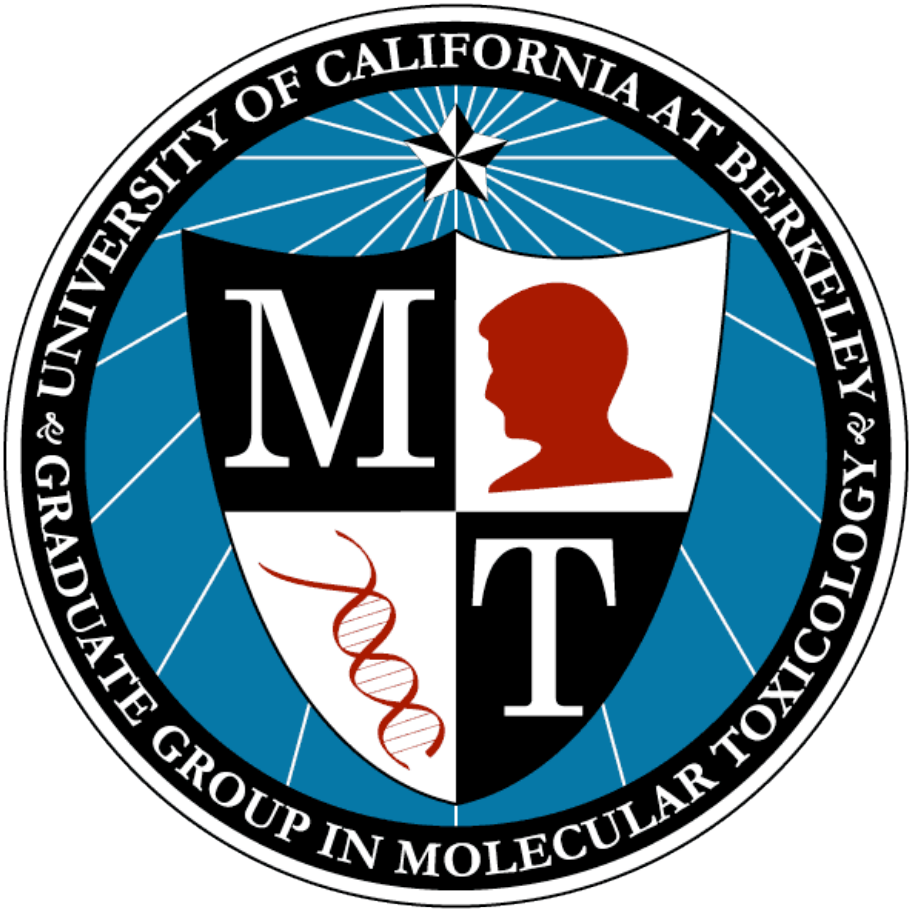
GRADUATE GROUP IN MOLECULAR TOXICOLOGY

2013 - 2014



University of California, Berkeley

General Information

The Interdepartmental Graduate Group in Molecular Toxicology administers the Ph.D. degree for students interested in a biochemical and molecular approach to study the adverse effects of chemicals on organisms. Opportunities for research exist with faculty from diverse departments and research units on the Berkeley campus including Molecular and Cell Biology, Nutritional Sciences and Toxicology, Plant and Microbial Biology, Chemistry, Public Health, Environmental Science and Policy Management, Integrative Biology, the Lawrence Berkeley National Laboratory and the Lawrence Livermore National Laboratory.

Program

The academic program is designed to provide students with rigorous training in Molecular Toxicology. The multidisciplinary nature of the program encourages students to pursue their unique research interests and work with faculty from a variety of fields. Graduates of the program will receive the PhD degree in Molecular Toxicology.

Additional academic requirements of the Graduate Division are found in the Berkeley General Catalogue.

Prerequisites

The following is a list of undergraduate course requirements. In parentheses are courses at UC Berkeley that fulfill these requirements. Students admitted with prerequisite deficiencies must remedy these deficiencies during the first year in residence.

