemistry Assistant Professor	To start Fall 2011	NA	NA	NA
General Pharm. Sci. Assistant Professor	To start Fall 2011	NA	NA	NA

Although many of the faculty members listed above currently serve at the rank of assistant professor, they are all highly qualified to participate in the program, having many years of postdoctoral training and research experience.

8b. Resources: Physical

A permanent facility for the CoP is currently in the planning and design phase. The State of Hawaii has provided \$5.5 M for this purpose, and the planning phase will be 100% complete by March 2011. The site for construction has been selected. It is not currently known when the building will be completed, but we currently have interim space that is sufficient to amply support the program.

Physical space that is available to the PhD program and associated faculty include:

Wainaku Executive Center: The 2875 sq ft of leased space occupied by the College at this facility houses the Dean's office, the Director of Continuing Education and Strategic Planning, Director of Community Partnerships, Chair of Pharmacy Practice, six other faculty and three staff members. A large conference room at this facility is also used extensively.

Interim Modular Facility: Phase 1 of the Interim Modular Facility on the UHH campus consists of three new buildings. Currently, Building A (4610 sq ft) houses the Student Services and Academic Affairs offices, the IT group office and server room. Office space was recently modified to provide four breakout rooms, each 262 sq ft, for student use. This now provides six breakout rooms of sufficient size to accommodate small group instruction. A photocopy machine and printers for student use are available in this building. Two additional offices (each 131 sq ft) for faculty expansion, storage space and restrooms are also located in this building. Building B (2951 sq ft) consists of a 1900 sq ft lecture hall and adjacent restrooms. Most of the didactic coursework in the College now takes place in this building. Building C (5873 sq ft) represents the College's research presence on campus. The three research laboratories (each 1200 sq ft) contains the research programs of six faculty members. Six offices for research staff are located adjacent to the laboratories. A 285 sq ft support room is currently being refit to contain another breakout room for student use as well as a small vending area. Two small support rooms and a storage room are also located in this building. A generous gift from the J.M. Long Foundation (\$1 M) will help to support construction of Phase 1-B of the modular facility. We will construct a second lecture theatre student laboratory for the instruction of pharmacy practice and pharmaceutics, and additional office and study

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areas. The current projected completion date is July 2011. A revenues bond has provided \$3 million for this project. The addition is currently underway and should be complete by June 2011.

UHH Campus: The College uses lecture hall UCB-100 (3000 sq ft). Use of this facility will continue until the second lecture hall in Phase 1-B of the Interim Modular Facility is completed. A teaching laboratory, Wentworth 4 (approximately 1500 sq ft) is currently shared with the Chemistry Department. This will continue until a new teaching laboratory is constructed in Phase 2 of the Interim Modular Facility or in the permanent College of Pharmacy building. Additionally, one faculty member conducts his research in laboratory space shared with a member of the Chemistry faculty comprising an X-ray crystallography facility in Wentworth Hall (3A/3B).

Forestry Building, Nowelo Street: The College continues to lease one laboratory (1200 sq ft) and associated office space in this facility. This laboratory houses the Dean's research group as well as some instrumentation used by several other faculty members.

County Annex Building: Office space at the County Annex Building on Rainbow Drive currently houses 14 faculty members, including the Chair of Pharmaceutical Sciences, three staff members and the Pre-Pharmacy Program office. The Dean also maintains a satellite office in this location. Five offices are available for future faculty expansion. Four conference rooms of varying size and two support rooms are also located in this facility.

Waiakea Research Station: The Waiakea Research Station, located five miles south of Campus on Stainback Highway, is a complex of laboratory and office space (7200 sq ft total). This complex of 14 laboratories with associated office and support space is the major site of the College's research activities. While already partially occupied, the complex is undergoing a phased renovation which will restore it to full utility. When fully populated, it is expected that this facility will house the research programs of up to 12 faculty members, an instrumentation laboratory and a fluorescence microscopy laboratory. The Associate Dean for Research and his staff, as well as the Director for Pharmacy Innovation and Facilities Planning, maintain their offices at the Waiakea Research Station.

While it is clear that having facilities and activities spread across five locations spanning the town of Hilo is somewhat less than optimal, the current situation allows us to move forward with both our teaching and research missions. The faculty, staff and students all understand that this is a temporary necessity while we work toward our permanent building. The current situation serves to highlight the importance of the construction of a permanent building to consolidate the College's activities and optimize the relationships of our faculty and staff. As noted above, planning and design is ongoing.

8c. Resources: Instrumental and IT

Instrumentation and IT services that will be available to the program include:

Research Infrastructure: Some of the equipment currently available and in use within the College include a Bruker Avance DRX 400 MHz multinuclear NMR spectrometer (a second 400 MHz NMR was recently donated to the College by Wyeth Laboratories and is awaiting installation), a Varian MS500-IT LC-MSn system with ESI and APCI interfaces, a Bruker powder Xray diffractometer, a Nicolet iS10 FT-IR with Centaurus infrared microscope attachment, a Shimadzu 1800 UV-Vis spectrophotometer, a Rudolph Research Autopol IV multiwavelength polarimeter, a Buchi B-540 melting point instrument, a Beckman Quanta MPL flow cytometer, a Sorvall WX90 ultracentrifuge, 2 Sorvall Legend XTR high speed centrifuges, 2 Sorvall Legend 17R microcentrifuges, Perkin Elmer Cyclone Plus phosphor scanner, Perkin Elmer Gelliance 1000 gel imager, Licor Odyssey Infrared Imager, Perkin Elmer Microbeta Filterman-96 cell harvester, Perkin Elmer Microbeta Trilux microplate liquid scintillation counter, Beckman Coulter LS6500 liquid scintillation counter, Stratagene Mx3005P realtime QPCR, 2 BioRad C-1000 thermal cyclers, Biotek Synergy 2, Synergy MX, Microquant and ELx808-NB plate readers, Lumistar luminescence plate reader, Zeiss upright, inverted, stereo and fluorescence microscopes, Olympus and Leica stereomicroscopes, Reichert-Jung Blostar inverted microscope, several New Brunswick I-24, E24 and E24R incubating shakers, several Napco and Fisher Isotemp CO₂ incubators, Fisher Isotemp forced air incubators, several Mettler-Toledo and Shimadzu analytical and top-loading balances, a Cahn Analytical C-35 microbalance,

