ENVIRONMENTAL AND MOLECULAR TOXICOLOGY

The Department of Environmental and Molecular Toxicology offers courses leading to MS, and PhD degrees in toxicology.

Training in toxicology prepares students for careers in industry, government, and academic institutions. Biochemical, chemical, and molecular research approaches are emphasized, focusing on the following areas: analytical and exposure assessment, aquatic, biochemical, comparative, environmental, food, immuno- and neurotoxicology.

Research is promoted by the faculty’s close ties to the National Institute of Environmental Health Sciences (NIEHS), which supports the Environmental Health Sciences Center at OSU. The center contributes additional research and training opportunities for students. Opportunities in the area of neurotoxicology are provided by scientists of the Oregon Institute of Occupational Health Sciences (formerly CROET) at Oregon Health and Sciences University.

Financial support is available to most students in the program through graduate research assistantships or from an NIEHS environmental health predoctoral training program. Completing the application by the end of January assures full consideration for funding for fall of that year.

Students who wish to enter the program should have a BS degree (or equivalent) in a science related field and are expected to select an MS or PhD curriculum related to their own area of specialization. Students will take a core set of courses and will attend and participate in the toxicology seminar class. Courses in toxicology also may be taken by students in engineering or the basic sciences.

PhD Preliminary Exam Guidelines

Objective

The overall objective of the preliminary examination for advancement to PhD candidacy should assess whether a graduate student has the capacity and promise to:

1. understand the basic science of environmental and molecular toxicology;
2. be a creative and critical thinker;
3. understand the scientific literature;
4. conduct original and independent research; and
5. communicate the ideas and results of experiments.

Thus, the ideal examination format would select from those characteristics and prepare the student for the selective pressures that will be encountered upon completing the Environmental and Molecular Toxicology PhD degree program. In order to maintain high standards and produce quality graduate students, the examination must be rigorous and challenging. In addition, the exam format should set specific limits on the amount of time that the student dedicates to this process.

Exam Format

The preliminary examination format outlined below consists of both oral and written elements. This examination must be completed no later than the end of the eighth academic term (not including summer terms) after entering the program. In most cases, the student would schedule the exam in the fall term of the third year of residence although students may take the exam earlier, after completing at least one year in the program. The examination consists of a written and oral presentation of a research proposal that cannot be closely related to the student’s thesis project. As outlined, the student’s ability to develop, research, and defend original scientific ideas would be evaluated. The student is expected to demonstrate a capacity for critical thinking and a command of the specific field of focus. In addition, the student’s general knowledge of environmental and molecular toxicology would be evaluated.

Procedural Outline

Research Proposal (written/oral)

1. Student submits outline descriptions (required elements listed below) of two potential research projects. The subject of each project must be chosen by the student based on their knowledge and review of the literature, and must describe original, hypothesis-driven research. The proposed projects cannot have been defined previously in published or unpublished form (i.e., manuscript, abstract, database of funded projects, submitted grant application, etc.), or cannot be known to be in progress. Proposed research also must not be closely related to the thesis research of the student. “Closely related” is defined as any research that conceivably could be part of the student’s thesis or that conceivably might be initiated by the student’s major professor.

Project outlines (limited to one page each) must include:

a. Description of an unresolved question relevant to the field of environmental and molecular toxicology. (1–3 sentences)

b. Statement of specific hypothesis to be tested. (1–2 sentences)

c. Description of an experimental approach designed to test the hypothesis, including a minimum of two specific aims, and a statement of the rationale (justification) for the proposed approach. (2–6 sentences)

d. Statement of the significance of the proposed research. (1–2 sentences)

2. The student’s graduate committee reviews both outlines and approves one topic to be developed into a written proposal. The research topic is chosen based on originality, quality, potential significance, and the likelihood of expanding the student’s education and training. Approval of the topic would occur within one week after the outlines are submitted. During this period, the outlines would be returned to the student, and the student would receive feedback from the committee concerning the quality and design of the outlined projects. Major strengths and weaknesses in the experimental design or rationale would be identified.