Mathematics:	Differential and Integral Calculus (Math 1A,)	1 Semester
Statistics:	Introduction to Statistics (Stat 2, 20)	1 Semester
Chemistry:	General Chemistry (Chem 1A, 1B or 4A, 4B)	2 Semesters
Organic Chemistry	Lecture and Lab (Chem 3A, 3B; 112A, 112B)	2 Semesters
Biology	General Biology (Bio 1A, 1B or introductory courses in Genetics, Microbiology, Nutrition, Plant Biology or Zoology)	2 Semesters
Physiology	Cellular or Organismal (Int. Biol. 132, 132L)	1 Semester
Biochemistry/ Molecular Biology	General Biochemistry, Lecture and Lab (MCB 100, 102, 110, 110L)	2 Semesters
Toxicology	Introduction to Toxicology (NST 110)	1 Semester

Course Requirements

Students generally proceed directly from the Bachelor's degree to the Ph.D. degree without taking the M.S. degree. The M.S. degree in Molecular Toxicology is available only under exceptional circumstances. The Group operates under Plan B as described in the UC Berkeley General Catalog.

Although the Ph.D. has no minimum unit requirement, it is expected that students will enroll in a core curriculum totaling 30 units. This includes the core courses and at least 6 units of elective courses. A student will gain additional units for thesis research. Students are not required to declare a specific field of emphasis, but possibilities exist to focus in any of the following areas of toxicology:

- Developmental toxicology
- Environmental toxicology
- Food/Nutritional toxicology
- Genetic toxicology
- Immunological toxicology
- Neurological toxicology
- Reproductive toxicology

Core Course Requirements

In the first year of the program, students will be introduced in the required core courses to the fundamental concepts and methods of toxicology and examples of their current applications. In addition, through participation in the first year laboratory research course, students will begin to acquire in-depth knowledge of several specific problems of toxicology, as well as a familiarity with specialized research methods and techniques. The student's in-depth expertise in a specialized area will be further developed in the dissertation research. Knowledge of the broader field of which the dissertation research is a part will be acquired through selection of 2-3 elective courses that cover selected fields of importance to toxicology. This breadth of knowledge will be fostered further by participation in the required seminar courses (NST 290), which will focus on selected topics in toxicology.

YEAR 1 (Core Courses)

Semester	Course	Title	Credits
Fall			
	[a]NST 110	Toxicology	4
	NST 299	Dissertation Research	1-12
	NST 292	Graduate Research Colloquium	1
	MCB 110	Molecular Biology	4
	NST 301	Teaching in Nutritional Sciences	1-2
	NST 293	Research Seminar (Faculty Presentations)	1
		TOTAL UNITS	

Semester	Course	Title	Credits
Spring			
	PH C270B/NST C219	Advanced Toxicology	3
	NST 220	Molecular Toxicology	4
	NST 299	Dissertation Research	1-12
	[b]XXX290	Advanced Seminars (in any applicable department)	1

NST 292	Graduate Research Colloquium	1
MCB 136	Physiology	5
NST 250	Advanced Topics in Metabolic Biology	3
NST 302	Professional Preparation: Supervised Teaching in NST	1-4
	TOTAL UNITS	

[a]Students who have not taken an upper division toxicology course are required to take NST 110 during the fall semester of their first year *and* NST C219 in the spring of their first year. Students who have taken an undergraduate toxicology course are only required to take NST C219 in the spring semester of their first year.

[b]All students must enroll in one 290 course each year and NST292 each semester in addition to research units.

YEAR 2 (Core Courses)

Semester	Course	Title	Credits
Fall			
	Elective	(According to research area)	3
	XXX290	Advanced Seminars (in any applicable department)	1
	NST 292	Graduate Research Colloquium	1
	NST 299	Dissertation Research	3-8
	MCB 236	Advanced Mammalian Physiology	5

Semester	Course	Title	Credits
Spring			
	Elective	(According to research area)	3
	XXX290	Advanced Seminars (in any applicable department)	1
	NST 292	Graduate Research Colloquium	1
	NST 299	Dissertation Research	3-8

Other Course Requirements

Electives (6 units): In consultation with the PI (Major Advisor), a student must select a minimum of 6 units from the approved list of elective courses (see page 5), to comprise an area of emphasis consistent with the student's research interests. Alternative courses require approval of the Graduate Advisor.