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several Heidolph and Buchi rotary evaporators with Lauda recirculating chillers, 2 Labconco Freezone Plus lyophilizers, 3 Savant SpeedVac concentrator systems, several Mettler and Orion pH meters, hotplates, stirrers, vortex mixers and ultrasonic baths, several Yamato and Tuttnauer autoclaves, several Millipore DirectQ-5 water systems, a CEM microwave reactor, a Richard-Allan HM-550-MVP cryostat and a Microm HM-380 microtome. Chromatography equipment includes 6 analytical HPLC systems (one Beckman System Gold, 2 Shimadzu Prominence, 2 Dionex Ultimate 3000, 1 Perkin Elmer Series 200) with PDA, UV-Vis and/or electrochemical detectors, Shimadzu and Varian ELSD detectors, ESA Coulochem-III electrochemical detector, 2 Shimadzu preparative HPLC systems, a Buchi MPLC system, a BioRad Duoflow FPLC system and a Kromaton FCPC-A200 HPCPC system, a Rigaku LN40 liquid nitrogen generator to support the NMR laboratory. Numerous refrigerators, -20 freezers, -80 freezers and liquid nitrogen storage systems are also distributed among the laboratories. This list does not include smaller items such as electronic pipettes, and any items considered disposable. The College will continue to invest in its research infrastructure to the limits of the available budget in order to provide state of the art laboratory capabilities for all of its faculty members.

Appendix H contains a comprehensive listing of all equipment within the college as of January 2011 that cost more than \$5000.

IT Infrastructure: IT Infrastructure includes three Apple XServe servers, one Mac Pro Server, an XServe RAID and a Tape Backup unit, as well as each faculty and staff member having access to either a Mac or PC, laptop or desktop computer. This equipment is located in the Interim Modular Facility and being upgraded to the current server operating system. Servers now support BLOGs, WIKIs VPN and web-based calendars in addition to other services. The IT infrastructure is currently maintained and supported by two fulltime staff members with a third being recruited during the present school year.

8d. Resources: Admissions and Student Services and Counseling

Organization of Student Services: The UHH-CoP Office of Student Services (OSS) is staffed with a Director of Student Services (DSS) who supervises one full time Academic Advising Specialist, one full time Admissions Counselor and two part time student employees. The CoP is in the process of recruiting two additional student services employees to meet the student service needs of the growing College of Pharmacy. The Director of Student Services reports to the Associate Dean for Academic Affairs. The OSS has conducted and coordinated the recruitment, admissions and student services processes in conjunction with CoP committees (e.g., Admissions Committee and Awards & Scholarship Committee) as well as UHH Departments (including Financial Aid, General Admissions, University Registrar, Student Services, New Student Programs Office and the Business Office). The staff of the OSS addresses the needs of prospective and incoming students as well as aids the current students in their progression through their degree program. Additionally, the student employees assist the staff in the OSS to prevent potential backlogs of administrative processes. The Director of Student Services will continue to direct and coordinate the necessary processes and planning in order to best allocate resources to meet the recruitment, admissions and student services needs for the CoP. The CoP OSS will continue to build and implement student support structures that specifically address the needs and concerns of CoP students. Everyone employed in the OSS is made knowledgeable of FERPA law and its requirements, and student records are maintained in compliance with FERPA law.

Student Services Offered: The CoP Office of Student Services works in conjunction with the UH Hilo Division of Student Affairs in order to offer CoP students the broadest and most comprehensive range of services and to encourage their academic and personal success while at the UHH-CoP. A complete list of services available and offered to our students can be found in the Appendix I.

Academic Advising and Career Counseling for PhD Students: Academic and career advising and counseling is facilitated through faculty advisors who are able to effectively address the specific academic and career concerns and questions for CoP students.

Faculty advisor responsibilities include:

1. Serving as the student's advisor and academic/professional counselor.
2. Overseeing and monitoring the academic progress and professional growth of the student.

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3. Assisting the student in seeking academic and personal counseling services provided by the institution.
4. Serving as an advocate for the student when appropriate.

Advising of students is required of all UHH-CoP faculty members. Faculty advisors meet with each student individually at least once per semester. In addition to faculty advisors, the Dean and Associate Deans as well as other faculty members will also be available to assist students with academic advising, counseling, enrichment, and non-academic concerns.

UHH Career Planning and Placement: The Career Center provides support and assistance to students in the career planning and job placement process. The Center provides resources for career exploration, including self-assessment inventories, access to career exploration software, and access to a library for career exploration and graduate/professional school planning. The Director organizes a variety of career-oriented activities, such as bi-annual job fairs and workshops on topics such as resume writing which are offered throughout the academic year, and a career website that allows employers a free place to advertise positions to students and alumni.

The Career Center also administers the student employment program. Funds are available through both the Federal Work-Study Program and from University General funds for students to work part-time in various jobs on campus. The Center also provides referrals to off-campus employment opportunities.

Financial Aid: Financial aid at UH Hilo is designed to provide financial assistance to students who would not be able to attend college without such assistance. In conjunction with the CoP Office of Student Services, the Financial Aid Office provides support for the College of Pharmacy by administering the financial aid application and awarding process, as well as providing financial aid counseling to prospective and currently enrolled students and their families. Financial aid may take the form of scholarships (based on both need and merit), grants, loans, or work-study programs.

Scholarship Program: In coordination with the UH Foundation Office, UH Hilo Financial Aid Office and the Office of Student Services, the CoP administers scholarships to students. The purpose of the UH Hilo College of Pharmacy scholarship program is to recognize and reward students who have demonstrated outstanding academic performance and have shown a commitment to leadership and community activities within the college. Many awards also consider financial need. The scholarship awards imply the expectation of continued exceptional performance and leadership by the recipients in the years ahead. Scholarships are contingent upon availability of funds and the continued commitment of our generous sponsors. All UH Hilo CoP scholarship funds come from a variety of sources such as private donors, professional associations, and state and local business firms.

Housing: College of Pharmacy students are eligible to reside on campus in University residence halls. On-campus housing includes traditional dormitory style residence and apartment-style accommodations. The Housing Office also administers an off campus housing program which includes several nearby privately owned apartment complexes. In addition, the Housing Office maintains a listing of off campus residences and apartments that have vacancies, and provides referrals to students for these accommodations. A range of meal plans are available to students who reside on and off campus, and are provided in two dining halls on campus.

