A STUDENT GUIDE TO THE M.D./PH.D. PROGRAM

SAINT LOUIS UNIVERSITY SCHOOL OF MEDICINE

2019 – 2020 ACADEMIC YEAR

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TRAINING OBJECTIVES AND PROGRAM SUMMARY

Saint Louis University (SLU) offers M.D./Ph.D. training to promote academic excellence in clinical medicine and disease-based scientific research. Faculty mentors train M.D./Ph.D. students to become physician-scientists with the credentials to succeed in academic medicine and related careers. As coordinated by the M.D./Ph.D. Program Steering Committee, applicants are selected based on their past transcripts and demonstrated ability in scholarly research. In turn, graduates of this program reflect the best features of our innovative M.D. curricula and our exceptional Ph.D. training environments. Throughout their tenure at SLU, the M.D./Ph.D. trainees are continuously evaluated to assure that they develop into self-motivated intellectual leaders and compassionate problem-solving diagnosticians, as well as being creative scientists capable of sustained research productivity.

The program is available to all interested applicants to the School of Medicine. Candidates for on-site interviews are selected from a national applicant pool based on their undergraduate credentials (including science/math GPA and MCAT), and a demonstrated ability to participate in publishable, bench-level research. Interviewees come to St. Louis to meet with current students and potential mentors, the Dean of Admissions of the Medical School, and the M.D./Ph.D. Admissions Committee, which attends and evaluates a brief research seminar given by each visiting applicant. Successful applicants receive full tuition support and competitive stipends throughout their M.D. and Ph.D. training, contingent on continued academic excellence and acceptable progress toward their research objectives. Most trainees are chosen in the early spring in order to begin research rotations by early June before commencing their Year 1 M.D. studies in mid-August. Other qualified individuals may apply after beginning their M.D. training.

In addition to completing the specific courses and research requirements for both degrees, trainees participate in M.D./Ph.D. colloquia to enhance critical thinking, scientific writing, career selection, research presentations and public speaking skills. By midwinter of M.D. Year 2, trainees select a Ph.D. mentor in whose department they will complete their Ph.D. research. The Steering Committee has specific grant writing and research presentation requirements for trainees during their Ph.D. years, and at least one Steering Committee member serves on each dissertation committee. Completion of all Ph.D. candidacy requirements and oral defense of the doctoral dissertation are followed by a transitional clerkship that facilitates reentry into Years 3 and 4 of the M.D. training. As this clinical training is being pursued, each student receives individualized career guidance from physician-scientists at SLU, to assure that appropriate academic residency/fellowship programs are achieved. Trainees in this program normally should complete all requirements for both degrees within 7-9 years, including the coursework, clerkships, laboratories, and national licensure exams through USMLE Step 2.

APPLICATION PROCESS AND SELECTION CRITERIA

All completed AMCAS applications received by December 15th are evaluated by the M.D./Ph.D. Program Admissions Committee for the quality and breadth of students' undergraduate training, including their science/math GPA and MCAT scores. Although the Graduate Record Examination (GRE) and advanced coursework are not required, GREs are recommended for the Ph.D. in Health Care Ethics, and many applications are strengthened by such information when available. All applicants must have completed at least one year of bench-level research, during which they should have demonstrated their intellectual involvement by writing honors theses, abstracts for scientific meetings, and/or peer-reviewed publications. Three letters of recommendation are solicited from individuals identified by the applicants. These individuals are asked to provide a candid assessment of an applicant's research aptitude, integrity, interpersonal skills, and commitment to completing dual-degree training.

The Admissions Committee invites selected applicants to SLU School of Medicine for on-site interviews at institutional expense, usually in groups of 4 – 6 students whose visits are scheduled January through February. These 3-day visits are designed to acquaint applicants with the intellectual and physical environment of the University, particularly the available research opportunities and potential mentors in their areas of interest. Applicants meet privately with current trainees and with at least three potential mentors of their choice, as well as with the Associate Dean of Admissions for their M.D. interview if not completed previously. In addition, applicants are required to make a brief presentation of their previous research experience(s) to the members of the Program Admissions Committee. These informal presentations may last up to 25 min, including time allowed for questions by the faculty, and must be made without audiovisual support except for the dry-erase board provided.

Interviewees are ranked by the Admissions Committee for their perceived competence and likelihood of individual success in the University's training environment. Successful applicants are admitted with offers of full tuition remission plus annual stipends for the duration of their M.D./Ph.D. training, the continuation of which are contingent upon academic performance and progress toward Ph.D. research objectives. The Admissions Committee may also invite applicants to join the M.D./Ph.D. Program as non-funded trainees. Such non-funded trainees receive the same support provided to funded trainees in the M.D./Ph.D. Program. The University holds M.D. tuition costs for non-funded M.D./Ph.D. students to the level paid by their entering medical school class, to reduce the impact of inflation on completing M.D. training after finishing their Ph.D. degree. Members of the Year 1 and Year 2 M.D. classes who are in good academic standing and who meet the other requirements identified above may apply to the M.D./Ph.D. Program. Such applicants are rapidly screened and may be considered for acceptance at any time during the year.

LABORATORY ROTATIONS

Rotations introduce M.D./Ph.D. students to the research areas of individual faculty and to daily operations in those labs. Students complete at least two rotations (≥ 7 wk, 40 h/wk) before completing the first two years of medical school. New students normally begin their first rotation in early June before starting M.D. training in August, having selected a mentor prior to arriving in St. Louis. By spring of Year 1 M.D. studies, students select a second mentor in whose lab they will perform a second research elective, during the summer between Years 1 and 2 of M.D. training. As detailed below, students normally must choose their Ph.D. mentor and graduate department by December 1 of their Year 2 M.D. training. Year 1 and Year 2 M.D./Ph.D. students are also expected to present the results from their SLU lab experiences at the AOA Medical Student Research Forum convened in January each year. Trainees who choose to complete their Ph.D. in Health Care Ethics or in Health Outcomes Research often use these summer lab rotation periods to complete additional courses and directed readings that are required by those programs.

CHOOSING A PH.D. MENTOR AND A GRADUATE PROGRAM

Research mentors must be members of the Graduate Faculty and should be selected based on scientific expertise and personal compatibility with trainees and their career goals. The Program Director provides guidance and maintains a Mentor Roster of faculty whose published research and grant support demonstrate a suitable training environment. Four basic science departments in the Medical School grant Ph.D. degrees with curricula approved for M.D./Ph.D. trainees: Biochemistry & Molecular Biology; Molecular Microbiology & Immunology; Pathology; and Pharmacological & Physiological Science. Descriptions of their curricula and degree requirements are enclosed. Each basic science department transfers 30 credits equated to Year 1 and Year 2 M.D. courses (p. 7) toward the 36 didactic credits required by SLU for a Ph.D. Then M.D./Ph.D. trainees complete 6 didactic credits plus 12 credits of dissertation research required by the Office of Graduate Education for completion of the Ph.D. Owing to unique features of the Ph.D. programs in Health Care Ethics (HCE) and Health Outcomes Research (HOR), those departments transfer fewer credits from M.D. years 1 and 2, and their trainees use the summer rotations to complete other required courses and *practica* (pp. 27-32). Throughout training, students are continuously monitored by the Steering Committee and requires that each Dissertation Committee include a member of the Steering Committee. All trainees are expected to submit at least one extramural grant application for pre-doctoral support within their first 2 years of graduate training, written with guidance from their Ph.D. mentors.

THE M.D./PH.D. COLLOQUIA

Participation is required of all trainees throughout their tenure at SLU, although the recommended style of presentation depends on a student's level of experience. During M.D. years 1 and 2, trainees usually present by ***journal club format*** a summary of recent publications pertinent to a chosen or assigned topic, including selected historical materials that establish the relevance of more recent findings. While in their Ph.D. training, students are expected to provide a personal account of their ongoing research activities in a ***dissertation seminar format***. During M.D. years 3 and 4, trainees select interesting patients whom they encounter during their clerkships for development in a ***case presentation format***. While respecting patient confidentiality, trainees summarize the general and specific features of the underlying disease(s) including differential diagnoses, the current status of a particular patient or group of patients, and likely prognoses based on treatment options available.