Departmental Seminar: All graduate students are expected to attend the regular Departmental Seminar in the Department of Nutritional Science and Toxicology on Wednesdays at 4pm as an integral part of graduate training. The informal refreshments before seminars offer a good opportunity for students and faculty to interact and exchange ideas.

Dissertation research units. Students should consult with the department Graduate Student Affairs Advisor for the appropriate course control number for their major advisor's 299.

Graduate students in Molecular Toxicology must enroll in at least 12 units per semester, in courses of the 200 series or higher, or 15 units of 100/200 series courses to qualify as full-time students. These courses must be taken for a letter grade (not S/U), if the letter grading option exists. The unit requirement may be met by enrollment in courses, seminars, and/or research units (NST299).

Descriptions of Core Courses

NST 110 Toxicology (3 units) Introduction to toxicology covering basic principles, dose-response, toxicity testing, chemical metabolism, mechanisms of toxicity, carcinogenesis, interpretation of toxicological data for risk assessment, and target organ toxicity

NST 115 Principles of Drug Action (2 units) Basic principles and quantitative aspects of drug action and risk/benefit as applied to the discovery, design, and development of human therapeutics. The course will highlight the importance of integrating pharmacology, toxicology, and pharmacokinetics to create effective and safe treatments for human disease. Special emphasis will be placed on pharmacogenomics and variation in individual response.

NST C219/PH C270B Advanced Toxicology (3-4 units)
Introduction to toxicology covering basic principles, dose-response, toxicity testing, chemical metabolism, mechanisms of toxicity, carcinogenesis, interpretation of toxicological data for risk assessment, and target organ toxicity.

NST 220 Molecular Toxicology (3 units) Discussion of the principles and mechanisms of molecular toxicology along with the assays used in determining the toxicity of substances. The knowledge of how toxicity can be applied to therapy and how genomics and bioinformatics relate to the determining individual/population exposure will be addressed.

NST 250 Advanced Topics in Metabolic Biology A graduate course taught by the Department of Nutritional Sciences and Toxicology in the College of Natural Resources with 3 hrs of lecture. Overview lectures and discussion of primary literature will be combined in this course to provide a working knowledge of principles, regulation, and experimental approaches in metabolic biology. Select topics ranging from molecular mechanism of metabolite synthesis and cellular signaling to integrative physiology of organismal metabolic homeostasis will be discussed with a particular emphasis on their connection to human diseases.

NST 290 Advanced Seminars in Molecular Toxicology (1-2 units) A seminar course, one per year. With approval of major professor, other graduate seminar courses may be substituted.

NST 292 Graduate Research Colloquium (1 unit) A seminar that includes presentations by graduate students of research proposals and results of their research for discussion and evaluation by the group. This class is to be taken every semester. Students are not required to present until their second year (and each year following). Note: once the student has a major advisor, the student should attend the colloquium offered in the department of his or her major advisor.

NST 293 Faculty Research Presentations Intended to educate first-year graduate students on topics and techniques of faculty research to broaden their education, and as an aid in choosing rotations/mentors/committee members.

MCB 110 General Biochemistry and Molecular Biology (3 units) An undergraduate course taught by the Division of Biochemistry and Molecular Biology of the Department of Molecular and Cell Biology in the

College of Letters and Sciences. Molecular biology of prokaryotic and eukaryotic cells and their viruses. Mechanisms of DNA replication, transcription, translation. Structure of genes and chromosomes. Regulation of gene expression.

MCB 236 Advanced Mammalian Physiology (5 units) Principles of mammalian (primarily human) physiology emphasizing physical, chemical, molecular, and cellular bases of functional biology.

NST 301 Professional Preparation: Teaching in Nutritional Sciences (1-2 units) Creative approaches to teaching to diverse audiences are emphasized. Participants will identify needs of target populations, formulate educational objectives, design and/or use motivational teaching strategies, and evaluate the impact of their teaching on knowledge, attitudes, and behavior. Undergraduates may teach nutrition to elementary school children. Graduates may become teaching assistants.