UHM Student Support Programs: A variety of student support programs are administered through the UH Hilo Division of Student Affairs, including the Student Support Services Program, the Kipuka Native Hawaiian Student Center, and the Minority Access and Achievement Program. These programs target students who may need additional support to be successful in college, such as first-generation college students, low-income students, Native Hawaiians, and students from ethnic groups that have historically been under represented in higher education. Students in the CoP are eligible for participation in all of these programs that provide a range of services, such as peer tutoring, peer mentoring, assistance with obtaining financial aid and scholarships, academic counseling and advising, study skills workshops, social and educational enrichment activities, and field trips. Tutoring is also available on campus through the Kilohana, Academic Success Center whose mission is to improve learning and retention through course specific assistance, tutoring, and skill development workshops. Kilohana also supports the Math Lab and the Writing Center which offers free drop in tutoring for all UH Hilo students.

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UHH Counseling: Counseling staff assist students in academic, career and personal areas of development. Students experiencing academic difficulties or any of a variety of personal problems (relationships, depression, and anxiety) can contact the Counseling Center. Counselors will work with students directly or may refer students to other resources. PharmD students will access UHH counseling services as appropriate via self referral and/or faculty mentors.

Health Services: UH Hilo students may take advantage of a wide range of health services provided on campus by a full-time nurse and two part-time physicians. Services include health insurance information, TB tests and routine immunizations, first aid for illness and injury, health and wellness information, pregnancy testing, sexually transmitted diseases testing, contraception, and referral to off-campus health care if necessary.

UHH Student Life: The Campus Center serves as the hub of campus life / activity for students, faculty and staff as well as the general community. Student life programs, services and activities are an integral part of the UH Hilo student's total educational experience. The Center provides support and assistance to the student-led UH Hilo Student Association, Student Activities Council, Advocacy Council for Students, student mediation center, *Ke Kalaheea* (student newspaper), *Kanilehua* (student literary and art magazine), *Hohonu* (student academic journal), Board of Student Publications, Student Service Corps, Board of Media Broadcast, Campus Center Fee Board and all registered independent student organizations. Leadership training is provided to students to assist them with developing their leadership skills and abilities. The service-learning program enables students to broaden their educational experiences by engaging in service activities both on and off campus. The Campus Center facility serves as the "living room" of the campus with convenient food service, meeting rooms, big screen television, indoor and outdoor gathering spaces and lounges, computer stations, and a computer lab.

The University also offers recreational and intramural sports programs. Additionally, the Student Life Center (SLC) provides an open, safe environment for recreation, learning, and social interaction. This beautiful facility consists of nearly 23,000 square feet of indoor fitness/recreational rooms, a cardio and weight room, dance and aerobics rooms, a lounge with wireless internet, an indoor cafe, locker rooms, an Olympic-sized swimming pool, and an open deck by the swimming pool. The SLC also runs an Outdoor Adventure program which provides a wide range of outdoor activities and programs at a variety of skill levels for the UHH community. Participants have the opportunity to explore the Big Island by participating in diverse adventure trips. They also can develop skills and learn safety and proper technique for a variety of activities through classes and workshops (e.g., Kayaking, SCUBA, Mountain Biking, and Ocean Canoeing to name a few.).

Testing: UHH serves as a testing site where students and individuals from the community can take standardized tests such as the Graduate Record Examination, Medical College Admissions Test, Pharmacy College Admissions Test and Law School Admissions Test. These tests are offered periodically throughout the year. Test proctoring services are also available for students who are enrolled in distance education courses at another institution. Placement tests to enter English, Mathematics, and Chemistry courses are administered by the respective academic departments at the University.

Disabilities Services: The University Disability Services Office provides services and support to students with disabilities, in compliance with Section 504 of the Rehabilitation Act (1973) and the Americans with Disabilities Act. Services focus on determining and providing reasonable and appropriate accommodations. The office also serves as an advocate for people with disabilities at UH Hilo by providing consulting on facilities development and planning; public accommodations for campus programs, services, or activities; educational and awareness programs; and general support for diversity activities at the institution. Course Coordinators are kept informed through the University Disability Services Office if any student needs any additional support due to a disability.

International Student Services: The International Student Services office assists international students in clarifying and attaining their personal and academic goals while complying with regulations pertaining to their immigration status. The office serves as an interface between UH Hilo and international students to facilitate communication, understanding and appreciation. The office promotes cross-cultural activities on campus and conducts orientations and workshops to assist students in their cultural adjustment to life at

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UH Hilo. Though they are not required to have visas, students from the US-affiliated Pacific Islands are included in the population served by the International Student Services office.

Women's Center: The Women's Center is committed to supporting the leadership, safety, empowerment, and intellectual growth of women at UH Hilo through educational programs, advocacy, direct services, and policy development. Working collaboratively with other campus programs and community agencies, the Center serves students, faculty and staff on issues relating to women and gender equity.

8e. Resources: Library

As the majority of the resources required by this PhD program are already available to our current Professional Students and CoP Faculty, there will only need to be a modest increase in Library resources, see documents of resources and support from the current librarian (Appendix J). The CoP supports a full-time librarian and provides the library with a generous stipend each year.

9. Program Parameters

The core group of disciplines that make up the pharmaceutical sciences are pharmaceuticals, medicinal chemistry, pharmacognosy, and pharmacology. Individuals with expertise in these areas will always play a key role in providing products and services to consumers, medical professionals, government policy makers, Government regulatory and enforcement bodies, research scientists, and a multitude of private industries related primarily to healthcare, but also to associated areas that deal with dietary supplements, cosmetics, fine chemicals, agriculture, animal health and the like. To help provide such products and services and to improve the health of people in Hawaii and the Asia-Pacific region, as well as the nation as a whole, we have designed a PhD program to take the best advantage of our location and resources. Primarily, the program is designed to prepare future leaders in these areas of expertise who can expand our knowledge base concerning the pharmaceutical sciences in a general sense but with an emphasis on natural products and their use in traditional healthcare and natural healing systems. In so doing the program will help with the discovery, synthesis, analysis, preparation, delivery and development of new and known chemical entities as products or leads to new products. It is also expected that new approaches to drug discovery, analysis, synthesis, analysis, preparation, delivery and development will also be developed, and that existing approaches will be refined and improved upon.

