



**University of Hawai'i at Hilo
College of Pharmacy**

PhD in Pharmaceutical Sciences

**Student Handbook
2012 - 2013**



Education • Scholarship • Service

Improving Health in Hawai'i & Throughout the Pacific

Introduction

Guidelines for Graduate Study for the College of Pharmacy, PhD in Pharmaceutical Sciences supplements the policies and procedures set forth by the University of Hawai'i at Hilo Graduate Council. As graduate students at the University of Hawai'i at Hilo, you are members of the Graduate Program. The Graduate Program has certain policies and procedures which are outlined in the [UH-Hilo Graduate Student Handbook](#). **This document outlines additional policies and procedures**—departmental policies and procedures that have been established by the faculty of the College of Pharmacy. Upon reading these procedures and requirements, you will realize that the faculty of the department has set basic goals for all graduate students. We hope that each of you will set higher goals for your own personal and scientific development. The faculty of the department will do everything possible to assist you in achieving those goals.

Accreditation

The PhD in Pharmaceutical Sciences was provisionally approved by the Western Association of Schools and Colleges (WASC) on April 11, 2011.

Program Mission

The mission of the Ph.D. program in Pharmaceutical Sciences is to train students to be skilled researchers and critical thinkers who will play key leadership roles in furthering the development of the Pharmaceutical Sciences and related fields now and into the future.

Program Description

Utilizing the extraordinary intellectual, biological, physical and cultural diversity of its geographic region as a focus of investigation and study, the University of Hawaii at Hilo's College of Pharmacy is proud to offer a Ph.D. program in the Pharmaceutical Sciences.

This program, which is the only program of its type in the Pacific region, provides graduate training in the Pharmaceutical Sciences including; Medicinal Chemistry, Pharmacology, Pharmaceutics, and Pharmacognosy. It is aimed at students with B.S., M.S., or Pharm.D. degrees, and those currently working in the field. Studies 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.

Students will be prepared for senior leadership positions in the pharmaceutical sciences in academia, research, education, government, industry and related fields and become leaders who can identify, research, and problem solve issues related to the pharmaceutical sciences. The Ph.D. program is designed to foster student development as critical thinkers, team players, self-directed interdisciplinary scholars and communicators.

Selection of a Major Professor

It is essential that each graduate student select a dissertation supervisor (Major Professor) early in their graduate career. This selection process is begun by first visiting with various faculty members in the department. These interviews will help you to become acquainted with the individual faculty members and to learn of their research interests. As you approach a final decision on the selection of a Major Professor, you may wish to talk more than once with those faculty members of particular interest. Your selection of a Major Professor must be completed by the end of the first academic year (exceptions require approval of the Director of the Ph.D. program). It is strongly suggested that you select as early as possible as this will permit you to formulate a plan of study with your Major Professor and your Advisory Committee so that you are able to select the proper courses during your second year in the department. Before the selection becomes finalized individual faculty must agree to becoming the student's Major Professor. In addition, you are encouraged to begin your research no later than the summer of your first academic year. Until you select a Major Professor, the Director of the Ph.D. program will serve as your faculty advisor.

Dissertation Committee-Selection of Advisory Committee

Please refer to appropriate section of the [UH-Hilo Graduate Student Handbook](#).

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 Associate Professor	Biology	University of Zurich	1998	andre@hawaii.edu
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-Karls 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 Assistant Specialist	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
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 Wongwiwatthanakit PharmD, PhD Associate Professor	Pharmacy Practice	Purdue University	2001	supakit@hawaii.edu
Anthony D. Wright PhD Associate Professor	Organic Chemistry	James Cook University, Australia	1988	adwright@hawaii.edu

Graduation Requirements

1. Successful achievement of candidate status after year one of the student's program.
2. Regardless of any previous graduate experience, a minimum of 24 graduate didactic credit hours must be taken at UH Hilo before the Ph.D. degree can be granted.
3. Completion of all first year graduate courses with a grade of no less than "B", and all subsequent courses with an average grade of no less than "B".
4. Successful completion of one seminar each year.
5. No later than the end of the third year of the program successful completion of a comprehensive oral examination following a seminar presentation of the candidate's plans for their dissertation. In this examination the student's Graduate Committee will determine if the student is sufficiently prepared in the selected field of study to continue with their dissertation.
6. Successful completion of a dissertation, with enrollment in a minimum of 56 credits of PHPS 800. Upon completion of the dissertation a final oral dissertation defense will follow.
7. Completion of at least 96 combined credits of graduate courses and dissertation; PHPS 600, PHPS 700 and PHPS 800.
8. Compliance with UH Hilo rules and regulations for graduation.

Academic Calendar

Please go to: <http://hilo.hawaii.edu/registrar/currentterm.php>

PhD in the Pharmaceutical Sciences Curriculum

To successfully complete the PhD degree candidates must complete; qualifying year 1 (Minimum GPA = 3.0); a minimum of 24 graduate level didactic credits; after first year courses must be completed with GPA average of no less than 3.0; a minimum 56 credits of Dissertation; a minimum of 96 credit hours overall (Minimum average GPA = 3.0).