3. The student develops a written research proposal using the format and topic guidelines of application for the EPA, NIH, NSF, or other appropriate granting agency. The written proposal must be completed and returned to the committee within four weeks after the topic was approved. The scope of the project will be equivalent to that of a "pilot project" proposal and if conducted would be expected to take approximately one year of research time. The proposal is limited in length to 10 pages of double-spaced text (12 point font with 0.5-inch margins), and must include the following elements:

a. Specific Aims. State concisely and realistically what the research described in this application is intended to accomplish and what hypothesis is to be tested. Do not exceed one page.

b. Background and Significance. Briefly describe the background to the present proposal, critically evaluating the existing literature and specifically identifying gaps, which the project is intended to fill. State concisely the importance of the research described.
in this application, and relate the specific aims to the long-term objectives. Limited to two pages.

c. **Research Design and Methods.** Discuss in detail the experimental design and procedures to be used to accomplish the specific aims of the project. Describe the protocols to be used and the tentative sequence of investigation. Include the means by which the data will be analyzed and interpreted. Discuss the potential difficulties and limitations of the proposed research and alternative approaches to achieve the aims. Point out any procedures, situations, or materials that may be hazardous to personnel and the precautions to be exercised. Limited to seven pages.

d. **Literature Cited.** Do not scatter literature citations throughout the text. List them at the end of the proposal. All papers cited in the text must be listed in the reference list and vice versa. The list of literature citations at the end of the proposal does not count toward the 10-page limit.

e. **Appendix.** Students may include additional figures in an appendix, limited to five pages. The appendix may not be used to circumvent the page limits of the proposal.

4. The oral exam should be scheduled within two weeks of completion of the written proposal. This deadline can be extended with the approval of the student's graduate committee.

5. During the exam, the student would present the research plan and defend the experimental approach. The presentation would involve a seminar format with slides/overheads and would be expected to last no longer than 30 minutes. Following the presentation, the student would be judged on the soundness of the hypothesis, their understanding of the subject matter, their ability to defend the proposed experimental design, and their general knowledge of the field of environmental and molecular toxicology. The exam is expected to last approximately two hours and is limited in length to three hours.

**Examination Committee**

The examination committee is the graduate student’s doctoral committee. The doctoral committee consists of a minimum of five members of the graduate faculty, including at least two members of the major department and a representative of the Graduate Council. If a minor is declared, the committee must include a member from the minor department. All committee members must be on the graduate faculty with appropriate authorization to serve on the student’s committee. The major professor would serve as the chairperson of the committee to oversee the exam. The decision concerning whether the student merits advancement to PhD candidacy would be the responsibility of the examination committee.

**Evaluation**

The basic question for the committee is whether or not they believe the student is adequately prepared to conduct doctoral level research and has a good chance of successfully completing such research. Following a discussion of the student's performance on the examination, each committee member is then asked to vote on the basic question. It is appropriate for secret ballots to be used, and secret ballots must be used if requested by any committee member.

If there is one negative vote on this question, the student will **pass**. If there are two or more negative votes on this question, the student will **not pass**.
TOX 360. *THE WORLD OF POISONS. (3 Credits)
Provides a basic understanding of how we are exposed and respond to chemicals, examples of human diseases associated with toxic insult, the role of technology and the interface of society and toxicology in risk perception and legislation. (Bacc Core Course)
Attributes: CSST – Core, Synthesis, Science/Technology/Society
Recommended: One 3-credit course in chemistry or one 3-credit course in biology.

TOX 401. RESEARCH. (1-16 Credits)
This course is repeatable for 16 credits.

TOX 405. READING AND CONFERENCE. (1-16 Credits)
This course is repeatable for 16 credits.