To ensure that graduates are prepared for these undertakings, students will be expected to demonstrate (1) a comprehensive understanding of core pharmaceutical sciences knowledge, (2) advanced scholarship in a specialty area (pharmaceuticals, medicinal chemistry, pharmacognosy, and pathophysiology) with an emphasis, where appropriate, on one of the other topic areas as well, and 3) appropriate exposure to social and career-building disciplines (e.g., education, communications, information technology, technical writing, behavioral sciences). Students will also be expected to conduct original scholarly research, develop skills in research methodologies and grant writing, understand research ethics, and be able to disseminate research findings to others via peer-reviewed publications, participation in local and national scientific conferences and other practical applications. The specific admission and degree requirements needed to gain admission into the program follow.

9a. Admissions. The admission process will be considered a key step in ensuring the success and quality of the program and its graduates; consequently, applicants will be carefully evaluated and selected. Students will need to submit all of their application materials to the UHH CoP PhD Program Admissions Committee, who will select entrants into the program. This Committee is made up of faculty members with proven records in successful mentoring of graduate students. The admission criteria and procedures will conform to the UH Graduate Division's standards for doctorate programs. To ensure consistent quality of training and financial support, the number of applicants admitted will be kept in line with the availability of dissertation advisors and available support (i.e., funding to support the student for 4-5 years). A student cannot be admitted into the program by the Admissions Committee in the absence of a plan to support them and evidence of a good "fit" between the student's needs and interests, and a faculty member's ability to serve as a dissertation advisor and mentor. It is anticipated that 5-10 doctoral students will be admitted into the program each year reaching a total enrollment of about 25-30 students when the program matures.

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Applicants should have a BS, MS, PharmD and/or equivalent degree. Additional admission requirements include; successful passing grades in General Biology I and II for Science Majors with Labs, Human Anatomy and Physiology I and II with Labs, Microbiology with Labs, General Chemistry I and II for Science Majors with Labs, Organic Chemistry I and II for Science Majors with Labs, Calculus 1 or Advanced Calculus, a minimum grade point average of 3.0 out of 4.0 (exceptions may be granted on a case by case basis), submission of GRE general test scores that demonstrate performance above the 50% percentile, three positive letters of recommendation including one from a Professor of one of the Natural or Physical Sciences, and a completed Graduate Admissions Application including a personal statement of objectives and resume. Foreign applicants must obtain a TOEFL score of 600 or above. Interviews in person will be required of all applicants deemed admissible by the Admissions Committee for the PhD in Pharmaceutical Science. In selecting applicants for admission, particular attention will be paid to the quality and depth of the personal statement, the strength of the letters of recommendation (i.e., they must indicate exceptional potential) and the professional qualities and academic depth presented in the personal interview.

9b. Degree requirements. The principal requirements for the PhD degree are: (1) During first, or qualifying year in the program, obtain an overall grade of B or better when all core courses and one elective have been completed, (2) complete required coursework, (3) pass a comprehensive exam to demonstrate advanced scholarship in the field, and (4) defend a doctoral dissertation that presents original, independent research. In addition, all PhD candidates will be required to participate in a substantial teaching project with a faculty mentor during at least one semester of their program. This is intended to augment their training, enhance their overall training dossier so they will be more competitive for the marketplace, while at the same time improving the quality of the PharmD program.

Qualifying Year. The purpose of the qualifying year is to determine whether the student has the necessary background to proceed with a doctoral program and to enable their selected primary advisor and other advisors to assist the student in planning their program of study. The core subjects and electives may be examined by oral and/or written examination as decided by the examining committee. All students entering the program with a BS degree will be required to pass the first, or qualifying year, with a grade of B or better. Candidates entering with an MS or higher degree must also pass the first, or qualifying year with a grade of B or better. PharmD graduates entering from the UHH CoP program are exempt from the exam, as suitability for the PhD program will be based on their successful completion of the PharmD program.

Also during this year students must select a primary advisor. This selection process is started in first year fall semester by the student first visiting and interviewing with each of the faculty members in the Department. These interviews will help the student become acquainted with the individual faculty members and to learn of their research interests. As they approach a final decision on the selection of a primary advisor, they are encouraged to talk more than once with those faculty members of particular interest. Once a primary advisor is selected students are expected to start their research in the summer of their first academic year. Until a primary advisor is selected the Director of the PhD Program will serve as the student's informal advisor.

Research proposal defense. All students will be required to defend their dissertation research proposal and, where applicable, research progress to the satisfaction of their dissertation committee. They must do this after they pass their qualifying year, and before they complete their second year. This defense will serve as a capstone, and assure that the student can demonstrate sufficient research skills and knowledge of the research plan to proceed with the dissertation research.

Required course work. The required course work, research defense, and qualifying year described above will assure that all students obtain sufficient core knowledge and introductory research skills to proceed toward the PhD degree. After the above requirements are met, all PhD students will be expected to take a recommended minimum of 40 (24 being the official recommended minimum) credits of graduate level coursework (excluding research credits) as described below:

- 19 credits of graduate level core coursework
- 12 credits of courses related directly to their research topic
- 2 credits related to publication and grant preparation

Proposal for PhD in Pharmaceutical Sciences

4 credits of approved electives

3 credits of directed reading and research assignments (seminars)

The student, in consultation with his/her dissertation advisor, will decide on the specific courses selected to meet satisfactorily meet program requirements. An example of a typical course of study for a student entering the PhD program is shown in **Appendix D**.

To foster the development of teaching skills, all PhD candidates must also participate in a substantial teaching project during at least one semester of their program. All students who are not paid teaching assistants are required to develop, with a willing instructor of their choice, an instructional experience equivalent to a half time TA. At the conclusion of the experience their instructional mentor must submit a written evaluation of their performance to the Director of Graduate Studies. Unsatisfactory evaluations will result in the need to repeat the experience until a favorable evaluation is achieved.

Comprehensive exam. When candidates have completed all, or most of their coursework toward the PhD, they must pass a comprehensive exam. The timing of the exam will be decided upon by the student in consultation with their advisor. The purpose of this exam is to determine the student's comprehension of fundamental pharmaceutical sciences knowledge, theoretical expertise in their research discipline, and competence in research, communications, and critical thinking skills to ensure that they can excel as a professional in the field. The form of the exam will be both written and oral. It will be conducted by an examination committee composed of at least three members of the faculty (including the student's advisor) with collective expertise to cover the range of expectations listed above. The composition of the Committee can be proposed by the student in consultation with their advisor. To ensure the quality and consistency of exam committees, its composition must be approved by the Director of Graduate Studies. The time frame and grading of the exam will be decided by the committee. The examination criteria and procedures will conform to UH Graduate Division's standards doctorate programs.