PhD Year 1 (Qualifying Year) Fall Courses *Total of 11 credits*

PHPS 750 PhD Overview of the Pharmaceutical Sciences (3)

PHPS 751 PhD Biochemistry I– Biomolecules (4)

PHPS 755 Advanced Pharmaceutics I, including Dosage Form Design and Processing (3)

PHPS 718 Research Laboratory Rotation and Graduate Seminar (1)

PhD Year 1 (Qualifying Year) Spring Courses *Total of 13 credits*

PHPS 800 Dissertation Research and Graduate Seminar (6)

PHPS 752 PhD Biochemistry II– Metabolism (4)

PHPS 756 Advanced Pharmaceutics II, including Dosage Form Design and Processing (3)

PhD Year 2 Fall Courses *Total minimum of 12 credits*

PHPS 800 Dissertation Research and Graduate Seminar– (Minimum 6)

Electives – (No minimum)

PhD Year 2 Spring Courses *Total minimum of 12 credits*

PHPS 800 Dissertation Research and Graduate Seminar– (Minimum 6)

Electives – (No minimum)

PhD Year 3 Fall Courses *Total minimum of 12 credits*

PHPS 800 Dissertation Research and Graduate Seminar– (Minimum 6)

Electives – (No minimum)

PhD Year 3 Spring Courses *Total minimum of 12 credits*

PHPS 800 Dissertation Research and Graduate Seminar– (Minimum 6)

Electives – (No minimum)

PhD Year 4 Fall Courses *Total minimum of 12 credits*

PHPS 800 Dissertation Research and Graduate Seminar– (Minimum 6)
Electives – (No minimum)

PhD Year 4 Spring Courses *Total minimum of 12 credits*

PHPS 800 Dissertation Research and Graduate Seminar– (Minimum 6)
Electives – (No minimum)

PhD Year 5 and beyond are taken on an as required basis. *Total minimum of 12 credits*

PHPS 800 Dissertation Research and Graduate Seminar– (Minimum 6)
Electives – (No minimum)

Electives – Listed Alphabetically

Course code	Course Title	Credits
PHPS 701	Apoptosis and Angiogenesis in Disease Processes and Drug Development	1
PHPS 702	Biological Evaluation of Natural Products	3
PHPS 703	Cancer Biology	2
PHPS 704	Combinatorial Chemistry and High Throughput Technologies in Drug Discovery	2
PHPS 705	Designing Clinical Research	3
PHPS 706	Environmental Toxicology	2
PHPS 707	Genetics in Medicine	2
PHPS 708	Isolation methods for natural product discovery	2
PHPS 709	Instrumental methods and structure elucidation of mainly natural products	2
PHPS 710	Laboratory Animal Care, Management and Medicine I	2
PHPS 711	Laboratory Animal Care, Management and Medicine II	2
PHPS 712	Medical Cell Biology	2
PHPS 713	Medicinal Chemistry I	2
PHPS 714	Medicinal Chemistry II	2
PHPS 715	Medicinal Chemistry III	2
PHPS 716	Medicinal Chemistry IV	2

PHPS 717	Medicinal Chemistry of CNS Drugs and Development of <i>in vivo</i> CNS Tracers	2
PHPS 719	Molecular Biology Techniques and Applications for Healthcare Professionals	2
PHPS 720	Natural Products and Cancer Chemoprevention	2
PHPS 721	Neuropsychopharmacology	2
PHPS 722	Pharmaceutical Marketing	2
PHPS 723	Pharmacognosy	2
PHPS 724	Pharmacology I	3
PHPS 725	Pharmacology II	3
PHPS 726	Pharmacology III	3
PHPS 727	Pharmacology IV	3
PHPS 728	Phytochemistry of Terrestrial Plants	2
PHPS 729	Receptor Theory and Signal Transduction	2
PHPS 730	Sample collection, documentation and preservation	1
PHPS 731	Toxicants and Toxicity	3
PHPS 732	Toxic plant natural products and their therapeutic potential	2

PhD Course Listings

PhD First Year, Fall (11 Core credit hours)

PHPS-750* PhD Overview of the Pharmaceutical Sciences (3 Core credit hours)

This 3 credit, 45 lecture and written research assignment, course will draw on the basic principles of chemistry, biology and physics to provide an introduction to the basics of the Pharmaceutical Sciences. Some of, but not all, the areas covered include; an overview of the subject as a whole, basic organic functional group chemistry, an introduction to Pharmacognosy, an introduction to Medicinal Chemistry, Combinatorial Chemistry and high throughput technologies in modern drug discovery, architecture of drugs, metabolic changes that occur to drugs, introduction to general Pharmacology, transport of drugs across the biological membranes, introduction to Pharmacodynamics and Pharmacogenomics, general mechanisms of drug action, and variations in drug action.

PHPS-751* PhD Biochemistry I– Biomolecules (4 Core credit hours)

This course is designed to provide a basic foundation for the understanding of medicinal biochemistry, pharmacology, and the structure and function of various biomolecules. Topics will include physical and chemical properties of amino acids, structural and

physical properties of proteins, nucleic acids (DNA and RNA), lipids, and their relationship to their biological function, fundamentals of signal transduction, DNA replication, mutation, and repair, nucleotide biosynthesis, protein synthesis, and transcription. These principles will provide the basic concepts for understanding the biochemical basis for disease states and drug action.