TOX 411. FUNDAMENTALS OF TOXICOLOGY. (3 Credits)
Introduction to the discipline of toxicology. Examination of the basic concepts that define how chemicals are absorbed, distributed, metabolized, and eliminated by the body. Overview of associated dose/response relations.
Prerequisites: BB 350 (may be taken concurrently) with D- or better or BB 450 (may be taken concurrently) with D- or better or BB 490 (may be taken concurrently) with D- or better

TOX 413. ENVIRONMENTAL TOXICOLOGY AND RISK ASSESSMENT. (3 Credits)
Procedures for defining exposure and the use of toxicological data in defining risk assessment. Recent application of mechanistic concepts are reviewed.
Prerequisites: TOX 411 with D- or better

TOX 429. TOXIC SUBSTANCES IN FOOD. (3 Credits)
Toxicology and epidemiology of human exposures to pesticides and food toxicants.
Prerequisites: BB 350 (may be taken concurrently) with D- or better or BB 450 (may be taken concurrently) with D- or better or BB 490 (may be taken concurrently) with D- or better

TOX 430. CHEMICAL BEHAVIOR IN THE ENVIRONMENT. (3 Credits)
Applications of chemical concepts in the definition and solution of pollution problems; analytical considerations, thermodynamic factors influencing movement of chemicals, physical and metabolic transformations occurring in the environment.
Prerequisites: CH 123 with D- or better or CH 331 with D- or better

TOX 435. *GENES AND CHEMICALS IN AGRICULTURE: VALUE AND RISK. (3 Credits)
A multidisciplinary course that examines the scientific, social, political, economic, environmental, and ethical controversies surrounding agricultural and natural resource biotechnologies. Lec/rec. CROSSTRAINED as FES 435/FES 535, FES 435H, MCB 535. (Bacc Core Course)
Attributes: CSST – Core, Synthesis, Science/Technology/Society
Recommended: One quarter each of biology and chemistry

TOX 435H. *GENES AND CHEMICALS IN AGRICULTURE: VALUE AND RISK. (3 Credits)
A multidisciplinary course that examines the scientific, social, political, economic, environmental, and ethical controversies surrounding agricultural and natural resource biotechnologies. Lec/rec. CROSSTRAINED as BI 435H, FS 435H. (Bacc Core Course)
Attributes: CSST – Core, Synthesis, Science/Technology/Society; HNRS – Honors Course Designator
Equivalent to: FES 435, TOX 435
Recommended: One quarter each of biology and chemistry

TOX 455. ECOTOXICOLOGY: AQUATIC ECOSYSTEMS. (3 Credits)
Focuses on transport, fate, and effects of toxic substances in freshwater ecosystems. There is special emphasis on impacts on fish.
Prerequisites: CH 331 with D- or better

TOX 490. ENVIRONMENTAL FORENSIC CHEMISTRY. (3 Credits)
Principles of Good Laboratory Practice Standards, methodology, utility and limitations of chemical forensic methods as applied to real investigations.
Recommended: One year of college chemistry and one term of organic chemistry.

TOX 499. SPECIAL TOPICS. (1-16 Credits)
This course is repeatable for 16 credits.

TOX 501. RESEARCH. (1-16 Credits)
This course is repeatable for 16 credits.

TOX 503. THESIS. (1-16 Credits)
This course is repeatable for 999 credits.

TOX 505. READING AND CONFERENCE. (1-16 Credits)
This course is repeatable for 16 credits.

TOX 507. SEMINAR. (1-16 Credits)
This course is repeatable for 16 credits.

TOX 511. FUNDAMENTALS OF TOXICOLOGY. (3 Credits)
Introduction to the discipline of toxicology. Examination of the basic concepts that define how chemicals are absorbed, distributed, metabolized, and eliminated by the body. Overview of associated dose/response relations.
Prerequisites: BB 550 (may be taken concurrently) with C or better or BB 590 (may be taken concurrently) with C or better

TOX 512. TARGET ORGAN TOXICOLOGY. (3 Credits)
Examination of toxicological effects of chemicals at organ level. Normal physiology of the organ system is received.
Prerequisites: TOX 511 with C or better

TOX 513. ENVIRONMENTAL TOXICOLOGY AND RISK ASSESSMENT. (3 Credits)
Procedures for defining exposure and the use of toxicological data in defining risk assessment. Recent application of mechanistic concepts are reviewed.
Prerequisites: TOX 511 with C or better

TOX 529. TOXIC SUBSTANCES IN FOOD. (3 Credits)
Toxicology and epidemiology of human exposures to pesticides and food toxicants.
Recommended: Completion or concurrent enrollment in BB 350, BB 450 or BB 490

TOX 530. CHEMICAL BEHAVIOR IN THE ENVIRONMENT. (3 Credits)
Applications of chemical concepts in the definition and solution of pollution problems; analytical considerations, thermodynamic factors influencing movement of chemicals, physical and metabolic transformations occurring in the environment.
Recommended: CH 106 and CH 331 and graduate standing.