Students must attend all colloquia unless excused by the Program Director. Trainees in M.D. Years 3 and 4 are provided letters to clerkship directors and attending physicians explaining the importance and required nature of the colloquia. Presentations will be held on the Medical School Campus 4 p.m. on Tuesdays. About once a month, students may invite an external speaker whom they consider to be a suitable role model. Invited speakers are encouraged to describe in detail their own training and career paths, including the problems they encountered and solved to achieve their present positions.

TRANSFERABLE CREDITS FOR M. D. COURSES IN PHASES 1 AND 2*

PHASE 1 (August of Year 1 – February of Year 1)

Course Titles	Credits
Fundamentals of Biomedical Sciences	
Cell and Molecular Biology	7
Clinical Anatomy	9
Immunology, Pharmacology & Therapeutics	8
Introduction to Pathology	4
Human Organ System Modules	
Hematology	3
Basic Clinical Neurosciences	7
Behavioral Medicine and Health	2
Clinical Interviewing (Med 101)	13
Foundations in HCE (HCE-101)	1
Epidemiology and Biostatistics	3
Medical Information Management	1
Healthcare Quality Improvement (HQI-101)	1
Research Elective	1
Total Credits Available for Phase I	60

PHASE 2 (March of Year 1 – February of Year 2)

Course Titles	Credits
Human Organ System Modules	
Cardiovascular System	5
Respiratory System	5
Renal/Urinary System	4
Endocrine and Reproductive Systems	4
Gastrointestinal System	4
Skin, Bone, and Joint Systems	3
Clinical Diagnosis (MED-202)	8
Clinical Reasoning in HCE (HCE- 201)	1
Healthcare Quality Improvement (HQI-200)	1
Research Elective	1
Total Credits Available for Phase 2	36

CURRICULUM TIMETABLE AND IMPORTANT MILESTONES

M.D. YEAR ONE

April (Before starting M.D. program): Choose first mentor and lab rotation.
Early June: Arrive in St. Louis to register, complete finance and health care forms, obtain ID and parking pass, locate housing, and begin first rotation (~ 7 weeks).
Early August: Complete first lab rotation and begin M.D. curriculum Phase 1; begin participation in M.D./Ph.D. Colloquia
November: Evaluate data from first lab rotation and prepare AOA abstract.
December: Choose second mentor and lab rotation
January: Participate in AOA student research program.
May: Complete all M.D. year 1 exams and begin second lab rotation (~ 10 weeks).

M.D. YEAR TWO

Early August: Complete second laboratory rotation and return to M.D. classes; resume active participation in M.D./Ph.D. Colloquia
November: Evaluate data from 2nd lab rotation and prepare AOA abstract.
December: Select Ph.D. mentor and department
January: Participate in AOA student research program.
February: Request leave of absence from medical school effective July 1; alert Ph.D. department to select Year 1 and 2 M.D. credits for transfer to graduate transcripts.
March: Complete all M.D. year 2 exams and study for USMLE Step 1.
April: Take USMLE Step 1 exam.
May: Complete 8 weeks Phase 3 Clerkship
July: Join Ph.D. department as full-time graduate student.

PH.D. YEAR ONE

1. Register for and complete all required coursework as specified by Ph.D. department.
2. Identify faculty members to serve on preliminary exam committee, including chairperson and Steering Committee representative.
3. Submit at least one individual extramural pre-doctoral fellowship application.
4. Continue active participation in M.D./Ph.D. Colloquia (Ph.D. research format).

PH.D. YEAR TWO

1. Complete any remaining coursework and register for dissertation research credits.
2. Pass preliminary exam, select dissertation committee including a Steering Committee member and file candidacy papers.
3. Continue pursuing pre-doctoral support mechanisms including NIH F30 applications as appropriate.
4. Present interim research results as first author at regional or national meetings.
5. Prepare and submit research manuscripts to peer-reviewed journals.
6. Continue participation in M.D./Ph.D. Colloquia (Ph.D. research format).

FINAL PH.D. YEAR

1. Conclude all experiments and writing of chapters for Ph.D. dissertation.
2. Notify Offices of Student Financial Aid and Curricular Affairs of intent to rejoin M.D. curriculum; select desired sequence of Phase 3 M.D. clerkships.
3. Continue submitting abstracts/manuscripts to relevant scientific venues.
4. Seek assignment of clinical mentor(s) to provide career guidance, and register for appropriate transitional clerkship (see below).
5. Complete all Graduate Education Requirements.
6. Continue participation in M.D./Ph.D. Colloquia (dissertation seminar format).

M.D. YEARS THREE AND FOUR

1. Complete all Phase 3 M.D. clerkships and floor services, including any required subject exams, written reports and USMLE Step 2 CK and CS licensure exams.
2. Schedule and attend regular meetings (recommended bimonthly) with appropriate clinical mentor(s) for guidance in career and residency selection processes.
3. Continue to meet with Ph.D. dissertation advisor and committee members to ensure timely publication of all relevant research results in peer-reviewed journals.
4. Utilize Year 4 elective time to thoroughly evaluate career options and potential academic residency programs in chosen area(s) of specialization.
5. Continue participation in M.D./Ph.D. Colloquia (case presentation format).

TRANSITIONAL CLERKSHIPS

The M.D./Ph.D. Program Steering Committee at SLU concurs with the national recommendation that trainees complete non-graded transitional clerkships after completing their Ph.D. degrees and before commencing their required Year 3 M.D. clerkships. This policy has evolved because at least three years usually have elapsed since such trainees completed preclinical M.D. training and USMLE Step 1, and learned the skills necessary to perform a basic history and physical exam on patients. Thus, transitional clerkships provide a 2 – 3 week period of adjustment to the schedule, expectations, content, and demands of clinical medicine. By the time the dissertation defense is scheduled, trainees should have chosen their desired sequence of Year 3 clerkships (see above). Using that sequence as a guide, the Steering Committee recommends to the Sr. Associate Dean for Undergraduate Medical Education that trainees be assigned to an open Year 3 clerkship position in Internal Medicine. Once assigned, the trainee is expected to participate fully in all rotations, call schedules, and other clerkship activities despite the non-graded nature of the transitional experience.

PREPARING FOR RE-ENTRY TO MEDICAL SCHOOL

While you are in the final year of your PhD:

As you begin your final PhD year, you should set up an appointment with one of the deans in the Office of Curricular Affairs in September or October to assist with your re-entry into the MD program: Chad Miller, MD (chad.miller@health.slu.edu) or Fr Dr Duffy (james.f.duffy@health.slu.edu). A curricular audit can be completed at that time and re-entry advice discussed.

Critical on-boarding information for third year starts as early as late October-early November with on-boarding at the VA Hospital. Lotteries for the coming year are in the January-February time frame.

Returning students need to ensure that you have access to class list-servs, Canvas, OASIS, and other curricular systems. Students in their last year of PhD work, should be attending class meetings with the class they will join as much as possible. A third year guide and fourth year guide will be provided and posted in the class folder on Canvas by Thanksgiving.

Background checks, Drug Screening, Vaccination and PPD records must be collected and issued to Student Affairs.

If students still have @slu.edu emails, these must be elevated to a HIPAA compliant state and converted to @health.slu.edu before starting on the wards.