PHPS-755* Advanced Pharmaceutics I, including Dosage Form Design and Processing (3 Core credit hours)

This course will draw on the basic principles of chemistry, biology and physics to provide an understanding of how drug physico-chemical properties at the molecular and macroscopic assembly level are manifest in dosage form properties and performance. Students will integrate these principles to understand issues in the rational selection of dosage forms and drug delivery systems as well as their role in drug product development. Discussions of Good Manufacturing Practices and Good Compounding Practices will carry over into the lab portion of the class. Students will become comfortable with equipment; procedures and records used in the compounding of various dosage forms, and will practice clinical dispensing skills vital to shaping a truly professional pharmacist.

PHPS-718 Research Laboratory Rotation and Graduate Seminar (1 Core credit hour)

Each PhD candidate will visit with at least five (5) of the Graduate level professors to discuss research possibilities and what they would recommend as a course of study for the candidate to gain the experience and knowledge necessary to be granted the PhD degree in the Pharmaceutical Sciences.

PhD First Year, Spring (13 Core credit hours)

PHPS-800 Dissertation Research and Graduate Seminar (6 Core credit hours)

Once the PhD candidate has selected a Primary Advisor with whom to undertake their remaining PhD studies they will start research in this professor's laboratory during the Spring Semester.

PHPS-752* Biochemistry II– Metabolism (4 Core credit hours)

Biochemistry II- Metabolism will delve into metabolism and the interrelationships/integration of metabolic processes. The biochemistry of metabolism focuses on glycolysis, the tricarboxylic acid cycle, gluconeogenesis, and the synthesis

and breakdown of biomolecules (carbohydrates, lipids, and amino acids). Metabolic control and regulation of pathways will be emphasized. This includes a discussion of mechanisms and control of signal transduction pathways, and recurring motifs in metabolism. Clinical correlates and metabolic diseases will be examined, with a substantial emphasis on metabolic syndrome. A sampling of biochemical techniques will also be described.

PHPS-756* Advanced Pharmaceutics II, including Dosage Form Design and Processing (3 Core credit hours)

This course will draw on the basic principles and developmental aspects of drug formulation to deliver the active pharmaceutical ingredient through biological membranes to exert the therapeutic effect at site of action. Understanding of physicochemical properties of active pharmaceutical ingredient and additives or excipients, pharmacological properties and processability of drug delivery systems can be utilized for optimal performance of the drug delivery systems. Understanding of active pharmaceutical ingredient and additive or excipients physico-chemical properties at the molecular and macroscopic assembly level are manifest in dosage form properties and performance.

Students will integrate these principles to understand issues in the rational choice of dosage forms and drug delivery systems as well as their role in drug product development. Discussions of Good Manufacturing Practices and Good Compounding Practices will carry over into the lab portion of the class. Students will become familiar with development aspects of various drug delivery systems, comfortable with equipment; procedures and records used in the compounding of various dosage forms, and will practice clinical dispensing skills vital to shaping a truly professional pharmacy professional scientist.

PhD Second Year Fall to end of Program

A minimum of 12 credit hours have to be taken each semester.

PHPS-800 Dissertation Research and Graduate Seminar – (6 Core credit hours)

A minimum of 6 credit hours of PHPS-800 have to be take each semester.

Electives – (No minimum)

Electives (Listed Alphabetically)

PHPS-701 Apoptosis and Angiogenesis in Disease Processes and Drug Development (1 credit hour)

The course will cover mechanisms of apoptosis, or programmed cell death, and angiogenesis, or new vessel growth, and mechanisms of their regulation in different cell types. Students will learn how unbalanced angiogenic and apoptotic responses contribute to a wide variety of disease conditions, including cancer, neurodegenerative, cardiac, inflammatory and autoimmune diseases. The course will discuss experimental techniques that are used in the studies of these processes. Part of the course is devoted to approaches to development of drugs that will modulate apoptotic and angiogenic processes, and discussions of critical signaling molecules in these pathways as potential targets for drug development efforts.

PHPS-702 Biological Evaluation of Natural Products (3 credit hours)

The biological activity of secondary metabolites is central to the process of drug discovery and development from nature. Natural products may be explored as potential sources of food supplements, pharmaceuticals and agrochemicals. The majority of academic-based research efforts are essentially “biologically driven”, hinging upon the bioassay-guided separation of crude natural product extracts that have been identified as active through a strategic screening and prioritization process that emphasize potency, specificity and selectivity. The chemically-driven approach that seeks biological activities for purified compounds plays a lesser, but nevertheless, significant role. This course will introduce students to the technologies and procedures useful for the discovery and characterization of potential natural product drugs, and principles of more advanced drug development at the preclinical stage. Lectures will discuss the use of specific assays with target receptors and enzymes involved in the pathogenesis of select diseases, in addition to procedures involving tissues, whole cells and organisms (“functional assays”). Lectures will also include the applications of genetically engineered microorganisms in drug discovery, as well as animal models where applicable. The genomics era will present opportunities for the exploration of novel assays as new molecular targets for chemotherapy are identified.

PHPS-703 Cancer Biology (2 credit hours)

An introduction to cancer biology covering the processes involved in tumorigenesis (oncogenes, mutagenesis, proliferation, apoptosis, angiogenesis, invasion and metastasis). There will be discussion of active areas of interest such as cancer stem cells and the role of inflammation in cancer. Lectures will include descriptions of current therapeutics, describe efforts to design new drugs and recent clinical trials.