Examples of Elective Courses

(Course names and numbers change over the years. Please see the online catalog for the most up-to-date information on courses. http://schedule.berkeley.edu/)

- CEE 108 Air Pollutant Em. & Control
- NST C114 Pesticide Chem. & Tox.
- NST 115 Principals of Drug Reaction
- HMS 202 Anatomy of Human Development
- HMS 209 Principles of Human Pathology
- HMS 219 Human Histology
- HMS 220 Human Physiology
- IB 106 Biological Oceanography
- IB 132 Survey of Human Physiology
- IB 152 Marine pollution
- IB 176 Ichthyology
- MCB 135A Molecular Endocrinology
- MCB 135E Physiology of Human Development
- MCB 135G Biology of Human Cancer
- MCB 135K Physiology of Aging Process
- MCB 150 Molecular Immunology
- MCB 160 Intro to Neurobiology
- MCB 165 Molecular Neurobiology
- MCB 204 Molecular biology of cell reproduction
- MCB C214 Protein Chemistry, Enzymology, and Bio-organic Chemistry
- MCB 230 Advanced Cell Biology
- MCB 231 Advanced Developmental Biology
- MCB C232 Advanced Topics in Endocrinology
- MCB 244 Developmental Genetics
- MCB 250 Advanced Immunology
- PMB C102 Diversity of Plants and Fungi
- PMB C102L Lab in the Diversity of Plants and Fungi
- PMB C103 Bacterial Pathogenesis
- PMB 110 Biology of Fungi
- PMB 110L Lab for Biology of Fungi
- PMB 180 Environmental Plant Biology
- PH 250 Epidemiologic Methods
- PH 270A Exposure Assessment & Control
- PH 270B Toxicology I
- PH 270C Advanced Pharm. & Tox.
- PH 271B Reprod. Hazards of Industrial Chemicals

Teaching Requirement

All graduate students in the Group are required to obtain teaching experience as a Graduate Student Instructor (GSI) before taking their Oral Qualifying Examination (OQE). This assignment may involve lecturing, leading discussions, lab preparation, examination writing, and grading. Each student must serve as a GSI for at least one semester. Graduate Division has stipulated that first time GSIs must have completed or be enrolled in a 300-level semester-long seminar on teaching in the discipline offered by the department and participate in the one-day teaching conference at the start of the semester. For more information on being a GSI and to find teaching resources, please look at Graduate Student Instructor (GSI) Teaching & Resource Center's website at http://gsi.berkeley.edu/.

Students who are non-native speakers of English must meet the language proficiency requirements of the Office of GSI Training in the Graduate Division. For a schedule of test dates and times, contact the GSI Teaching and Resource Center (301 Sproul Hall) at 642-4456. More information is available online at http://gsi.berkeley.edu/lpp/index.html.

GPA Requirement

All graduate students on the Berkeley campus are required to maintain a 3.0 cumulative GPA or above. Failure to maintain a 3.0 cumulative GPA will lead to probation and possible dismissal.

The Graduate Group in Molecular Toxicology requires its graduate students to maintain a 3.0 cumulative GPA in its core courses. Research units are not calculated into this GPA requirement. To continue receiving financial support from the Graduate Group, the Graduate Group in Molecular Toxicology requires its graduate students to have a 3.1 cumulative GPA

Departmental Financial Support and Leave

Students in the Graduate Group in Molecular Toxicology receive support from a combination of sources. Students are funded using a combination of Graduate Student Researcher (GSR) and Graduate Student Instructor (GSI) support. The combination of GSI/GSR funding is based on 5 months as a GSI and 7 months as a GSR. The student may be funded from individual faculty research grants. If the student chooses to decline to teach more than the one semester requirement (for any reason), they will not be eligible to receive support from the Department of NST.

Any possible funding beyond the period of maximal support by the Department of NST (i.e. 60 months for Ph.D. students) will be the responsibility of the Major Professor.

Students who receive financial support are expected to devote full-time to their graduate work. Arrangements for vacation or other leaves must be discussed with the Major Professor or Head Graduate Advisor. Graduate students are eligible for no more than four weeks of leave per year including school breaks. Financial support may be suspended for students absent for longer periods of time.