The student must pass this exam to remain in the PhD program. The exam is repeatable once after successful petition to the Director of Graduate Studies.

Dissertation. All PhD candidates must conduct scholarly, independent, original research that contributes new knowledge to the field. The candidates develop and conduct research projects under the direction of their dissertation advisor and committee. At the conclusion of the research, students write a dissertation, i.e., a scholarly presentation of their research in publication form. The student's dissertation committee then conducts a final examination to assess the student's ability to orally present their dissertation in a seminar format and defend their research and dissertation by answering any questions from the audience. The dissertation committee will attend the seminar but reserve most questions for the private examination to follow. The final exam is repeatable once after successful petition to the Director for Graduate Studies. The final exam criteria and procedures will conform to the UH Graduate Division's standards for doctorate programs.

9c. Program Administration

The PhD in Pharmaceutical Science will be housed within the University of Hawaii at Hilo's College of Pharmacy. The current planning Chair of this program will serve as the programs first Director and will be responsible for day-to-day leadership and administration of the program. The Program Director will Chair the Graduate Program Committee that will have the responsibility to propose policy and facilitate program development. If needed, the Committee may choose to add additional members drawn from the faculty involved in the program. The Graduate Program Committee will seek input from, and poll the faculty for approval of any major proposed changes in program policy or requirements. As with all graduate programs, overall administrative leadership will come from the Graduate Division.

Dissertation committee. This committee will be comprised of the primary advisor and a minimum of four other members. The examination committee will be chaired by the primary advisor. Additional members of the committee will be other faculty members actively involved in the PhD program. Typically, at least one outside member will be included who will hold a doctorate and have at least two years experience as an Assistant Professor or equivalent.

10. Program Efficiency

From the information presented in the spread sheets found in **Appendix K** it is evident that the program in the short to medium term will essentially be financially neutral. While being financially neutral the program will in other ways start to be extremely profitable in terms of generating economic and educational prosperity within the State of Hawaii. As noted elsewhere in this document, the College of Pharmacy is already generating significant revenue for the University and the community. With the addition of a PhD program this quality of the College will be further enhanced. PhD students will enable faculty to better use their time and also increase the chances for making unique scientific discoveries as well as facilitate the production of many more research results than one faculty member would likely produce alone. These discoveries and results will be used to support grant applications and also to leverage support from other potential funding organizations. It is also likely that in the medium to long term organizations from the both the private and public sectors will approach the College for partnerships, collaborations and consultations, all of which will further enhance the overall efficiency of the program. Once graduated, our students will all give back to the program, and hence the State, in-kind throughout the rest of their careers. This latter quantity is extremely difficult to estimate as efficiency but it is clear that the graduates never stop giving back in some way to the PhD program they graduated from.

Aside from these obvious efficiencies it is expected that the establishment of a PhD program will greatly assist with faculty retention, a variable whose significance cannot be undervalued. Every time a faculty member has to be replaced the cost to the overall system is significant, so any step that ensures faculty remain productive, stable and content in their activities should be embraced. Many faculty associated with the College, especially those in the Department of Pharmaceutical Sciences, have the expectation of being part of a full academic program, meaning one that offers a PhD. Without this program, there is a greater chance of faculty turn-over.

In conclusion, it is expected that the PhD Program in Pharmaceutical Sciences will generate significant value for the State of Hawaii, and this is especially appealing since no new resources are required or requested.

11. Program Quality and Evaluation

The most important aspects determining the quality of a PhD program are the quality of its faculty and their resources. By examination of the faculty members listed Section 8a, it is evident that the potential for a quality program exists at the College of Pharmacy at the University of Hawaii at Hilo.

All current faculty members obtained their graduate degrees from programs within highly regarded Universities either nationally or internationally. The faculty members know from experience what a quality PhD program in the pharmaceutical sciences entails and can provide quality mentorship for students in the program. Currently, all faculty are successfully training PharmD and post-doctoral research associates in the Pharmaceutical Sciences.

The experience and training of current faculty members is illustrated by the curricula vitae found in **Appendix G**.

11a. Evaluation Benchmarks for Program Progress

The program will be expected to reach benchmarks of quality and productivity at the time of provisional review that show it emerging in the upper half of pharmaceutical sciences PhD programs in the nation. Benchmarks are listed below. The data given represents an average from queries made of Graduate Chairs of seven (7) PhD programs in the pharmaceutical sciences considered to be in the top 50% nationwide (Rutgers University, Purdue University, Oregon State University, University of the Sciences in Philadelphia, University of Utah, University of Illinois at Chicago, Temple University), and of the Chemistry Department at UH Manoa.

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Benchmarks:

Results for Benchmark questions from seven (7) high ranking Colleges of Pharmacy for the last four (4) years and UH Manoa Chemistry Department:

Benchmarks	Benchmark Results for Colleges 1 – 7 and UH Manoa Department of Chemistry (8)							
	1	2	3	4	5	6	7	8
Average number of PhD students graduated per year	2-3	21	6	4	6-8	20-25	1-2	2-3
% of graduates accepted into post doc or other professional positions	100	100	>80	NA	>95	>95	100	100
Average number of publications by PhD student based on their dissertation research	4-6	NA	2-3	NA	3	2-4	2-3	6-9
% of PhD students that are supported by faculty research grants	50	66	50	15	100	35	40	28
% of PhD students that are supported by teaching assistantships	30	34	50	60	0	65	60	70
Average number of presentations at national meetings during PhD program	1-2 ^a	NA	1-2	1-2	2-3 ^a , 1 ^b	3-4	4 ^a	1

Colleges: 1. Rutgers University (Med. Chem.); 2. Purdue University; 3. Oregon State University; 4. University of the Sciences in Philadelphia; 5. University of Utah; 6. University of Illinois at Chicago; 7. Temple University; 8. UH Manoa Chemistry.

^aPoster presentations

^bOral presentations

11b. Program Assessment

The program will be assessed using the benchmarks and assessment steps listed in Section 11a, and the post-graduate survey instrument shown in Appendix L.