PHPS-704 Combinatorial Chemistry and High Throughput Technologies in Drug Discovery (2 credit hours)

This course is designed to teach students the essential elements of combinatorial chemistry and evolving high throughput technologies in drug discovery. Combinatorial chemistry and high throughput chemistries are dynamic, rapidly evolving fields that have an important role in drug discovery. Most pharmaceutical companies have now incorporated combinatorial and high throughput platforms into their drug discovery research program. Combinatorial chemistry is a relatively new approach to the synthesis of compound libraries in a highly efficient and automated fashion. The topics of this course will include, but not limited to, combinatorial chemistry and parallel synthesis; solid-phase organic synthesis; solution-phase synthesis with solid supported reagents and scavenger resin technology; diversity-oriented synthesis; dynamic combinatorial chemistry; high throughput screening of combinatorial libraries; microwave-assisted organic synthesis; fluoros technology, fragment-based drug discovery; and automation and instrumentation.

PHPS-705 Designing Clinical Research (3 credit hours)

This course introduces the science and methodological principles of doing clinical research. Besides conventional medicine, emphasis is placed upon clinical trials of complementary and alternative medicine therapies. Topics include research question/problem/objective, research hypothesis, research processes, types of clinical research design, measurements, sampling designs, recruitment, sample size determinations, chance and bias, threats to the internal and external validity, monitoring safety and efficacy data, statistical tests and data management, ethical issues, translational research and funding agency. Students will be given the opportunity to identify a researchable idea/question and design his/her own clinical or translational research project by preparing a written mini-proposal and presenting the proposal.

PHPS-706 Environmental Toxicology (2 credit hours)

This course is designed to introduce students to the field of environmental toxicology. The emphasis will focus more on ecotoxicology, rather than classical toxicology. Topics that will be covered include toxic and radioactive metal, toxicity of solvents and pesticides, halogenated aromatic compounds, environmental endocrine disruptors, and pharmaceuticals and personal care products in the environment. The environmental impact of global warming will also be addressed. Course format will include student lead discussions and presentations, lectures, and general discussion.

PHPS-707 Genetics in Medicine (2 credit hours)

This course will provide an exposition of the fundamental principles of human and medical genetics with emphasis on the genes and molecular mechanisms operating in human diseases. The contributions made by genetic variation to disease susceptibility and treatment outcomes will be discussed. Clinical cases will be used to demonstrate and reinforce the general principles of disease inheritance, pathogenesis, diagnosis, management, and genetic counseling. Students will learn how understanding genetics can lead to new strategies in drug development and treatment. A combined laboratory and seminar experience will provide students with hands-on experience and keep students abreast of recent developments in the field by presenting current literature.

PHPS-708 Isolation methods for natural product discovery (2 credit hours)

This course will examine the theory and practice of the various types of chromatographic and non-chromatographic methods that are commonly used for the isolation of biologically active natural products from plants, microorganisms and marine organisms on scales ranging from microgram to kilograms of pure compound. Starting with simple extraction methods, the course will progress through liquid-liquid interactions to liquid-solid interactions and then to gas-solid interactions. Completion of this course will provide the student an understanding of the application of each of the techniques discussed, as well as their relative advantages and disadvantages.

PHPS-709 Instrumental methods and structure elucidation of mainly natural products (2 credit hours)

This course will introduce all of the pieces of spectroscopic equipment relevant to solving the three dimensional structure of organic molecules. Hands on use of the equipment to obtain spectroscopic data will be an emphasis of this course. The other emphasis of this course will be how to interpret this information to enable a viable chemical structure to be proposed. During each session it is anticipated that prepared examples and examples arising from current research will be used enhance participants' knowledge.

PHPS-710 Laboratory Animal Care, Management and Medicine I (2 credit hours)

This course is part one of a two part lecture series and is designed to introduce students to the care and use of laboratory animals in accordance with the National Research Council and the Institutional Animal Care and Use Committee (IACUC). Included in this course are alternatives to traditional use of live animal species and the laws, regulations and guidelines important to laboratory animal research. Emphasis will be placed on the use of rats and mice, rodent anesthesia and analgesia and rodent surgery.

PHPS-711 Laboratory Animal Care, Management and Medicine II (2 credit hours)

This course is part two of a two part lecture series and is designed to introduce students to the care and use of laboratory animals in accordance with the National Research Council and the Institutional Animal Care and Use Committee (IACUC). Included in this course is a review of Laboratory Animal Care, Management and Medicine I. Emphasis will be placed on rabbits, Mongolian gerbils, guinea pigs, Syrian hamsters, dogs and cats, and primates.

PHPS-712 Medical Cell Biology (2 credit hours)

This course focuses on the scientific aspects of cell biology important to graduate students with primary focus on eukaryotic cell biology. The course will provide a basis to general cell biology principles in the context of organ systems and human and animal disease. Clinical cases will be used to build a framework for the basic concepts of medical cell biology and help reinforce conceptual understanding.

PHPS-713* Medicinal Chemistry I (2 credit hours)

Organic Medicinal Chemistry I provides the chemical and structural basis for the interdisciplinary field of therapeutics related to diuretics, autonomic nervous system and cardiovascular system. The topics will include the drug discovery and development process of these important medicines, the chemical and structural basis for the pharmacological and therapeutic action of drugs, structural classifications, molecular mechanism of actions, structure activity relationship, and how the physicochemical properties of drug molecules affect their route of administration, stability, and absorption, distribution, metabolism and excretion. Synthesis of important drug molecules from each drug class will also be presented.