Instructions for all these items will be best managed with re-entry discussions with one of the curricular deans

ACADEMIC STANDARDS AND PERFORMANCE REQUIREMENTS

All M.D./Ph.D. trainees are evaluated throughout the academic year to ensure their adequate performance in all required coursework and research activities. At least yearly and most often in September, trainees meet privately with the Program Director to review their updated *curriculum vitae* (CV) and their individual development plans (IDPs) for the current academic year. Funded trainees must pass all courses, labs, electives, and research rotations during Years 1 and 2 of M.D. training. Regular attendance and participation in the M.D./Ph.D. Colloquia are also required. Students who do not maintain these performance standards in M.D. Years 1 and 2 must meet with the Program Director to develop a revised IDP or remediation plan, and are placed on academic probation for at least the next medical school semester. Performance is deemed improved, and probationary status may be removed, if the student passes all major courses in the next semester. Students who do not improve to these standards in the next semester are interviewed by the Program Steering Committee. The Committee may decide to maintain a trainee's probationary status for another semester or to permanently revoke a trainee's tuition waiver and stipend support. Trainees who enter the program with non-funded M.D./Ph.D. status are subject to these same academic standards. Further, it is strongly recommended that non-funded trainees strive to rank highly among their medical school peers to be considered competitive applicants for any funded positions that are identified by the Program Steering Committee.

Regardless of funding status, all M.D./Ph.D. trainees must complete USMLE Step 1 by April 30th of their Year 2 of M.D. training before a leave of absence is granted from the M.D. program to pursue Ph.D. training. Once trainees have formally entered their chosen Ph.D. program, they are subject to all rules and regulations normally imposed upon other graduate students in that department. These regulations may include, but are not limited to, trainee participation in coursework, research seminars, journal clubs, student-led discussions and laboratories, teaching assignments, and research symposia. When such departmental obligations directly conflict with a trainee's ability to attend M.D./Ph.D. Colloquia and/or other program activities, it is the trainee's responsibility to seek resolution by informing the Program Director. In addition to those departmental regulations, the M.D./Ph.D. program requires that all trainees attempt to obtain extramural funds that support the cost of their Ph.D. training. This requirement is usually satisfied when a trainee submits pre-doctoral fellowship applications to appropriate, non-institutional funding agencies within first 2 years of joining a graduate department. Beyond these regulations, all M.D./Ph.D. trainees are expected to follow specific departmental guidelines regarding preliminary exams, advancement to doctoral candidacy, and defense of the Ph.D. dissertation. It is the firm policy of the M.D./Ph.D. program that trainees cannot return to Year 3 M.D.until all degree requirements of the Ph.D. department and Office of Graduate Education have been completed, notably final submission of the signed dissertation.

TUITION WAIVERS AND STIPENDS FOR M.D./PH.D. STUDENTS

In compliance with institutional policy at Saint Louis University, the tuition costs of funded M.D./Ph.D. trainees enrolled in M.D. Years 1 and 2 are paid in the form of loans, whose repayment is waived upon completion of the Ph.D. degree. When trainees who have completed their Ph.D. degrees return to the M.D. program, their tuition costs for the final two years are also paid in the form of a loan, whose repayment is waived upon completion of the M.D. degree. All paperwork required establishing these loans and their relief by waiver is originated and maintained by the Office of Student Financial Services or Student Financial Services Office in the Medical School. Funded trainees who withdraw from the M.D./Ph.D. Program before completing both degrees have the same responsibilities to repay these tuition loans as other M.D. students, as stipulated by the Office of Student Financial Services or Student Financial Services Office. Such trainees also have the same eligibility as other M.D. students to seek additional loans or financial aid to complete their M.D. degree at Saint Louis University. The obligation to repay tuition loans assumed by M.D./Ph.D. trainees who withdraw from the Program may be waived only by the Dean of the Medical School, acting upon recommendations from the Program Steering Committee. Such a recommendation to waive repayment requires a two-thirds majority vote by the Steering Committee, followed by written notification to the Dean by the Program Director.

Funded M.D./Ph.D. trainees also receive competitive stipends throughout their M.D. and Ph.D. training, contingent upon the aforementioned academic standards while in medical school and acceptable research progress toward the Ph.D. degree. These stipends normally begin on July 1 of the summer before trainees join the M.D. program, and originate from the Office of Student Financial Services or Student Financial Services Office or from the various Ph.D. departments, depending on trainee status. All such stipends are considered direct grants to the trainee and are not subject to repayment if a student is removed for academic cause, or voluntarily withdraws, from the M.D./Ph.D. Program. Fees for health insurance that are normally incurred by trainees also are provided by the M.D./Ph.D. loan waiver or by the Ph.D. department, depending on trainee status. All trainees may choose to purchase supplemental health insurance for dependents at reduced rates.

The Steering Committee and University administration also make a good-faith effort to reduce the personal financial debt incurred by non-funded M.D./Ph.D. trainees enrolled in this Program. As mentioned above, such trainees receive preferential consideration for any available funded positions if they are academically qualified. Further, their medical tuition is held at the same level as these trainees would have paid had they not taken a leave of absence to complete their Ph.D. degree. These non-funded M.D./Ph.D. trainees are also given preference for any stipend monies that may be made available by the Dean of the Medical School for medical students pursuing summer research activities. Finally, non-funded students in good academic standing often are specifically nominated by the Steering Committee for various cash awards, travel fellowships, and other incentives that are available only to M.D./Ph.D. trainees.

THE M.D./PH.D. CURRICULUM IN BIOCHEMISTRY AND MOLECULAR BIOLOGY

Students accepted for the M.D./Ph.D. program are subject to the regulations and residency requirements of the Office of Graduate Education and the Medical School. Students are also required to meet the course requirements in the Department of Biochemistry & Molecular Biology. However, courses taken in the School of Medicine are accepted toward fulfillment of course requirements for the Ph.D. degree. These include 30 credits for coursework in M.D. Phases 1 and 2 (see p. 7). After successfully completing the M.D. Phases 1 and 2 curricula and USMLE Step 1, the M.D./Ph.D. trainee begins studies toward the Ph.D. in Biochemistry and Molecular Biology, commencing on or about May 1 of their second full year at SLU.

REQUIRED EXAMINATIONS

Each M.D./Ph.D. trainee in the Department of Biochemistry & Molecular Biology must pass written and oral examinations based on a research proposal written by the student in the form of an NIH Predoctoral Fellowship application (NRSA F31, without a budget). This proposal is written on the research topic to be undertaken for the Ph.D. degree, and is reviewed by the **Preliminary Exam Committee**, consisting of two course directors plus three committee members, at least one of whom is a member of the M.D./Ph.D. Program Steering Committee. This preliminary exam committee prepares a detailed written evaluation of the written proposal, and if modifications are recommended the student must submit a revised version. Once the written proposal has been approved by the committee, the trainee then presents an oral defense of the proposed project to the committee. During this defense, the preliminary exam committee may question the trainee both on the project's specific details and on its broader scientific context. Students must successfully defend their proposal before advancement to candidacy.

Upon successful defense of the research proposal, the student and mentor assemble the **Dissertation Committee** that is chaired by the mentor and includes at least two other medical school faculty, one of whom must be a member of the M.D./Ph.D. Program Steering Committee. The dissertation committee oversees the preparation of and signs the trainee's Ph.D. candidacy papers that must be submitted to the Office of Graduate Education within six months of completing the preliminary exams. This committee also meets annually to evaluate, advise, and approve the student's progress. When the committee determines that the student is ready to defend the dissertation, the student prepares the dissertation document and defends the dissertation both in a public presentation and in a private defense before their dissertation committee.

THE PHILIP AND LILLIAN KATZMAN SCHOLARSHIP FUND

A second point of entry to the M.D./Ph.D. program follows the second year of the traditional medical school curriculum. Medical students who have strong scholastic records plus interest and experience in research may be accepted directly as Ph.D. trainees by the Department of Biochemistry and Molecular Biology. Such students entering the Ph.D. program after their second year of medical school are eligible to apply for a Katzman Fellowship award from the Philip and Lillian Katzman Scholarship Fund. This fund was established by the family of Dr. Philip Katzman, a former faculty member in the department, to encourage research training of medical students. The fellowship provides tuition remission for medical students during both their graduate Ph.D. training and Years 3 and 4 of medical school.

SUMMARY OF COURSEWORK REQUIRED

Prerequisites: Successful completion of Phases 1 and 2 of the M.D. Curriculum and USMLE Step 1. M.D./Ph.D. trainees receive up to 30 graduate credits that are transferred from Phases 1 and 2 courses.