TOX 535. GENES AND CHEMICALS IN AGRICULTURE: VALUE AND RISK. (3 Credits)
A multidisciplinary course that examines the scientific, social, political, economic, environmental, and ethical controversies surrounding agricultural and natural resource biotechnologies. Lec/rec. CROSSTRAINED as FES 435/FES 535, FES 435H, MCB 535.
Equivalent to: FES 535, MCB 535
Recommended: One quarter each of biology and chemistry
TOX 554. GENOME ORGANIZATION, STRUCTURE, AND MAINTENANCE. (4 Credits)
How diverse organisms store their individual sets of genetic information (genomes). Evolution of genomes and gene families. Structures of DNA and chromosomes. Biochemical and regulatory pathways that protect cellular genomes against environmental and endogenous damage and ensure transmission of faithful copies to progeny. Remodeling of genomes by recombination and transposition. CROSSLISTED as MCB 554.
Equivalent to: MCB 554
Recommended: BI 311 (genetics or equivalent) and (BB 450 and BB 451 and BB 452) or (BB 490 and BB 491 and BB 492) or equivalent.

TOX 555. ECOTOXICOLOGY: AQUATIC ECOSYSTEMS. (3 Credits)
Focuses on transport, fate, and effects of toxic substances in freshwater ecosystems. There is special emphasis on impacts on fish.
Recommended: CH 331

TOX 575. ADVANCED XENOBIOTIC METABOLISM AND DISPOSITION. (2 Credits)
Course will focus on structure, function and regulation of specific proteins that function in uptake, distribution, metabolism, and excretion of drugs and other chemicals that are foreign to the body (xenobiotics). The course will focus on proteins which are termed Phase I and Phase II xenobiotic metabolizing enzymes and xenobiotic transporters. There will be an emphasis on Cytochrome P450 enzymes and hepatic and renal xenobiotic transporter proteins and their key roles in xenobiotic metabolism and excretion.
Recommended: TOX 512

TOX 590. ENVIRONMENTAL FORENSIC CHEMISTRY. (3 Credits)
Principles of Good Laboratory Practice Standards, methodology, utility and limitations of chemical forensic methods as applied to real investigations.
Recommended: One year of college chemistry and one term of organic chemistry.

TOX 599. SPECIAL TOPICS. (1-16 Credits)
This course is repeatable for 16 credits.

TOX 601. RESEARCH. (1-16 Credits)
This course is repeatable for 16 credits.

TOX 603. THESIS. (1-16 Credits)
This course is repeatable for 999 credits.

TOX 605. READING AND CONFERENCE. (1-16 Credits)
This course is repeatable for 16 credits.

TOX 607. SEMINAR. (1-16 Credits)
This course is repeatable for 16 credits.

TOX 611. TESTING FOR GENOTOXICITY. (4 Credits)
A lab-based course geared toward toxicology, biochemistry, biology, food science, nutrition, pharmacy and MCB students. Introduces principles and methods of several key assays used to screen for DNA damage and mutation. These tests will include the following: (i) Salmonella mutagenicity assay ('Ames test'), (ii) single cell gel electrophoresis ('comet') assay, (iii) micronucleus assay, and (iv) PCR-based single strand conformation polymorphism (SSCP) screening for oncogene/tumor suppressor gene mutation in cancers. This 2-week, intensive lab/lecture class runs Mon-Fri in the LPSC during the first session of summer term. Each day includes laboratory work and a 2-hour lecture covering basic principles of the assays, as well as technical details of the experiment for the day.
Prerequisites: TOX 514 with C or better
Recommended: BB 400 series, prior course work on DNA repair and mutagenesis

TOX 699. SPECIAL TOPICS. (1-16 Credits)
This course is repeatable for 16 credits.

TOX 808. WORKSHOP. (1-16 Credits)
This course is repeatable for 16 credits.