PHPS-714* Medicinal Chemistry II (2 credit hours)

Organic Medicinal Chemistry II provides the chemical and structural basis for the interdisciplinary field of therapeutics related to diabetes, thyroid/pituitary disorders, hormones/osteoporosis/adrenal, asthma/COPD, and infectious diseases. The topics will include the drug discovery and development process of these important medicines, the chemical and structural basis for the pharmacological and therapeutic action of drugs, structural classifications, molecular mechanism of actions, structure activity relationship, and how the physicochemical properties of drug molecules affect their route of administration, stability, and absorption, distribution, metabolism and excretion. Synthesis of important drug molecules from each drug class will also be presented.

PHPS-715* Medicinal Chemistry III (2 credit hours)

Organic Medicinal Chemistry III provides the chemical and structural basis for the interdisciplinary field of therapeutics related to antiviral agents, OA/RA/Gout, migraine, CNS agents including Parkinson/Alzheimer/Seizure. The topics will include the drug discovery and development process of these important medicines, the chemical and structural basis for the pharmacological and therapeutic action of drugs, structural classifications, molecular mechanism of actions, structure activity relationship, and how the physicochemical properties of drug molecules affect their route of administration, stability, and absorption, distribution, metabolism and excretion. Synthesis of important drug molecules from each drug class will also be presented.

PHPS-716* Medicinal Chemistry IV (2 credit hours)

Organic Medicinal Chemistry I provides the chemical and structural basis for the interdisciplinary field of therapeutics related to gastro-intestinal/genito-urinary, chemotherapy, pain management, radiopharmaceuticals. The topics will include the drug discovery and development process of these important medicines, the chemical and structural basis for the pharmacological and therapeutic action of drugs, structural classifications, molecular mechanism of actions, structure activity relationship, and how the physicochemical properties of drug molecules affect their route of administration, stability, and absorption, distribution, metabolism and excretion. Synthesis of important drug molecules from each drug class will also be presented.

PHPS-717 Medicinal Chemistry of CNS Drugs and Development of *in vivo* CNS Tracers (2 credit hours)

The course will focus on modern aspects of the design and development of compounds for the treatment of central nervous system disorders, and in addition on the development of PET (positron emission tomography) and SPECT (single photon emission computed tomography) tracers to monitor functional processes *in vivo* in the human body. Important properties and steps for profiling a drug to enhance the access to the brain will be discussed. The course will start with an overview about CNS targets and pharmacophore models for diverse compound families and will provide synthetic aspects of important drug templates. The production of relevant radio-nuclides, precursor and radiochemical synthesis, quality control and radio-pharmacological aspects (*in vitro*, *ex vivo*, *in vivo* experiments) will be discussed.

PHPS-719 Molecular Biology Techniques and Applications for Healthcare Professionals (2 credit hours)

This course will provide students with basic and advanced information regarding DNA, RNA, and proteins, and describe current available techniques used in detecting genetic variation. Potential applications of these techniques to disease screening, drug resistance, and drug discovery and development will be reviewed. Isolation and purification of DNA samples from different cell types and tissues, DNA concentration techniques, restriction digestion and analysis, ligation of DNA to create recombinant molecules and designer genes will be discussed. Students will be provided with access to reference texts and selected online peer-reviewed articles in .pdf format by the Instructor. The Instructor will conduct lectures for sessions 1 and 15 and provide background material. Each student will select a topic from the remaining sessions (2-14) and will lead the discussion for that selected topic on the assigned day. Students may work in pairs (or more if necessary), depending on student enrollment. Students will learn to retrieve information from a variety of sources, comprehend and critically evaluate it, and subsequently lead a discussion on the selected topic. There will be no laboratory component.

PHPS-720 Natural Products and Cancer Chemoprevention (2 credit hours)

The course will concentrate on the molecular aspects of chemoprevention as a viable strategy in the fight against cancer. The treatment of many diseases is dependent on natural products. Over half of the currently approved anti-cancer and anti-infective drugs are of natural origin. Active leads from different structural classes such as alkaloids, flavonoids, coumarins, and phenazines will be described. Since carcinogenesis is a multistage process, different approaches to monitor inhibition of cancer initiation, promotion and progression will be characterized. The course will provide the student with an understanding of detailed aspects of research processes leading to the discovery of promising natural as well as synthetic and semi-synthetic chemopreventive compounds. Special attention will be given to ensure students are aware that the science of chemoprevention research is well established and offers great research opportunities.

PHPS-721 Neuropsychopharmacology (2 credit hours)

This course is designed as an intense, doctoral level class that amalgamates the disciplines of neuroscience, animal behavior, neurochemistry, and pharmacology. The course will cover the major topics of neuropharmacology such as cellular and molecular foundations of neuropsychopharmacology, behavioral pharmacology, receptor biology, major neurotransmitter systems and antidepressants, anxiolytics, antipsychotics, drugs of abuse, and cognitive and movement disorders. Further, this course will integrate some of the principle topics in behavioral neuroscience, including aggression, fear, stress, memory, internal state, and evolution of sex and mating systems, communication, feeding behavior, anti-predator behavior, and the evolution of behavior. Course format will consist of lectures and exams, student presentations, and require a capstone research

review paper.