Required Courses during Ph.D. Training Years:
Coursework required during Ph.D. training is determined by the advisory committees of the students involved, depending upon their backgrounds and individual needs. The only course required of all graduate students in the department is BCH-G6250, *Preparation and Evaluation of Scientific Research Proposals*, as described below.

Course Descriptions:
BCH-G6230 *Macromolecules: Structure, Function, and Interactions* (4 credits). Students participate in laboratory and computer database demonstrations, and then complete self-directed problem-solving exercises. These exercises provide familiarity with concepts and methodology in the analysis of enzyme catalysis, protein-nucleic acid interactions, and protein function and regulation. Students learn to independently investigate available information and resources, design experimental approaches, evaluate data, manage time in independent study, and discuss and defend the rationale for their research plans and expected results.

BCH-G6240 *Advanced Topics: Molecular Basis of Human Disease* (3 credits). The objective of this lecture-based course is to study human diseases that illustrate important biochemical principles, concepts, and mechanisms. Recent topics include defects in cell signaling, protein folding and turnover, and metabolic regulation.

BCH-G6250 *Preparation and Evaluation of Scientific Research Proposals* (4 credits). The ability to write a fundable grant proposal is one of the most important skills of biomedical research scientists. A systematic strategy to mastering this skill is taught, practiced, and evaluated. Lectures include the basic organization of an NIH proposal, the purpose and importance of each component, and an overview of the grant review

process. These are followed by presentations of published papers selected by students in areas outside their dissertation research. Students develop and prepare research proposals on their topic through weekly meetings, which faculty and students critique in an NIH-style grant study section. The students then revise their proposals in light of the written critiques, and resubmit them for final evaluation and grading.

BCH-G6280 *Introduction to Bioinformatics and Genomics* (2 credits). Students are introduced to current computational techniques to find information in biological sequence, genome, and molecular structure databases. The course also covers identification of informational patterns in DNA and approaches to linking genome data to information on gene function. Lectures are integrated with practical hands-on exercises designed to reinforce concepts and develop the necessary computer skills to effectively use publicly available databases and tools.

BCH-G6910 *Biochemistry and Molecular Biology Colloquium* (1 credit). Students attend weekly seminars on topics in the literature of biochemistry and molecular biology. Each student presents once during the semester. Students work with mentors toward the dual goals of mastering the techniques of public presentation of scientific research, and developing the ability to critically evaluate scientific publications. (One semester required)

BCH-G6950 *Special Study for Examinations* (0 credit).

BCH-G6970 *Research Topics* (1-3 credits). Prior permission of mentor and graduate program director required. May be repeated. Titles of topics must be registered.

BCH-G6980 *Graduate Reading Course* (1-3 credits).

BCH-G6990 *Dissertation Research* (0-6 credits).

THE M.D./PH.D. CURRICULUM IN MOLECULAR MICROBIOLOGY AND IMMUNOLOGY

The Department of Molecular Microbiology and Immunology (MMI) offers a program in molecular microbiology and immunology leading to the Ph.D. degree. The goal of the MMI graduate program is to graduate exceptionally well-trained researchers who are prepared for a career in academic science or biotechnology. Research in the Program is diversified. Areas of research emphasis include cell and molecular biology, virology, immunology, cancer therapy and antiviral drug development. Graduate training in the Program includes advanced coursework, training in scientific writing and oral presentation skills, and performance of original biomedical research leading to the Ph.D. Dissertation.

Students in the M.D./Ph.D. program select a dissertation mentor in the MMI Graduate Program following laboratory rotations as part of the M.D./Ph.D. program. Although each Ph.D. candidate has a primary Ph.D. research mentor plus a dissertation committee of at least two additional MMI faculty members, the responsibility for educating each student ultimately lies with the Department as a whole.

M.D./Ph.D. trainees pursuing their Ph.D. studies in MMI must complete all requirements of the Office of Graduate Education. A total of 36 coursework credits and 12 credits of dissertation research are required. Of these 36 credits, M.D./Ph.D. trainees receive 30 graduate credits for Phase 1 and 2 courses passed as medical students. In addition to the requirements below, other coursework may be recommended or required by the mentor and/or the preliminary exam committee, to strengthen trainees' background knowledge in their chosen fields of research.

REQUIRED EXAMINATIONS

Two examinations plus a dissertation defense are required. The first exam, the Preliminary Degree Examination, must be taken before the end of the summer session of the first year of graduate studies in the MMI program. This is an oral examination whose goal is to determine whether the student has an adequate foundation of knowledge in the biomedical sciences to support Ph.D. studies. The Examination allows weaknesses and deficiencies in the student's training to be identified, which then can be corrected. The Examination covers all material expected as a prerequisite to enter the MMI program, taught as part of the medical school curriculum or covered in the second year MMI coursework. A committee of 5 faculty members appointed by the MMI Graduate Program Directors administers the Examination. A pass in this examination requires a majority vote of the committee. Should the student fail, a second Examination may be taken prior to the end of fall semester of his/her third year of graduate studies. Successful completion of the Preliminary Degree Examination is required to continue as a student in good standing in the MMI graduate program.

The second or Candidacy Examination is composed of both Written and Oral components. The Candidacy Examination will be administered by a committee (the Candidacy Examination Committee) of the Graduate Faculty which includes the student's mentor as Chairperson plus four other faculty members appointed by the Graduate Program Directors, two of whom may have primary appointments outside of MMI if their scientific expertise is felt to be beneficial to the student. The Candidacy Examination will be taken for the first time before the end of summer session of the second year of studies in the MMI program.

The goals of the Candidacy Examination are to determine whether the student can formulate, test, and evaluate hypotheses at a level suitable for a Ph.D. scientist, and to evaluate the suitability of the student's proposed dissertation project. A pass in the Candidacy Examination requires a favorable vote from the majority of the Candidacy Examination Committee on both the Oral and Written Components. If the student fails either component, the Candidacy Examination Committee plus the Associate Provost for Graduate Education must approve a second attempt on the failed component. The Candidacy Examination must be successfully completed by the end of the summer session of the third year in the MMI program.

The Candidacy Examination-Written Component must be written in a grant-style format [e.g. AHA, NIH F30 (M.D./Ph.D.), NIH F31 (Ph.D.), or NIH F31-Diversity (Ph.D.) predoctoral grants] and focus on the student's anticipated Ph.D. research project. It should contain preliminary data developed by the student if his/her research project has advanced to a point where this is possible. The Candidacy Examination-Written Component usually forms the basis of the required application for support from an external granting agency. The Candidacy Examination-Written Component must be submitted to the Candidacy Examination Committee at least 1 week prior to administration of the Oral Component.

Candidacy Examination-Oral Component. The student is examined by the Candidacy Examination Committee on the both Candidacy Examination-Written Component and their area of research. To pass, the student must 1) Display adequate knowledge of their project, appreciation of the scientific method, and intellectual flexibility; and 2) Be able to apply this understanding to their research project.

Once the M.D./Ph.D. trainee completes these exams, a **Doctoral Dissertation Committee** is organized with the research mentor as chair, who is joined by at least two other members of the Graduate Faculty. Additional Graduate Faculty may serve on a Dissertation Committee if their scientific expertise is felt to be beneficial to the student. Non-SLU faculty may serve on a Dissertation Committee if they have been granted Graduate Status. The Dissertation Committee's role is to guide the student and his/her mentor during the student's dissertation research, to assist as needed during writing of the student's dissertation, and to approve the final dissertation. The Dissertation Committee will meet at least two times annually to review and critique the research progress; more frequent meetings are strongly encouraged. Submitting a brief written report to the Dissertation Committee prior to each meeting is required. Students are highly encouraged to frequently interact with their Dissertation Committee members on an informal basis throughout their dissertation studies.

Ultimately, a trainee submits a written dissertation to, and makes an oral presentation before the dissertation committee, whose members then vote privately to approve the dissertation or to require additional studies. Upon gaining the committee's approval, the student schedules a public seminar. The MMI faculty consider that a Ph.D. is earned when students achieve an appropriate depth of knowledge, and demonstrate the ability to independently define a question and to execute experiments whose unambiguous results answer the posed question. It is expected that the dissertation research will consist of at least two or three publications in peer-reviewed journals, with the trainee being first author on at least one of these. Although students are considered individually, they are expected to write these manuscripts themselves while under supervision by the Ph.D. mentor.