Fees

All graduate students at UC Berkeley pay a University Health Insurance Fee, a Class Pass Fee (Transit), a Berkeley Campus Fee, a Document Management Fee, Tuition, and a Student Services Fee. Non-residents of California are required to pay in addition a Nonresident Supplemental Tuition Fee. Fees are

subject to periodic revision by the Regents. All students with GSR and/or GSI positions will have their tuition and fees covered by these positions.

Legal residence requires that the student be a citizen or a permanent resident of the USA and have lived in the State of California for at least one year prior to applying for legal residency. Students who wish to establish residency must contact the Residence Office in Sproul Hall immediately upon arrival in California to begin the process.

Advising

Major Professor

The Major Professor will directly supervise and guide the student's research, and chair both the Guidance Committee and the Dissertation Committee.

Guidance Committee (optional and self-directed)

The Guidance Committee will meet with the student at least once every year, for the first 2 years to prepare the program of study leading to the Oral Qualifying Examination and monitor the student's progress. The committee consists of the Major Professor (chair) and two additional program faculty members chosen by the Major Professor and student with the advice and consent of Head Graduate Advisor. The Guidance Committee determines whether all first-year core courses/ prerequisites have been completed with a grade of B or better, and evaluates the initial research plan usually with the student presenting a powerpoint on his/her research. The Guidance Committee advises the student during the second year and reviews progress, recommends course work, may recommend changes in experimental design of the research project, and guides students to the Oral Qualifying Exam (OQE) by examining their knowledge and aiding them with topics. In consultation with the Guidance Committee, the student should identify the areas for the OQE early in the doctoral program, since selection of courses and seminars will be directed towards acquiring competency in these areas. Members of the guidance committee normally attend the student's NST 292 presentation and will meet as a group with the student shortly after the presentation.

Oral Qualifying Examination (OQE)

At the end of or during the second year of study (and upon recommendation of the Guidance Committee), a student will take an oral qualifying exam (OQE). This examination will be administered by a four-member committee. The student's major professor may not sit on this committee.

OQE Committee Members

The OQE committee will be chosen by the student during the spring semester of the second year of study. The first two OQE members including the Chair, must be members of the Group who are also academic senate members. Group members who do not have appointments on the UC Berkeley campus cannot serve in these first two slots. The third OQE member must be a member of the group but need not be an academic senate member (Group members with only LBNL or CHORI appointments would be able to serve in this position). The fourth OQE member must be from outside of the group and also be a member of the academic senate.

Proposals

The student will prepare two proposals for the OQE: a formal proposal to describe their dissertation research, and a proposal on a topic not directly related to the dissertation research or to the research of their major professor, but in an area of toxicology. The topic of the outside research proposal is subject to the approval of the Chair of the OQE Committee and he/she will assist the student in preparing the proposal. Each proposal should be on a hypothesis-testing research project. The format includes 10-15 pages, double-spaced with background information, aims, methods, discussion and rationale. The student should distribute copies of both proposals to the members of the Committee at least two weeks before the exam.

A student must pass the OQE before being advanced to candidacy for the Ph.D. degree. Before taking the exam, the student must have: a) removed deficiencies in training; b) satisfactorily completed (or be in the process of completing) all course work and seminar requirements and resolved any incomplete grades; c) maintained at least a 3.1 GPA in all course work undertaken in graduate standing; and d) completed (or be in the process of completing) the GSI requirement for the Group.

Examination Format

The OQE committee will examine the student on:

- general scientific knowledge;
- background knowledge in the area of their dissertation research;
- ability to formulate and defend a hypothesis;
- ability to formulate and defend experiments and techniques to test the hypothesis;
- ability to postulate expected and alternative results; and
- interpretation of expected and alternative results.

General topics of the exam will be in three areas selected by the student from those listed below.

Areas for Examination

The expectation of breadth will be considered to include NST C219, NST 220, and all the coursework taken during the student's first and second year in the graduate program (including prerequisite material).