PHPS-722 Pharmaceutical Marketing (2 credit hours)

This course has two major areas of emphasis in pharmaceutical marketing. The first part of the course will introduce the basic theory of pharmaceutical marketing and creative thinking behind product development. Students will learn the basic principles of consumer behavior and evaluation, environmental framework, social, and various other marketing theories to provide an understanding of how these concepts can influence product development in laboratories or drug industries. This section will also integrate these principles and concepts to understand issues related to the distribution and design of an innovative drug product development. The second part of the course is intended to use the principles and concepts learned in the first part to effectively develop a market plan for an innovative product.

PHPS-723 Pharmacognosy (2 credit hours)

Pharmacognosy is a highly interdisciplinary field which is one of five major areas of pharmaceutical education. Its scope includes the study of the physical, chemical, biochemical and biological properties of drugs, drug substances, or potential drugs or drug substances of natural origin as well as the search for new drugs from natural sources. This course will focus on chemical aspects of Pharmacognosy. Natural products are normally classified according to their biosynthetic origins and chemical properties. Thus, the objective of the course is to familiarize students with an introduction to and classification of natural products (terpenoids, alkaloids, phenylpropanoids and allied phenolic compounds). The basic metabolic pathways and the origin of secondary metabolites such as the shikimic acid pathways, the acetate-malonate pathway, the mevalonate pathways will be discussed. It is a core course of Pharmacognosy and enable students to use this knowledge in the future to explore Advanced Pharmacognosy. A special emphasis will be placed on how chemical structure affects physiological function of various natural products.

PHPS-724* Pharmacology I (3 credit hours)

In this 3 credit, 45 hour lecture, course students will learn pharmacology of specific drug groups. The course uses organ system approach. This course will begin with a discussion of diuretics followed by autonomic nervous system pharmacology and conclude with a discussion of drug groups used for the treatment of cardiovascular disorders. In the autonomic pharmacology unit, students will learn about adrenergic and cholinergic drugs that possess agonist and /or antagonist activities at different types and subtypes of receptors that are present in autonomic nervous system and other tissues in the body.

Cardiovascular pharmacology will include drug groups that are used in the management of hypertension, hyperlipidemia, heart failure, disorders of coagulation, cardiac arrhythmias, and ischemic heart disease.

PHPS-725* Pharmacology II (3 credit hours)

In this 3 credit, 45 hour lecture, course students will learn pharmacology of specific drug groups. The course uses organ system approach. This course will begin with a discussion of endocrine disorders pharmacology followed by pharmacology of asthma and chronic obstructive pulmonary disease (COPD), and conclude with a discussion of drug groups used for the treatment of infectious diseases. In the endocrine pharmacology unit, students will learn about drug groups that are used in the treatment of diabetes, thyroid and pituitary disorders, osteoporosis, as well as corticosteroid drugs. Respiratory pharmacology unit will include pathophysiology and pharmacology of drug groups that are use in the treatment of asthma and COPD. Infectious disease pharmacology unit will include discussions of antibacterial, antifungal, antiviral, antiprotozoal and antihelminthic drugs.

PHPS-726* Pharmacology III (3 credit hours)

This graduate-level course introduces the student to the basis of disease and pharmacology of drugs used to treat viral infections, osteoarthritis, rheumatoid arthritis, gout, and CNS disorders. Course material covers principles of drug action including drug-receptor interactions and mechanism of action, adverse effects, absorption, distribution, metabolism, elimination and pharmacogenomics. The focus of CNS lectures include therapeutics used to treat migraine, schizophrenia, depression, bipolar disorder, attention deficit hyperactivity disorder, sleep disorders, anesthesia, and neurodegenerative diseases. Students will be assigned a scientific article to read in advance of “Special Topics” lectures. For five of these assignments, the student will also be required to write a one-page summary of the article and its main findings.

PHPS-727* Pharmacology IV (3 credit hours)

This graduate-level course introduces the student to the basis of disease and pharmacology of drugs used to treat gastrointestinal and genitourinary disorders, fertility and contraception, as well as cancer and pain management. Course material covers principles of drug action including drug-receptor interactions and mechanism of action, adverse effects, absorption, distribution, metabolism, elimination and pharmacogenomics. Students will be assigned a scientific article to read in advance of “Special Topics” lectures. For five of these assignments, the student will also be required to write a one-page summary of the article and its main findings.

PHPS-728 Phytochemistry of Terrestrial Plants (2 credit hours)

This course will survey the chemical structures, spectroscopic properties, biosynthesis/biogenesis and biological activities of a wide range of major and minor chemical classes occurring in terrestrial plants. These compound classes will include alkaloids, terpenoids, steroids, coumarins, Flavonoids, tannins and other polyphenols, pyrones, quinones, phenylpropanoids, lignans, depsides, depsidones, fats, waxes and lipids among others. Completion of this course will provide the student with a basic familiarity with the kinds of chemical structures found in plants enabling her/him to embark on a career in phytochemical research.

PHPS-729 Receptor Theory and Signal Transduction (2 credit hours)

This course will provide the student with information concerning the history and use of receptor theory to explain drug action, and to introduce how drug effects are mediated through relevant signal transduction cascades. Topics will include: models for receptor-drug interactions; methods for receptor identification; structure-function analysis of GTP-binding proteins and ligand-operated ion channels; receptor tyrosine kinases; nuclear receptors; and receptor-induced signal transduction cascades. Lab aspect of the course is designed to complement lecture topics.