SUMMARY OF COURSEWORK REQUIRED

Prerequisites: Successful completion of Phases 1 and 2 of the M.D. Curriculum and USMLE Step 1. M.D./Ph.D. trainees receive up to 30 graduate credits that are transferred from Phases 1 and 2 courses.

Required Courses during Ph.D. Training Years:
MB.6350 Virology
MB.6650 Basic Immunobiology
MB.6900 Microbiology Journal Club
MB.6920 Microbiology Colloquium

Course Descriptions:
Required courses
MB.6350 Virology (3 credits). This course is taken by M.D./Ph.D. trainees in the Fall semester of their first year of graduate Ph.D. studies.

MB.6650 Basic Immunobiology (3 credits). This course is taken by M.D./Ph.D. trainees in the Fall semester of their first year of graduate Ph.D. studies.

MB.6900 Microbiology Journal Club (1 credit). Selected topics in immunology, molecular microbiology, and related subjects. Students are expected to participate in this journal club every semester while in their Ph.D. training.

MB.6920 Microbiology Colloquium (1 credit). Students attend the MMI seminar series and critique the scientific presentations. Students also attend lunch meetings with the visiting speakers. Students are expected to participate every semester while in their Ph.D. training.

Electives
MB.6240 Advanced Topics in Immunology (2-3 credits). This course entails a discussion of research publications focused on topics of current importance in molecular and cellular immunology. (Offered every semester.)

MB.6750 Immunology Journal Club (2 credits) This is an advanced topics literature survey. Students attend weekly presentations of current publications on topics in molecular and cellular immunology, vaccine development and gene therapy. Each student presents once per semester. (Offered every semester)

MB.6970 Research Topics (0-3 credits) This is an advanced topics course taught by any of the MMI Faculty. It is designed for a class of several students who meet with the instructor once or more per week to discuss and analyze a research topic. Material is taken for current research papers published in leading research journals. The topic for the course is tailored to meet the interests of the students. (Offered every semester)

MB.6980 Graduate Reading Course (1-3 credits) Individualized reading courses taught one on one with a student and any of the MMI faculty. Topics are tailored to the student's interest. (Offered every semester)

MB.5310 Introduction to Research Techniques and Topics (1-3 credits) Students in the first year of their MMI graduate studies spend a minimum of six weeks doing a research project with one or more MMI Graduate Program faculty members. Projects are designed to acquaint the student with a specific line of research and to help them learn techniques and develop new research skills. (Offered every Fall semester)

MB.6820 Advanced Topics in Virology and Cell Biology (1-3 credits) Prerequisite: MB.6350 or MB.6500. This course is taught by any one of the Faculty in the Department. Students meet with the instructor once a week to discuss and analyze a research topic in Virology or the relationship between viruses and their host cells. Material is taken from current research papers published in leading research journals. Topics for the course are selected by consensus of the students and Faculty member. (Offered every semester)

MB.6950 Special Study for Examinations (0 credit).

MB-G6990 Dissertation Research (0-6 credits).

THE M.D./PH.D. CURRICULUM IN PATHOLOGY

The Department of Pathology Graduate Training Program is a research oriented, interdisciplinary course of studies leading to the Ph.D. The goal of the program is to develop researchers with intellectual creativity and professional competence who will contribute new knowledge in the area of Pathology. The program consists of 36 credit hours of coursework and 12 credits of dissertation research. The Department of Pathology accepts 30 credits from courses in Phase 1 and Phase 2 of the medical curriculum. The remaining 6 course credits are satisfied by participation in the required courses as described below. Other elective courses also may be recommended or required to meet the individual needs of each trainee.

REQUIRED EXAMINATIONS

Each M.D./Ph.D. trainee must write and defend an original proposal describing the intended dissertation research, written in the style of an NIH RO1 grant. The proposal is written in consultation with the research mentor and four additional Pathology faculty members, including one MD/PhD Steering Committee member, who comprise the **Preliminary Exam Committee**. After an initial draft is generated, it is reviewed and critiqued by the Committee. When reviewed, the student has one month to address any criticisms and revise the written proposal in preparation for a **Preliminary Oral Exam**. The oral exam consists of a presentation of the written proposal by the student, followed by questions by the committee members. Committee members vote to approve or to disapprove the trainee's oral defense. If approved, the student advances to doctoral candidacy by filing the appropriate forms with the Office of Graduate Education. If disapproved, the student must consult with committee members to discuss deficiencies. The committee may allow the student to retake the exam after deficiencies are met.

Once the preliminary written and oral exams are completed, the **Doctoral Dissertation Committee** is formalized. This five-member committee may be the same as the oral exam committee, must include at least one member of the M.D./Ph.D. Program Steering Committee (who is not the mentor), and is normally chaired by the Ph.D. research mentor. This committee should meet with the student at least twice a year to evaluate progress and achievement of research goals. When significant progress has been made, the student presents this work to the committee. It is either approved as completed or additional progress may be required. When the committee is satisfied that the work is complete, a public presentation of the research is scheduled. After questions by the audience, the dissertation committee meets privately with the student for additional questioning. After committee approval of the dissertation, final copies of the thesis are submitted to the Office of Graduate Education and the student is then eligible to return to medical school.

SUMMARY OF COURSEWORK REQUIRED

Prerequisites: Successful completion of Phases 1 and 2 of the M.D. Curriculum and USMLE Step 1. M.D./Ph.D. trainees receive up to 30 graduate credits that are transferred from Phases 1 and 2 courses as listed on p. 7.

Required Courses during Ph.D. Training Years:
PATH-G5010: *Pathobiology (discussion sessions only)*
PATH-G6920: *Pathology Research Colloquium*.
PPY5140: *Grant Construction*

Optional Course:
PATH5350: *Introduction to Microscopy Techniques*

Course Descriptions:
PATHG5010 *Pathobiology* (1 credit). This course covers general pathology and the basic mechanisms of cell and tissue injury. MD/PhD trainees will participate in the discussion sessions built into this course.

PATHG5350 *Introduction to Microscopy Techniques* (1-3 credits). This is a combined lecture and laboratory course on the application of light and electron microscopic techniques in biomedical research. Hands-on experience at the microscope as well as practical approaches to problem solving are emphasized. The course includes practical aspects of light, fluorescence and confocal microscopy, as well as transmission and scanning electron microscopy.

PATH6920 *Special Topics in Pathology* (1 credit). Students and faculty present their research in their laboratories.

PATH6970 *Research Topics* (1-3 credits). Prior permission of mentor and chairperson required.

PATH6990 *Dissertation Research* (0-6 Credits)

PPY5140 *Grant Construction* (1 credit). See description under curriculum description for Pharmacology and Physiology.

THE M.D./PH.D. CURRICULUM IN PHARMACOLOGY AND PHYSIOLOGY

The Department of Pharmacology and Physiology (P & P) provides a Ph.D. program that trains students to become independent investigators in the interrelated disciplines of physiology and pharmacology. The department also contains the Center for Neuroscience. The overall goals of the Ph.D. program are to: instill enthusiasm for discovery and the scientific process; foster critical thinking, research competence, and oral and written communication skills; and promote a commitment to lifelong scholarship. Diverse research interests of the department faculty ensure that trainees can select projects that span physiology and pharmacology from the subcellular through integrative levels. M.D./Ph.D. trainees join this graduate program with 30 credits transferred from the Phase 1 and 2 M.D. curricula toward the total of 36 credits and 12 dissertation credits required for the Ph.D. degree by the Office of Graduate Education. The remaining six coursework credits are satisfied through completion of two 1-credit required courses described below, and by regular participation in the Department's scheduled journal clubs and seminar series that are also detailed below. Journal clubs cover a broad range of subjects, as do the weekly departmental seminars that feature outstanding speakers from the U.S. and abroad.