12. Student Assessment

The following steps will foster and assess students' progress:

Learning Outcomes. The learning objectives of the program are to have students demonstrate mastery of fundamental knowledge in the pharmaceutical sciences as well as advanced scholarship in their specialty area. In addition, students will be expected to be able to communicate both orally and in writing at a high level of proficiency, conduct and interpret scientific research data, and function as a professional in the pharmaceutical sciences.

Publication of Learning Outcomes. The above learning objectives will be published in the program summary sent to all prospective students, on the program's departmental website, and in the programs Guide for Graduate Students given to all prospective and admitted students.

Mapping Learning Outcomes into the Program. Fundamental knowledge in the pharmaceutical sciences is mapped into the program by requiring prerequisite degrees in basic science and related disciplines in the students undergraduate, MS, and PharmD preparation. An oral candidacy exam conducted by faculty with expertise spanning all areas of the pharmaceutical sciences is administered early in the student's program and any deficiencies in fundamental knowledge uncovered in the exam are required to be remedied by additional coursework or other appropriate approaches like independent studies, teaching assistant duties, faculty mentoring, or internships.

Advanced scholarship is mapped into the program by requiring at least 24 credits of graduate level coursework in the pharmaceutical sciences as well as 12 credits in interdisciplinary courses related to the student's specialty area and two credits in career building skills. Scholarship in the student's specialty area is mapped in by the Chair of the student's dissertation committee who guides the student in the selection of elective courses to shape that specialty area, as well as by mentoring the student in that area during the research and thesis writing processes. When candidates have completed all, or most of their coursework toward the PhD, they must pass a comprehensive oral and written exam. The purpose of this exam is to determine if the student can demonstrate advanced scholarship in the pharmaceutical sciences, expertise in their research discipline, and competence in communication and professionalism. A student must pass this exam to remain in the PhD program.

Oral communication skills are mapped in by requiring the students to enroll in at least three pharmaceutical science seminar classes where they present a critical evaluation of a selected topic, by the oral candidacy and comprehensive exam questions, by requiring all students to act as a teaching assistant during at least one semester of their program, by requiring an oral presentation of their dissertation research at their final exam, and by presentations at national conferences. Written communication is mapped in by writing assignments and essay type exams in courses, a written proposal for the student's research, written answers on qualifying and comprehensive exams, a written PhD dissertation required for the final exam, and by research articles submitted for publication.

Conducting pharmaceutical science research is mapped in by the requirement of a scholarly, independent, original dissertation research project conducted under the guidance of a research mentor (Chair of the dissertation committee) and a dissertation committee. Interpretation of research is mapped in by seminar courses requiring the oral presentation of a research paper or proposal, by proposal writing, by journal clubs, by the literature review required in the dissertation and in research articles submitted for publication.

The ability to function as a professional in the field is mapped in by the requirement of passing both a candidacy exam and comprehensive exam to demonstrate professional scholarship and communication skills, the requirement of at least one semester as a teaching assistant and three seminar presentations to demonstrate presentation and pedagogical skills, the production of an original, independent, scholarly dissertation, and the expectation to publish in peer-reviewed journals and present research findings at national conferences to demonstrate professional research skills.

Assessment events:

a) *Candidacy Exams.* Prior to the exams, the student's advisor and the Examination Committee review the student's academic progress. The purpose of this process is to ensure that the student has enrolled in, or plans to enroll in, the proper required courses. In addition, timely progress on the student's proposed research is also evaluated. The candidacy exam itself is used to evaluate if the student has a mastery of fundamental knowledge in the pharmaceutical sciences and related fields, and can express this knowledge in a professional manner. If any deficiencies in fundamental knowledge or communication skills are uncovered, then the Examination Committee recommends coursework, independent study, mentorship by a faculty member, seminar presentations, or other appropriate means to remedy the deficiency.

b) *Required research defense.* All students enrolled in the program will be required to orally defend their dissertation research proposal and, where applicable, research progress to the satisfaction of their Dissertation Committee. They must do this after they pass their candidacy exams. This will assure that the student can demonstrate sufficient research skills and knowledge of the research plan needed to proceed with the PhD dissertation.

c) *Required Seminar Presentations.* At least three seminar presentations focusing on research literature are required in the student's program. These presentations are used to evaluate the student's ability to interpret research literature and present literature reviews in a professional format using appropriate oral and visual (e.g., PowerPoint) communication skills. The presentations are used by the seminar instructor and the student's advisor to evaluate the student's proficiency and potential need for further development.

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d) *Required Teaching Assistant Experience.* All students are required to assist a faculty member with instructional-related work for at least one semester during their program. The faculty member and the student agree on a set of instructional-related duties prior to the start of the semester. At the end of the semester, the instructor evaluates the student's performance in writing with a copy forwarded to the Director of the graduate program. If the evaluation is unfavorable, the experience must be repeated until a favorable evaluation is achieved. This teaching experience is used to evaluate the student's ability to work in a professional educational context.

e) *Comprehensive exam.* When candidates have completed all, or most of their coursework toward the PhD, they must pass a comprehensive oral and/or written exam. The Dissertation Committee conducts the exam. The purpose of this exam is to determine the student's comprehension of fundamental pharmaceutical sciences knowledge, expertise in their area of specialty, and competence in research, communications and critical thinking skills to insure that they can excel as a professional in the field. A student must pass this exam to remain in the PhD program.

f) *Dissertation defense/final exam.* This culminating experience evaluates the student's ability to conduct and present original, independent, scholarly research in a professional manner. The Final Exam Committee evaluates these abilities by reading the dissertation, listening to the oral presentation, and conducting an oral exam covering all aspects of the dissertation and presentation. If any aspect of the final exam is unsatisfactory, the student is asked to remedy the situation. This may involve rewriting, conducting more research, preparing a new presentation, or enhancing their understanding of the research in order to demonstrate that they can function at the professional level as a researcher in the field.

Contributions to discipline:

a) *Publications.* All PhD students contribute to the discipline by publishing a dissertation. It is expected that all PhD graduates will publish at least two articles in a peer-reviewed professional journal.

b) *Presentations at professional conferences.* It is expected that all PhD students present their research at a national or international research conference sponsored by professional research organizations in the field such as the American Society of Pharmacognosy. Additional presentations will also be made in the CoP symposium series.