PHPS-730 Sample collection, documentation and preservation (1 credit hour)

Participants in this course will learn strategies for sample collection from both the terrestrial and marine environments and for both macro- and micro-organisms. The course will cover permit application, sample collection, and the various ways in which different sample types are persevered for long term storage and how taxonomic voucher specimens are prepared.

PHPS-731 Toxicants and Toxicity (3 credit hours)

This course will provide a general foundation in the understanding of basic toxicological principles. The mechanisms of toxicity and contemporary treatment plans for the most common chemical, environmental and pharmaceutical agents will be presented. Additionally, this course will provide an in-depth review of the neuropharmacology of substances of abuse including stimulants, depressants, hallucinogens and anabolic steroids. Other types of addiction will be discussed. Special emphasis will be given to basic pharmacokinetic and pharmacodynamic mechanisms as they relate to the effects of the individual substances of abuse. Current theories of addiction and tolerance development will be discussed.

PHPS-732 Toxic plant natural products and their therapeutic potential (2 credit hours)

This course will draw on the basic principles of organic chemistry and biology to provide an understanding of the biosynthesis of toxic natural products in plants, their bioassay-directed fractionation and isolation, structural identification, and mode of action in mammalian systems. Toxins discussed will be those responsible for hepatotoxicity, teratogenicity, cardiotoxicity, lysosomal storage diseases, and reproductive defects. Students will integrate these principles to understand the importance of dose in discriminating between toxicity and therapeutic action, as well as the role of natural products as lead compounds in drug development. The major classes of toxic compounds occurring in plants will be discussed, with particular reference to those occurring in Hawaii. Discussions of proper experimental design, plant sampling and identification, and structural classification will carry over into the laboratory portion of the class. Students will become familiar with procedures for plant collection, extraction and isolation of pure compounds, and structural identification.

Academic Performance during the First Year of Study

You must take a full course load during each semester of your first year and achieve a grade of B or better in each course. If you do not achieve a B grade or better in courses taken during the two semesters of your first year, the PhD in Pharmaceutical Science Committee will review your case, and you may be asked to leave the program.

Plan of Study

You will be required to file a Plan of Study tailored to your research interests and the goals of your Advisory Committee at least one month prior to the start of your second year. This Plan of Study will contain the proposed courses you will be taking during your studies in the department as agreed by your Advisory Committee.

Academic Performance during the Second and Subsequent Years of Study

A cumulative GPA of 3.0 or above is required for continuation in the department graduate program during the second and subsequent years. The department will review grades after each semester. After one semester with a GPA below 3.0, the student is placed on departmental probation. A semester GPA below 3.0 for two consecutive semesters constitutes grounds for dismissal from the departmental graduate program. In such cases, the student's Advisory Committee shall meet with the student and submit a

written report to the Director of the PhD program, with a copy going to the student, justifying continuation or recommending termination of the student.

Each student is required to receive a grade of A or B in all departmental courses. A student receiving a C grade in a departmental course may have to re-evaluate his/her commitment to graduate study in the department. In addition, the Advisory Committee may require a minimum B grade for other selected courses, which will be so noted on the plan of study.

Written and Oral Preliminary Examinations

The oral preliminary examination is based on a written research proposal and general knowledge in pharmaceutical sciences. The examination, that emphasizes literature review, formulation of a hypothesis/model, and experimental plan, must be taken within three years of starting the program. The oral preliminary examination does not require extensive data presentation. You must submit a copy of your research proposal to each member of your Advisory Committee at least two weeks prior to the day of the oral preliminary examination. The proposal should follow the NIH or NSF format, or an equivalent format as defined by your Major Professor. This proposal will serve as a basis for questions during the oral preliminary examination; however, the examination is not limited to the specifics of the proposal.

The University Graduate School regulations specify that the preliminary examination may be repeated once, but if it is not passed on the second attempt, the student may not continue in the graduate program. Thus, you may earn only one failing grade on the oral exam in this department.

Research Performance

The early selection of your Major Professor is important not only from the standpoint of course registration but also from the standpoint of initiating a research project early in your graduate career. Once your research is in progress your Major Professor and your Advisory Committee (listed on your Plan of Study) will monitor your research progress. Throughout the research phase of your program it is required that you provide research reports to your Advisory Committee at the beginning of each semester that summarizes your progress during the previous three months. It is further required that you meet with your Advisory Committee on an annual basis, typically at the end of each academic year, to discuss your research. Satisfactory or unsatisfactory performance in research will result in a satisfactory (S) or unsatisfactory (US) grade in PHPS 800. Students receiving a US grade are required to meet with their Advisory Committee. If a student receives a second US grade in research, she or he may be asked to leave the department.

Departmental Seminar Program

Each student will be required to present a seminar during the second semester of each academic year while enrolled in the graduate program or at a date acceptable to their Major Professor and Director of the program. The seminar will be on some aspect of the scientific literature, or their graduate research, and should be carefully thought out and prepared by the student. These seminars are evaluated by the faculty and are the basis for a grade in seminar during that semester as well as serving as an evaluation of new graduate students. Each student is also required to present a seminar on their graduate research near the end of their studies.

Attendance at all seminars is mandatory for all students unless excused by your Major Professor.