REQUIRED EXAMINATIONS

Every M.D./Ph.D. trainee in the Department must pass written and oral exams that are based on a research proposal written by the student as a grant application. Following a satisfactory performance in the PPY-5140 grant-writing course described below, the trainee develops an original proposal that complies with NIH R21 page limits (Specific Aims + 6 pages + bibliography) and that focuses on the intended Ph.D. research. Students may elect to revise and shorten the proposal they developed in the PPY-5140 course, or may prepare a new proposal that better aligns with their intended dissertation topic. Trainees develop the proposal in consultation with their research mentor plus two additional P & P faculty, who collectively form the core of the student's Preliminary Exam Committee. The proposal must emphasize hypotheses to be tested, their relationship to current knowledge, and an outline of experimental approaches to be pursued. When this proposal is deemed acceptable by the initial committee of three faculty members, the preliminary exam committee is expanded to five members and is chaired by a member who is not the trainee's Ph.D. mentor. This committee must include at least one member of the M.D./Ph.D. Program Steering Committee. The entire written proposal is reviewed privately by the preliminary exam committee, which may approve or disapprove it. If disapproved, the student must revise it by consulting with committee members to clearly identify and remediate its deficiencies. Revision can be repeated twice before the student may be dismissed from the program. When approved, the committee chairperson schedules an oral defense within three weeks. Following a 20 – 30 minute PowerPoint presentation by the trainee of the proposal, committee members question the trainee both on its details and its broader scientific context. The oral exam is not a comprehensive test of all postgraduate coursework, but probes the

trainee's knowledge in scientific areas considered essential for a full understanding of the research topic. Committee members vote privately to approve or disapprove the oral defense; failing students may be granted an additional opportunity to pass. Copies of past proposals are maintained by the department to aid future students as they prepare for their own exams.

Completion of the preliminary exam permits the M.D./Ph.D. trainee and mentor to assemble a Dissertation Committee and to file formal Ph.D. candidacy papers with the Graduate School. The research mentor chairs the dissertation committee, which must include at least two additional P & P faculty; at least one member of the committee must be on the M.D./Ph.D. Program Steering Committee (not the mentor). This committee meets at least every six months to evaluate, advise, and approve of progress being made; trainees are expected to make written and oral presentations at each meeting. It is expected that students will submit completed segments of their dissertation research to peer-reviewed journals during their training. After sufficient research progress, the trainee presents and defends the entire dissertation to this committee, whose members may approve the work as completed or may require additional experiments or exposition. Committee approval allows the trainee and mentor to schedule a public presentation lasting 50 – 60 minutes that is followed by questions from the audience, including the dissertation committee. Immediately afterwards, the dissertation committee members may meet privately with the candidate before casting their ballots; unanimous acceptance of the dissertation allows formal filing of the revised and signed dissertation with the Office of Graduate Education.

SUMMARY OF COURSEWORK REQUIRED

Prerequisites: Successful completion of Phases 1 and 2 of the M.D. Curriculum and USMLE Step 1. M.D./Ph.D. trainees receive up to 30 graduate credits that are transferred from Phases 1 and 2 courses as listed elsewhere in this Guidebook.

Required Didactic and Participatory P & P Courses during Ph.D. Training Years:

PPY-5110 Introduction to Pharmacology and Drug Discovery
PPY-5140 Fundamentals of Effective Grant Construction
PPY-6800 Pharmacology and Physiology Departmental Seminar
PPY-6900 Pharmacology and Physiology Colloquium Journal Club

Course Descriptions:

PPY-5110 Introduction to Pharmacology and Drug Discovery (1 credit). Taught at the beginning of each fall semester, this 5-week course is an intensive review of: basic pharmacokinetics; receptor binding theory; assessments of efficacy and potency; full and partial drug agonists/antagonists; and new drug design and discovery. The course format includes lectures, discussions, and problem-solving assignments.

PPY-5140 Fundamentals of Effective Grant Construction (1 credit). Beginning at the end of the spring semester and extending through mid-summer, this 12-week course includes didactic lectures, one-on- one mentoring sessions, and dedicated proposal writing time, culminating in a 20 – 30 min oral presentation followed by questions and faculty critiques. The final proposal must include all main narrative sections of an NIH-formatted R01 grant application (12 pages + bibliography). Students may use a shortened revision of their PPY-5140 proposals for their Preliminary Exam for advancement to doctoral candidacy (see above).

PPY-6800 Pharmacology and Physiology Departmental Seminar (1 credit per semester). Selected topics in pharmacology and physiology are presented by local, national, and international guest speakers. Seminars are held at least twice monthly and usually more often. Attendance and participation are required for all Ph.D. students for this yearlong course.

PPY-6900 Physiology and Pharmacology Colloquium Journal Club (1 credit per semester). Selected topics in pharmacology and physiology are discussed from the current literature in these fields. Colloquial journal clubs are held at least twice monthly and usually more often. Attendance and participation are required for all Ph.D. students.

Additional P&P Courses Available during the Ph.D. Training Years (12 credit hours required for graduation):

PPY-6980 Graduate Reading Course (0 – 3 credits per semester) Individualized reading courses taught one on one with a student and any P & P faculty on topics tailored to the student's interest.

PPY-6990 Dissertation Research (0 – 6 credits per semester).

THE M.D./PH.D. CURRICULUM IN HEALTH CARE ETHICS

The Department of Health Care Ethics offers a Ph.D. program in Health Care Ethics for the M.D./Ph.D. trainee. A minimum of 48 credits is required for the Ph.D. This ordinarily includes 33 didactic credits, three credits of practica, and 12 credits of dissertation research. The Department accepts 7 credits from Phase 1 and Phase 2 of the M.D. curriculum; the required courses HCE-6110 Introduction to Medicine for Ethicists (1 credit), one Topics and Scholars elective (3 credits), and HCE 6150 Practicum (3 credits) are waived based on medical school coursework in Patient, Physician, and Society I and II, and in Fundamentals of Biomedical Science. The 0-credit Research Tools requirement to ensure knowledge of medical terminology and biostatistics is also waived for M.D./Ph.D. students based on trainee knowledge and experience. The 0-credit library database searches Research Tool requirement, the remaining 27 credits of Ph.D. coursework, comprehensive exams, the dissertation, and the public defense of the dissertation must be completed during the three years of Ph.D. study.

REQUIREMENTS FOR COMPREHENSIVE EXAMINATIONS

After all courses and practica are complete, each student must pass the comprehensive examinations with an Examination Board (hereafter "Board") comprised of faculty. The Center Director recommends the Board to the Associate Provost for Graduate Education in care of the Doctoral Candidacy Advisor. These examinations will be written and oral and they will be scheduled as required by the Center Director or delegate. Ordinarily, comprehensive exams (written and oral) should be completed within one academic semester (excluding summer) of completing course work. Failure to pass the written and oral comprehensive exams within one year of completing coursework ordinarily will result in administrative withdrawal from the Ph.D. program.

The purpose of the written exam is to assess the student's ability to write a doctoral dissertation in Health Care Ethics. The following process will be followed for the written exam. Students will enroll HCE-6950 "Special Study for Examinations" during the semester they plan to complete their written exam. Students will work with their anticipated dissertation mentor to craft an essay question, ordinarily in the area of their anticipated dissertation. Because the purpose of the written exam is to demonstrate the ability to conduct independent research, the exam question must propose to develop arguments not previously developed in coursework. The entire Examination Board and the Center Director must approve the essay question prior to the commencement of writing. Students will write an essay of 25 pages addressing the question; it must be submitted prior to the conclusion of the semester during which they enroll in HCE-6950. The essay must display above all the ability to develop a critical ethics argument and to integrate the relevant interdisciplinary literature. Students may not receive mentoring of any kind from faculty or peers in writing the assigned essay. (Students who receive mentoring on the essay, plagiarize, or otherwise breach clear standards of scholarly integrity will automatically fail the exam and will ordinarily be denied the opportunity to re-sit the exam.) Essays will be assessed on four criteria: 1) development of the argument; 2) integration of the literature; 3) problem and significance; 4) writing style and form. Essays will be graded in the following manner:

• Pass. Essays that meet the evaluation criteria in their present form will receive a passing grade. Such essays may have only minor flaws. In general such essays should be of publishable quality.
• Revise and resubmit. Essays that show promise, but have some significant flaws will be returned to the student with feedback from the faculty. Feedback will identify flaws, but will not provide positive feedback on how to fix the flaws. Students will have one full week to revise and resubmit the essay. Resubmitted essays will be graded as pass or fail.
• Fail. Essays will be failed if they contain fatal flaws, problems that cannot be remedied within the current framework for the essay. Students who fail will be allowed to register in 6950 in the subsequent semester and submit a new essay on a new topic. The new essay will be graded using the same three grading options as the original submission (pass, revise and resubmit, or fail). In the event that the exam is failed a second time, the student will be ineligible to progress further in the PhD program. After the student has passed the written examination, an oral examination with the Board will take place, lasting 90 minutes.