In addition, the student must choose three areas from List A ***or*** two from List A and one from List B.

List A: Areas of Toxicology	List B: Fields Related to Toxicology (i.e., Minor Field)
▪ Mechanistic Toxicology ▪ Metabolism ▪ Molecular Epidemiology ▪ Environmental Toxicology ▪ Computational Toxicology	▪ Chemistry ▪ Biochemistry ▪ Molecular Biology ▪ Biostatistics ▪ Immunology ▪ Endocrinology ▪ Nutrition

The OQE committee may recommend: 1) an unqualified pass; 2) a qualified pass requiring additional course work and/or written reports and/or revision of research plans; 3) retaking the exam after addition

study and/or preparation of a different proposal; 4) re-direction to an M.S.; 5) dismissal. Upon successful completion of the OQE, the student enters into candidacy and responsibility for his/her further development passes to the mentor and the Dissertation Committee.

Advancement to Candidacy

Once the Oral Qualifying Examination has been passed, the student must file an application, properly approved by the Graduate Advisor, for Advancement to Candidacy for the Degree of Doctor of Philosophy. It should be filed with the Dean of the Graduate Division by the end of the semester following the one in which the Qualifying Examination is taken. Completion of the Ph.D. degree in Molecular Toxicology requires a minimum of two semesters of residency after Advancement to Candidacy for the degree.

Dissertation

Upon passing the OQE and Advancement to Candidacy, a three-member dissertation committee will be formed to guide the student's dissertation research. The chair will be the student's major professor. At least one member of the committee must be outside the Group to serve as the Graduate Dean's representative. The student must meet with this committee at least once a year, generally immediately following the students NST 292 presentation.
To satisfactorily complete the dissertation, the student must take the following steps:

- Develop a hypothesis. The topic may encompass a question of basic science in toxicology or an applied toxicology problem.
- Design experiments to test the hypothesis.
- Develop and/or apply analytical techniques to obtain data.
- Interpret the data, discuss the data in relation to reports of other workers, and evaluate the significance of the findings.
- Publish the results. A major activity of research scientists is communication of their results through timely reports in research literature.

Normative Time

Normative time is defined as the elapsed time in years that under normal circumstances would be needed to complete all requirements for the Ph.D. degree assuming that the student engaged in full-time, uninterrupted study and is making desirable progress toward the degree. Normative time for Molecular Toxicology is five years.

If you require additional information, please feel free to contact:

Graduate Group in Molecular Toxicology
C/o the Department of Nutritional Sciences and Toxicology
119 Morgan Hall #3104
University of California at Berkeley
Berkeley, CA 94720-3104
Tel: (510) 643-2863
Fax: (510) 642-0535
moltox@berkeley.edu

Outline of Program Leading to the Ph.D. in Molecular Toxicology

Step	Remarks
1. Admission	Undergraduates should apply in the early part of their senior year. Prospective students identify on their application form the name of one or more faculty members in the Group with whom they would like to work. Applicants are encouraged to make early contact with these faculty members regarding research opportunities.
2. Formal Course Work	To be completed during the first two years.
3. Oral Qualifying Examination	Should be taken by the end of the second year.
4. Advancement to Candidacy	Application to be made by the student immediately following completion of the Oral Qualifying exam.
5. Dissertation	To be ready in final form by the date specified by the Graduate Division.
6. Normative Time	All degree requirements should be completed within the established normative time of 5 years.

GENERAL TIMELINE

1st YEAR	Fall	required coursework
	Spring	required coursework By the end of the semester: select guidance committee
2nd YEAR	Fall	GSI, elective coursework, meet with guidance committee
	Spring	GSI (if not done previous semester), elective coursework, By the end of the semester: prepare for and take OQE (upon completion, apply for candidacy)
3rd YEAR	Fall	select dissertation committee
	Spring	By the end of the semester: meet with dissertation committee
4th YEAR	Fall/Spring	By the end of the semester: meet with dissertation committee
5th YEAR	Spring	Write your dissertation thesis, have it signed by dissertation committee and submit it

*Don't forget- **Each year**, students must take an NST290 and (after the first year), students must present in NST 292