Monitoring student post-graduate professional activities. A survey instrument has been developed, see Appendix L, to monitor post-graduate professional activities and obtain feedback on satisfaction with the PhD program.

The CoP retains a full-time Assessment Coordinator who will assist with the activities described above.

13. References and Notes

- [1] Report of the 2006/2007 COF/COD Task Force on Faculty Workforce June 15, 2007. Chairs of the Council of Faculties (COF) and the Council of Deans (COD) within the American Association of Colleges of Pharmacy (AAPC).
- [2] Augsburger, L. L. Ensuring the Supply of Highly Qualified Pharmaceutical Scientist Specialists in Product Development and Related Technologies for Present and Future Needs - Report of the 2004 PT Section Education Committee, *AAPS Pharm. Sci. Tech.*, 2007, 8 (1), Article 19 and <http://www.aapspharmscitech.org>.
- [3] Visit resources at:
<http://www.aacp.org/resources/research/institutionalresearch/Pages/TrendData.aspx>
- [4] Article from [channelnewsasia.com](http://www.channelnewsasia.com):
<http://www.channelnewsasia.com/stories/economicnews/view/412779/1.html>[10/3/2010 1:44:32 PM]

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- [5] Pellegrin, K. L., Pezzuto, J. M. Strategic direction for high demand degrees: an analysis of the US pharmacy degree competitive market, *Int. J. Management Edu.*, 2010, in press.
- [6] Greenwood, M. R. C. The University of Hawai'i for the 21st Century, 2010 Initiative Brochure.
- [7] B. Patwardhan, D. Warude, P. Pushpangadan N. Bhatt. Ayurveda and Traditional Chinese Medicine: A Comparative Overview, *Evid. Based Compl. Med.*, 2: 465-473, 2005.
- [8] Cheng, J., Lee, P., Li, J., Dennehy, C. E., Tsourounis, C. Use of Chinese herbal products in Oakland and San Francisco Chinatowns, *Am. J. Health-Syst. Pharm.*, 61: 688-94, 2004.
- [9] Visit the home page of the National Center for Complementary and Alternative Medicine:
<http://nccam.nih.gov/>
- [10] Weinman B., Hawaii should strive to be regional leader in health care, *Star Advertiser*, Editorial, Sunday, October 3, 2010.
- [11] Approved UH-Hilo College of Pharmacy Master Strategic Plan 2009-2015.
- [12] This is apparent from the millions of dollars of research funding awarded each year by NIH and NSF to drug discovery programs throughout the United States. Visit NIH and NSF home pages for more information.
- [13] Hoffer, T. B., Hess, M., Welch, Jr., V., Williams, K. NORC at the University of Chicago, Chicago, Illinois, *Survey of Earned Doctorates (SED) Summary Report 2006, 2007*.
- [14] Information for 2010; provided by Margaret Shiba, Senior Director of Development, University of Hawai'i at Hilo.
- [15] UUH College of Pharmacy economic impact:
<http://pharmacy.uhh.hawaii.edu/newsletter/KawiliLaauSpring09SE.pdf>
- [16] Survey was conducted using Survey Monkey®: <http://www.surveymonkey.com>
- [17] US Department of Labor, Bureau of Labor Statistics, Occupational Outlook Quarterly, Occupational Outlook Handbook, 2010-11 Edition, Overview of the 2008-18 Projections:
<http://www.bls.gov/oco/oco2003.htm>.
- [18] US Department of Labor, Bureau of Labor Statistics, Occupational Outlook Quarterly, Occupational Outlook Handbook, 2010-11 Edition, Overview of the 2008-18 Projections, Career Guide to Industries:
<http://www.bls.gov/oco/cg/home.htm>.
- [19] Hartzema, A.G., Perfetto, E.M. Internal Rate of Return and Pharmaceutical Sciences Manpower Supply. *Pharm. Res.*, 8: 676-682, 1991.
- [20] Dwoskin, L. of the University of Kentucky's College of Pharmacy:
<http://pharmacy.mc.uky.edu/faculty/LindaDwoskin.php> see CV and references and patents therein.
- [21] Luesch, H. of the University of Florida's College of Pharmacy: In January, the Luesch group from Florida reported (*J. Am. Chem. Soc.*, 130: 1806-1807, 2008) the isolation and characterization of an antiproliferative natural product called largazole. Subsequently, largazole has been synthesized and found to be an inhibitor of HDACs (*J. Am. Chem. Soc.*, 130: 8455-8459, 2008). The compound is moving towards clinical trials.
- [22] Kinghorn, A. D. of Ohio State University's College of Pharmacy, *NCI Cancer Bulletin*, October 20, 2009, Vol 6, No. 20, Pg. 4.

14. Cost Explanation and Budget Sheets

Cost analysis is presented in the next two pages. As noted in the program proposal, however, *there are absolutely no requests for any additional resources to implement this program.* When the College of Pharmacy (CoP) was started in 2007, implementation and phasing in of the PhD program was taken into account. The existing faculty members who will participate in the program are listed in the document. In addition, three additional PhD-level faculty members are currently being recruited in the Department of Pharmaceutical Science, and it is likely that at least three of the faculty members currently being recruited in the Department of Pharmacy Practice will either have a PhD or a PharmD/PhD. The number of faculty listed in the revenue template provides an indication of the number involved in the didactic portion of the curriculum. Existing faculty members who have been involved in planning and preparation of course syllabi are now ready to deliver. Obviously, many additional faculty members will be involved in research training, but these individuals are already conducting active research programs so the new graduate students will simply be incorporated. All necessary equipment is in place and the new graduate students will have access. Further, all CoP faculty members involved in research have postdoctoral associates working in the laboratories. As summarized on page 5 of the Executive Summary, with support derived from start-up funding or federal grants, there are currently 20 post-doctoral associates, four visiting scholars, seven research assistants, and several research volunteers, within the CoP. Importantly, in addition to faculty members themselves, these scientists will be instrumental in providing practical training for graduate students. In sum, due to cogent planning and success in meeting all of our benchmarks, the CoP has full confidence in launching a high quality graduate program without the necessity of requesting any additional internal resources.