The purpose of the oral examination is to assess the student's "integration of knowledge across the discipline." In particular, students are expected to demonstrate mastery of the PhD curriculum. To this end, as part of his or her application to the oral examination, the student must provide the Board with a comprehensive exam reading list comprised of all required readings indicated in the syllabus of each course completed in the PhD program.

After the oral exam, the Board will provide a grade of "Pass with Distinction" or "Pass" or "Fail". Students will not be told the number of pass or fail grades received. If students pass the written exam but fail the oral exam, the oral exam may be taken again. Ordinarily, students may take the oral exam twice with the permission Associate Provost for Graduate Education. Once students have successfully passed both the written and the oral comprehensive examinations, they are eligible to submit a dissertation proposal following CHCE policies.

DISSERTATION

Upon successful completion of the comprehensive exams, trainees request a dissertation director and two readers appointed by the Center Director who form the Doctoral Dissertation Committee. In the dissertation prospectus, the PhD candidate must present substantial evidence of ability to extend the knowledge base in the major field and demonstrate how the research competencies in the program are to be integrated with the proposed research of the dissertation. The Dissertation Prospectus must be approved in writing by all members of the dissertation committee before the student can proceed with writing the full dissertation. As the student writes the full dissertation, drafts of sections and chapters will be sent to the mentor and readers (through the mentor) for feedback and requests for revisions, a process that will likely be repeated multiple times as the student makes revisions. Once the student has produced a draft of the dissertation that satisfies the mentor and the readers, the

student will schedule an oral defense of the doctoral dissertation in an open forum before the interdisciplinary faculty and students in the program. The defense will last for 90 minutes and will be divided into two parts: approximately 30 minutes for an oral presentation of the dissertation followed by 60 minutes for questions and discussion, beginning with the readers and mentor, then the faculty, then the students and others in the audience. At the conclusion of the defense, the Doctoral Dissertation Committee will meet privately to evaluate the presentation. They may either pass the student or require revisions and possibly an additional oral defense. The Center Director will inform the student and Graduate Education of the committee decision formally in writing.

SUMMARY OF COURSEWORK REQUIRED:

Pre-requisites: MD/PhD students must complete a graduate-level Foundations of Ethics and applied ethics course. Students may satisfy this requirement as a directed reading course during the summer between the first and second years of medical school. Applicants to the Health Care Ethics program must provide a sample of writing in health care ethics that demonstrates the ability to do doctoral level coursework in the field.

Required PhD Coursework:
HCE 6010: Methods in Philosophical Ethics (3 credit hours): A study of the methodological issues in philosophy that concern the nature and justification of fundamental ethical norms.
HCE 6020: Methods in Religious Ethics (3 credit hours): A study of the hermeneutical significance of different religious methods in religious ethics and a critical analysis of the hermeneutical implications of these methods for the development of ethical theory.
HCE 6040: Interdisciplinary Methods (3 credit hours): A study of the scope, concerns and methods of interdisciplinary research in Health Care Ethics.
One of the following: HCE 6050 Philosophical Foundations in Ethics
HCE 6060 Psychosocial Foundations in Ethics
HCE 6070 Foundations of Catholic Morality
HCE 6120: Bioethics and the Law (2 credit hours): This course examines legal issues in health care decision making in areas typically considered a part of bioethics.
HCE 6130: Clinical Ethics (3 credit hours): Fundamental skills and core knowledge essential for clinical ethics consultation, integrating process and outcomes to identify, analyze and resolve ethical dilemmas in patient care, including skills and knowledge in ethics mediation and cultural competency.
HCE 6140: Research Ethics (3 credit hours): This course introduces students to a range of topics and issues in research ethics, focusing on academic human subjects research.
9 credit hours of elective courses, taught both within and outside of HCE
More details regarding the PhD program in Health Care Ethics can be found at:
http://www.slu.edu/bioethics/phd-program

THE M.D./PH.D. CURRICULUM IN HEALTH OUTCOMES RESEARCH

The Saint Louis University Center for Outcomes Research (SLUCOR) offers a Ph.D. program in Health Outcomes Research for the M.D./Ph.D. trainee. A minimum of 50 graduate credits is required for the Ph.D. This ordinarily includes 29 didactic credits (see below) and 12 credits of dissertation research. SLUCOR accepts 9 credits from M.D. Phases 1 and 2: Principles of Pharmacology (3); Epidemiology and Biostatistics (1); Elective in Clinical Research (1); Health Care Ethics (1); and a relevant Organ System (3). All remaining coursework, comprehensive exams, dissertation, and the public defense of the dissertation must be completed during the three years of Ph.D. study.

REQUIRED EXAMINATIONS

Students must pass comprehensive written and oral **Comprehensive Exams** to proceed to candidacy. The purpose of the written exam is to demonstrate proficiency in methodological and statistical skill necessary to complete the doctoral dissertation. The written exam covers learning objectives and competencies from the ***Required Courses*** shown below. The following process will be followed for the **Written Exam**. One week prior to the scheduled exam background material *may* be given to the students taking the examination. Students will be notified in advance if materials will be distributed. SLUCOR's Associate Director for Academic Affairs will coordinate the development, administration, and grading of the exam. A SLUCOR faculty member designated by the SLUCOR Curriculum Committee will coordinate the development of the examination questions and detailed grading criteria in conjunction with relevant faculty from core courses. Upon completion, the exam questions and grading criteria will be sent to the Associate Director who will distribute them to the Curriculum Committee for review. The Associate Director will provide students with the name of the faculty writing the exam questions so that students can meet with these faculty members and ask questions concerning content and format prior to the exam. Grading of the written exam will be conducted by a committee of three faculty members. The author of the exam and one additional reader will independently grade the exam as Pass/Fail without any consultation and provide their grades to the Associate Director. In the event of a tie, the third reader will independently grade the exam and break the tie. In the event that the written exam is failed, the student may re-take the failed portion of the exam the following semester following the same procedure. In the event that the exam is failed a second time, the student will be ineligible to progress further in the Ph.D. program.

The purpose of the oral examination is to focus on the proposal of the dissertation. The oral exam presentation consists of a statement of the problem, literature review, and proposed research design for the dissertation. The exam is structured to assess the student's comprehensive knowledge of literature in the field of study, the ability to integrate and synthesize information across the discipline, and to design an appropriate analytic approach that expands the current body of knowledge. The oral exam cannot

be taken until successful completion of the written exam. Once the student and his/her mentor have determined that the student is sufficiently prepared to take the oral exam, he/she will work to schedule the exam with his/her committee. The student is also responsible for reserving a room large enough to accommodate the committee and observers. In addition to the three committee members, the Associate Director will arrange for two at-large members to join the committee for the exam. After the oral exam, the committee will provide a grade of "Pass" or "Fail". If the student fails the oral exam, the oral exam may be taken again according to specifications of Graduate Education. If the student does not pass the second oral examination, he/she will no longer be allowed to progress through the program.