Overall Student Performance Review

The PhD in Pharmaceutical Science Committee will review the progress of all the graduate students at least once a year. This review will include academic performance, including grade index, course hours completed, and attainment of departmental and University minimal requirements. The purpose of this review is to provide graduate students with an early indication of faculty concern with their progress. If it is found that any aspect of the student's performance is lacking, the student, the student's Major Professor, and the student's Advisory Committee will be informed in writing. The faculty may, as a result of such a review, recommend that a particular student terminate graduate study. The student involved may request an appeal of that recommendation.

Some Potential Dissertation Topics

Supervisor	Research Areas
Robert P. Borris	-Terrestrial Phytochemistry: Production of metabolites by plant cell and tissue culture -Microbial chemistry
Leng Chee Chang	-Evaluation of Natural products as Inhibitors of Raf Targeting Oncogenic Kinases -Medicinal plants of Hawaiian as potential sources of Cancer Chemopreventive agents -Isolation and Structural Characterization of Potential Smoking Cessation agents from <i>Vernonia cinerea</i> Less
Mahavir	-Development and evaluation of targeted nanoparticles for treatment

Chougule	<p>of breast cancer</p> <ul style="list-style-type: none"> -Evaluation of multifunctional nano-carriers for treatment of lung cancer -Inhalable nano-spheres for treatment of asthma
Linda Connelly	<ul style="list-style-type: none"> -The role of inflammation in tumor progression
Daniela Guendisch	<ul style="list-style-type: none"> -Development of $\alpha 7^*$ nAChR radiotracers for in vivo imaging (PET, SPECT) -Design, synthesis and in vitro evaluation of novel nAChR ligands with specific subtype pattern for antidepressant activity -Using the hybrid concept for the development and synthesis of novel nAChR/NR2B ligands -nAChRs as new targets for anti-cancer agents: Design and Synthesis
Aaron Jacobs	<ul style="list-style-type: none"> -Molecular and phenotypic characterization of novel heat-shock induced gene products -Mechanisms of signal transduction cross-talk between heat shock and hypoxia-induced cellular responses
Susan I. Jarvi	<ul style="list-style-type: none"> -The role of host genetics in resistance to malaria (<i>Plasmodium relictum</i>) -Parasite-parasite interactions and influences on virulence
Eugene Konorev	<ul style="list-style-type: none"> -The Role of Thrombospondin-1 in the Antiangiogenic Effect of Anthracycline Antibiotic Drugs
Ken Morris	<ul style="list-style-type: none"> -Pharmaceutical Materials Science for dosage form design and processing
John M. Pezzuto	<ul style="list-style-type: none"> -Anti-cancer potential of synthetic indenoisoquinolines in breast cancer cells -Anti-inflammatory and chemopreventive potential of synthetic stilbenoids -Aromatase induction and cancer chemoprevention by analogs of casimiroin -4-Bromoflavone and the potential benefits of bifunctional inducers of phase II enzymes -Marine phenazines as possible chemopreventive compounds -Mechanistic studies of NFκB inhibition by resveratrol derivatives -Molecular mechanism phenazine inhibition of breast cancer cell lines invasiveness
Dianqing Sun	<ul style="list-style-type: none"> -Design and synthesis of potential anti-tuberculosis agents based on high-throughput screening hits or virtual screening hits -Design and synthesis of natural product based libraries toward anti-malarial and anti-cancer screening
Ghee Tan	<ul style="list-style-type: none"> -Pharmacological evaluation of raphidecurperoxin, an emerging

	<p>natural product lead against malaria</p> <p>-Fungi of Hawaii as potential sources of antimalarial agents</p>
Gary R Ten Eyck	<p>-Neuroendocrine and neurochemical studies in aggression and stress.</p> <p>-Investigations in behavioral neuroscience, particularly parental care and territoriality.</p> <p>-Pharmacological and/or environmental studies on <i>E. coqui</i> and its effect on the Island of Hawaii.</p>
Supakit Wongwiwatt hananukit	<p>-Clinical research of drugs, complementary and alternative medicine in the areas of tobacco cessation, hyperlipidemia, obesity, diabetes, cancer therapy</p> <p>-Investigation of the availability and use of medicines, complementary and alternative medicines by consumers in communities.</p> <p>-Development and validation of an instrument to assess humanistic outcomes and evaluation of the patient-oriented pharmacy services/interventions and/or interdisciplinary teams, and pharmaceutical care.</p>
Anthony D. Wright	<p>-Endophytic Fungi and Bacteria: Secondary metabolites their structure and biological activities</p> <p>-Marine Organism ~Macro and Micro~: Secondary metabolites their structure and their biological and ecological activities</p> <p>-Microbes from Marine and Terrestrial Sediments: Secondary metabolites their structure and biological activities</p> <p>-Analysis, quantification and validation of natural materials currently used or that may be used in the health care industry.</p>
Other Faculty	-TBD

Outside Employment

Graduate school is a full-time endeavor, and outside employment of any kind is discouraged. However, if you choose to pursue outside employment, please confer with your advisor.

Graduate Student Code of Conduct

Please refer to the Graduate Student Handbook which can be found at:

<http://hilo.hawaii.edu/academics/graduate/documents/UHHiloGraduateStudenthandbook2012-2103.pdf>

College of Pharmacy Directory

<http://hilo.hawaii.edu/directory/depts.php?dept=79>

UH-Hilo Campus Directory

<http://hilo.hawaii.edu/directory/>

UH-Hilo Security Report (Clery Act)

<http://hilo.hawaii.edu/auxsvc/security/AnnualSecurityReport.php>