15. Campus and System Approval

- CoP Graduate Program Planning Committee: Approve: 6; Not Approve: 0; Abstain: 0.
- CoP Faculty: Approve: 27; Not Approve: 0; Abstain: 0.
- UH Hilo Graduate Council: Approved without dissent.
- UH Hilo Curriculum Committee: Approved without dissent.
- UH Hilo Faculty Congress: Endorsed.
- UH Council of Chief Academic Officers: Endorsed.

	A	B	C	D	E	F	G	H	I	
	ENTER ACADEMIC YEAR (I.e., 2004-05)									
	Students & SSH									
	A. Headcount enrollment (Fall)									
	B. Annual SSH									
	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017				
7	6	12	18	24	30	30				
8	174	318	482	608	750	760				
11	Direct and Incremental Program Costs Without Fringe									
12	C. Instructional Cost without Fringe									
13	C1 Number (FTE) of FT Faculty/Lecturers									
14	1.50	3.00	4.50	6.00	6.00	6.00				
15	C2. Number (FTE) of PT Lecturers									
16	17,000	17,680	18,387	19,123	19,888	20,663				
17	20,000	40,400	80,816	81,649	84,915	88,311				
18	157,000	288,080	439,203	595,171	614,034	638,586				
19	F. Total Direct and Incremental Costs									
20	Revenue									
21	71,808	164,919	249,183	339,925	437,527	455,028				
22	Tuition	413	519	539	561	563				
23	Tuition rate per credit	100,000	150,000	200,000	250,000	250,000				
24	H. Other	171,808	314,919	449,183	599,925	687,527				
25	I. Total Revenue	-14,808	-16,839	-9,860	5,246	-73,493				
26	J. Net									
27										
28										
29										
30	Program Cost per SSH With Fringe									
31	K. Instructional Cost with Fringe/SSH									
32	931	1,019	1,052	1,101	917	953				
33	120,000	240,000	360,000	494,400	509,232	529,601				
34	162,000	324,000	486,000	667,440	687,463	714,962				
35	K2 Cost Including Fringe of K1									
36	K3. Total Salary PT Lecturers									
37	K4 Cost Including fringe of K3									
38	L. Support Cost/SSH	440	458	476	495	515				
39	Non-instructional Exp/SSH	391	407	423	440	457				
40	System-wide Support/SSH	49	51	53	55	57				
41	Organized Research/SSH	1,371	1,476	1,528	1,596	1,431				
42	M. Total Program Cost/SSH	745	775	806	838	872				
43	N. Total Campus Expenditure/SSH									
44	Instruction Cost with Fringe per SSH	931	1,019	1,052	1,101	917				
45	K. Instructional Cost/SSH	1,750	1,820	1,883	1,969	2,047				
46	O. Comparable Cost/SSH									
47	Program used for comparison	Manoa Graduate Level Natural Science								
48	Reviewed by campus VC for Administrative Affairs: <i>[Signature]</i> (date) 1/25/11									

Notes to Academic Cost and Revenue Template

	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017
A. Headcount enrollment (Fall)						
Resident	4	8	12	16	20	20
Non-Resident	2	4	6	8	10	10
Total	6	12	18	24	30	30
B. Annual SSH						
Headcount	6	12	18	24	30	30
SSH per full-time student per Academic Year	29	27	26	25	25	25
Total	174	318	462	606	750	750
D. Other Personnel Costs						
APT (Academic Support)	\$ 17,000	\$ 17,680	\$ 18,387	\$ 19,123	\$ 19,888	\$ 20,683
Total	\$ 17,000	\$ 17,680	\$ 18,387	\$ 19,123	\$ 19,888	\$ 20,683
CB increase		0%	0%	0%	0%	0%
Inflation increase		4%	4%	4%	4%	4%
E. Unique Program Costs						
Library	\$ 10,000	\$ 10,400	\$ 10,816	\$ 11,249	\$ 11,699	\$ 12,167
Equipment Maintenance	\$ 5,000	\$ 10,000	\$ 10,000	\$ 10,400	\$ 10,816	\$ 11,249
Others (Supplies)	\$ 5,000	\$ 20,000	\$ 40,000	\$ 60,000	\$ 62,400	\$ 64,896
Total	\$ 20,000	\$ 40,400	\$ 60,816	\$ 81,649	\$ 84,915	\$ 88,311
G. Tuition Rate Per Credit						
Tuition is based on 4 Resident (\$8352) and 2 Non Resident						
Tuition (Per year)	\$ 11,968	\$ 12,447	\$ 12,945	\$ 13,462	\$ 14,001	\$ 14,561
Credits per student	29	24	24	24	24	24
Tuition rate per credit	\$ 413	\$ 519	\$ 539	\$ 561	\$ 583	\$ 607
H. Revenue - Other						
Grants	\$ 100,000	\$ 150,000	\$ 200,000	\$ 250,000	\$ 250,000	\$ 250,000
Grants total	\$ 100,000	\$ 150,000	\$ 200,000	\$ 250,000	\$ 250,000	\$ 250,000
Total	\$ 100,000	\$ 150,000	\$ 200,000	\$ 250,000	\$ 250,000	\$ 250,000
K1. Total Salary FT Faculty/Lecturers						
New Faculty 1	\$ 80,000	\$ 80,000	\$ 80,000	\$ 82,400	\$ 84,872	\$ 88,267
New Faculty 2	\$ 40,000	\$ 80,000	\$ 80,000	\$ 82,400	\$ 84,872	\$ 88,267
New Faculty 3		\$ 80,000	\$ 80,000	\$ 82,400	\$ 84,872	\$ 88,267
New Faculty 4			\$ 80,000	\$ 82,400	\$ 84,872	\$ 88,267
New Faculty 5			\$ 40,000	\$ 82,400	\$ 84,872	\$ 88,267
New Faculty 6	\$ -	\$ -	\$ -	\$ 82,400	\$ 84,872	\$ 88,267
Total	\$ 120,000	\$ 240,000	\$ 360,000	\$ 494,400	\$ 509,732	\$ 529,601
CB increase		0%	0%	3%	3%	0%
Inflation increase		0%	0%	0%	0%	4%
K3. Total Salary PT Lecturers						
Number of credits taught	3	6	9	9	9	9
Step 8 rate	\$ 1,442	\$ 1,518	\$ 1,556	\$ 1,603	\$ 1,651	\$ 1,717
Total	\$ 4,326	\$ 9,108	\$ 14,004	\$ 14,427	\$ 14,859	\$ 15,453