Students who have passed both the written and oral examinations are expected to request a dissertation director and two additional members to be appointed as the **Doctoral Dissertation Committee**. After completing the dissertation research and with the approval of the dissertation committee, students schedule and **Oral Defense of the Dissertation**. This public defense lasts 90 minutes and is divided into two parts: 60 minutes for oral presentation and 30 minutes for discussion of questions, first from the dissertation committee, then from other departmental faculty and attendees.

SUMMARY OF COURSEWORK REQUIRED

Prerequisites: In addition to the 9 credits transferred from M.D. Phases 1 and 2 (see above), M.D./Ph.D. trainees must complete a graduate-level inferential statistics course. They may satisfy this requirement during the summer between the first and second years of medical school by taking ORES 501 Introduction to Biostatistics for Health Outcomes Research.

Required Courses during Ph.D. Training Years:

ORES-5010 *Introduction to Biostatistics for Health Outcomes Research* (or approved equivalent)
ORES-5160 *Data Management*
ORES-5300 *Foundations of Outcomes Research I*
ORES-5320 *Scientific Writing & Communication*
ORES 5400 *Pharmacoeconomics*
ORES-5430 *Health Outcomes Measurement*
ORES-5150 *Multivariate Analysis for Health Outcomes Research*
Plus: Nine credit hours of elective coursework selected from offerings of the Center for Outcomes Research

Course Descriptions *(Updates at http://www.slu.edu/medicine/slucor/academics/slucor-courses)*

ORES 5010 *Introduction to Biostatistics for Health Outcomes Research* (3 credits) This course introduces the basic principles and methods of biostatistics, providing a sound methodological foundation for health outcomes research.

ORES 5160 *Data Management* (3 credits) This course is an introduction to the design, maintenance and management of data involving human or animal subjects for research and analytic purposes.

ORES 5300 *Foundations of Outcomes Research I* (3 credits) This course will assist students in understanding outcomes research and provide a background in the basic tools used in outcomes studies.

ORES 5150 *Multivariate Analysis for Health Outcomes Research* (3 credits) This course covers advanced concepts and techniques of descriptive and inferential statistics with applications in the medical and public health fields.

ORES 5320 *Scientific Writing and Communication* (2 credits) This course develops the essential skills necessary for writing and communicating scientific information to both professional and lay audiences.

ORES 5430 *Health Outcomes Measurement* (3 credits) This course provides students with an understanding of the principles of instrumentation and measurement of health outcomes.

ORES 5260 *Pharmacoepidemiology* (3 credits) This course is an introduction to pharmacoepidemiology, which is the study of the use of and the effects of drugs in large numbers of people.

ORES 5400 *Pharmacoeconomics* (3 credits) Pharmacoeconomics involves the assessment of the costs and benefits associated with pharmaceutical interventions. The purpose of this course is to introduce the student to the concepts associated with pharmacoeconomic analyses.

ORES 5410 *Evaluation Sciences* (3 credits) This course deals with the application of research methods to judge the success of health programs. The course focus is public health programs and health services, although the concepts and methods are equally relevant to other sectors.

ORES 5420 *Clinical Trials Design & Analysis* (3 credits) This course is designed to provide students with an understanding of the main concepts and issues in clinical trial design and interpretation.

ORES 5440 *Comparative Effectiveness Research* (3 credits) This course will cover the fundamental concepts of Comparative Effectiveness Research-research evaluating the benefits and harms of alternate treatment methodologies.

GENERAL GUIDELINES FOR PUBLIC DEFENSE OF THE DOCTORAL DISSERTATION

INTRODUCTION

The Saint Louis University Graduate Council and the University's Board of Graduate Studies mandate a public oral presentation and defense of Ph.D. dissertations. The Council and the Board approved this policy for two reasons. First, Saint Louis University wishes to increase public awareness of the high quality of its research efforts. The opportunity for Saint Louis University colleagues and their peers from outside the University to attend these presentations provides an open forum for our doctoral research accomplishments across scientific disciplines. Second, the general scrutiny of all pre-doctoral research by faculty colleagues and peers promotes both quality assurance and accountability to due process among all Ph.D. degree programs.

PROCEDURE

It is the responsibility of the student and the Ph.D. mentor to ensure that the dissertation is properly formatted and that substantive disagreements among committee members have been discussed prior to scheduling its public defense. It is also presumed that the candidate will be evaluated on the dissertation's content and the level of preparation for its presentation, rather than on a student's public speaking ability. At least three weeks before the proposed date, the Graduate Education Doctoral Candidacy Advisor must be notified in writing that an oral defense has been scheduled, accompanied by two copies of an advanced draft of the dissertation. One copy is retained in the Office of Graduate Education office for review by all interested persons, but may not be removed. The Candidacy Advisor formally evaluates the second copy.

The Office of Graduate Education prepares a four-page program for each defense, unless the Ph.D. department wishes to provide one. In addition to copies of the draft dissertation, candidates must also submit the following items at least three weeks before the proposed date. Those items include: the student's full name and SLU identification number; the proposed date, time, and location of the defense; a disk copy of the dissertation digest (< 300 words); and a brief biographic statement for the program. The Office of Graduate Education distributes an announcement of the defense to a primary mailing list provided by the Ph.D. department for all of its dissertations. This list includes appropriate University deans, chairs, center/institute directors, all departmental faculty, and SLU faculty in related disciplines. A second list provided by the Ph.D. department for a specific defense may include organizations and individuals from the local scientific or business communities who are associated with the candidate or with the specific research topic. Individuals on this second list may be invited by the Ph.D. department, or by the Office of Graduate Education if so desired, whose invitations will be sent electronically when feasible. As a courtesy, the Office of Graduate Education also invites to each defense the University President, Provost, and Deans. The Ph.D. department should invite its own graduate students, fellows, and staff to the defense.

A representative of the Office of Graduate Education is assigned to attend each presentation to ensure that the examination is conducted according to an established protocol. This representative must be a member of the Graduate Faculty but may not be a member of the candidate's dissertation committee. The representative then submits a brief report to the Graduate Education Dean as to the duration, attendance, and adherence to guidelines that the Ph.D. department has previously had approved by the Office of Graduate Education. In general, the candidate's presentation should be 30-60 minutes in length, followed by a period for questions from the audience and answers by the candidate. The entire presentation/defense should not exceed two hours. In addition, each department must prepare a brief written protocol for dissertation defenses by all of its Ph.D. candidates. This protocol should include expectations of student performance during the defense, and it should be included in the department's graduate student handbook. The document should also explain any acceptable variations from its own guidelines, and must be submitted to the Graduate Education Dean for approval. Approved protocols typically include the following points:

1. The dissertation committee chair should introduce the candidate and may provide a brief oral biography of the student. The candidate may use audiovisual or other appropriate materials, and should conclude the presentation prior to questioning. If the department permits spontaneous questioning, this should be clearly stated in the department's protocol for the defense that has been made available to its students.

2. All questions from the audience should be recognized by the dissertation committee chair, who is expected to control this phase of the defense and who has sole authority to recognize those wishing to ask questions or make comments.

3. The dissertation committee meets immediately after the public defense to conclude evaluating the candidate and dissertation. Ballots of committee members are then completed, collected by the committee chair, and submitted to the Doctoral Candidacy Advisor with final copies of the dissertation. If minor revisions are required following the public defense, ballots should be withheld until all committee members are ready to cast their final votes. Unanimous affirmation by the dissertation committee whose signatures appeared on the candidate's approved prospectus is necessary for final approval of the dissertation.

4. Should the candidate not be approved for graduation because of one negative vote from a dissertation committee member, the Candidate may appeal. The appeal process is described in the current catalog of the Office of Graduate Education.

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***Jinsong Zhang, Ph.D.**, Associate Professor, Pharmacology & Physiology

Emily Cybulla & Zack Grese
M.D./Ph.D. Trainees (GS-2) at Saint Louis University School of Medicine

***Mrs. Nicole Clark**, Administrative Assistant (314) 977-9877; e-mail: Nicole.Clark@health.slu.edu

*Members of the M.D./Ph.D. Admissions Subcommittee