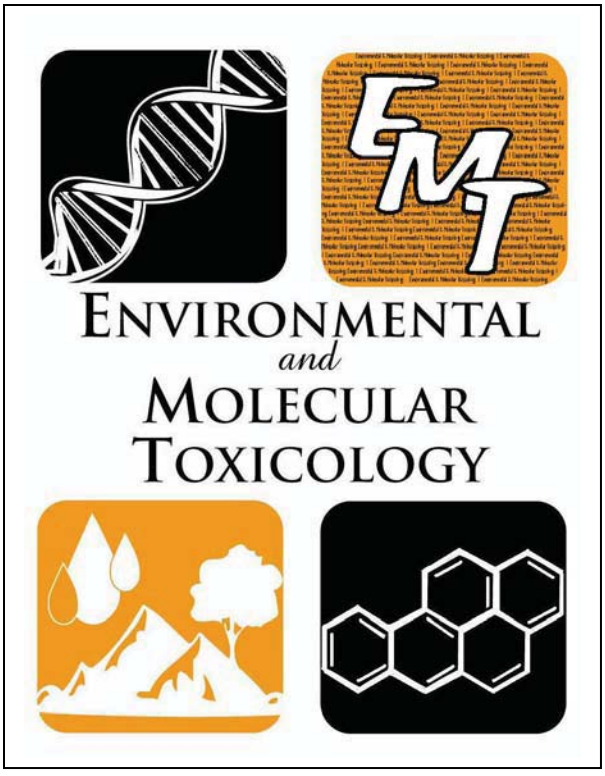
Oregon State University OSU

Environmental and Molecular Toxicology Program

Graduate Student Handbook



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Program Overview

The Environmental and Molecular Toxicology (EMT) Graduate Program focuses on creating, disseminating and applying new research knowledge in the areas of Molecular and Cellular Toxicology and Environmental Chemistry and Ecotoxicology to enhance the treatment and prevention of human disease, and to ensure the protection of the environment and public health. This integrated approach, combining both the biological and physical sciences, provides exciting training and research opportunities for graduate students and supports our state-of-the-art and internationally competitive research programs. EMT offers a highly collegial and exceptionally collaborative, research and training environment dedicated to the success and advancement of all EMT students, faculty and staff. Degrees offered in the Toxicology Program include both a Thesis and non-Thesis (M.Ag. and M.S., respectively, and a Ph.D.) All Ph.D. and M.S. students must complete the required core toxicology series (Integrated Environmental Chemistry and Molecular Toxicology I & II), enroll in a seminar course each term, and complete additional required and elective coursework. Ph.D. students in addition must complete the preliminary qualifying exam. All Ph.D. and Thesis M.S. students conduct thesis research, and ultimately must prepare their written thesis/dissertation and present and defend their research accomplishments in a public seminar and final examination. Generally, non-thesis M.S. degrees will take two years, thesis M.S. degrees 2-3 years, and Ph.D. degrees 4-5 years to complete.

Admission Requirements and Program Selection Criteria

1) A B.S. or B.A. or equivalent from an accredited US institution or a recognized foreign institution.

2) The following courses or equivalents as prerequisites for the program:

Biological Sciences	1 year
Organic Chemistry	1 year
Mathematics	Complete through integral calculus
Physics	1 year

Physical chemistry is also strongly recommended,

3) Minimum GPA of 3.25

4) GRE scores minimum total of 1100 in three required areas (verbal, quantitative, analytical)

5) Foreign students (non-English speaking) must score at least 550 on the TOEFL

Under exceptional circumstances, some of these requirements may be waived by the Graduate Program Committee.

December 31st is the target closing date for applications to the M.S. and Ph.D. Programs for the following Fall Term. Students may be admitted for other Terms, following review of the application materials by the Graduate Commttee.

M.S. (Thesis) Program Steps

1. Application to the Graduate School by the student, and forwarding of their application with statement of interest to the EMT Department.

2. Acceptance of the student by the EMT Graduate Program Admissions Committee, and notification to the Graduate School.

3. Beginning of coursework, selection of a major professor and initiation of thesis research project.

4. Development of student program by major professor and student; approval of program by major professor, minor professor (if applicable) and EMT Department Head; must be fulfilled prior to completing 18 credits of course work.

5. Complete and review first Annual Progress Report.

6. Complete approved coursework and continue thesis research; complete and review Annual Progress Reports each year.

7. Finish thesis research and write Thesis/Dissertation (see Dissertation Guidelines).

8. Notification of Graduate School indicating Intent to Graduate (note deadline dates).

9. Submit Thesis/Dissertation to Thesis/Dissertation Committee for reading and comments.

10. Defend Thesis/Dissertation in a public seminar.

11. Submit Thesis/Dissertation to Graduate School for approval.

M.Ag. (non-Thesis) Program Steps

1. Generally as listed above for Thesis M.S. students. Although students will conduct research, there is no requirement for the completion of a research project or defense of a Thesis/Dissertation. Students must complete a final report/research paper that is defended in the student's final oral examination.

Ph.D. Program Steps

1. Application to the Graduate School by student, and forwarding of student application with statement of interest to the EMT Department.

2. Acceptance of student by EMT Graduate Program Admissions Committee, and notification of the Graduate School.

3. Beginning of coursework and research rotations. Students who enter the program supported by their major professor may perform research rotations as appropriate, or begin their thesis research projects directly.

4. Selection of major professor by student and beginning of thesis research project. (No later than 12 months after beginning first term of coursework).

5. Constitute Thesis/Dissertation Committee and develop student program by advisor, student and thesis committee; complete and review first Annual Progress Report.

6. Approval of program of study by Thesis/Dissertation Committee; for new students with a M.S. degree, this must be accomplished within 12 months after entering the program (i.e. during the first summer after entering the program); a similar time frame is strongly encouraged for other students; program must be approved by the end of the 5^{th} quarter of enrollment.

7. Continued thesis research and advanced coursework; meet with Thesis/Dissertation Committee once per year to review Annual Progress Report and progress to date.

8. Completion of EMT Preliminary Examination within two years of entering the program.

9. Finish thesis research and write Thesis/Dissertation (see Dissertation Guidelines).

10. Submit Thesis/Dissertation to Thesis/Dissertation Committee for reading and comments.

11. Notification of Graduate School indicating Intent to Graduate (note deadline dates).

12. Defend Thesis/Dissertation in a public seminar.

13. Submit Thesis/Dissertation to Graduate School for approval.

II. Program Policies and Student Representation

Graduate Studies in Toxicology

General University Academic Regulations The general University academic regulations are described in the *OSU Catalog* which is available in the bookstore or online http://catalog.oregonstate.edu/. Additional policies governing all graduate students or specifically students enrolled in masters or doctoral degree programs are detailed within the catalog. All students must be familiar with these academic regulations, as they apply to all graduate students at Oregon State University. **In addition, EMT students also must adhere to** the Toxicology programmatic regulations described herein.

Prerequisites for the Toxicology Program The prerequisites for admission into the Graduate Program in Toxicology are: applicants should have a BS or BA degree in an area of science relating to toxicology (including but not limited to chemistry, biochemistry, biology, molecular biology, pharmacy, medicine, etc) or an advanced professional toxicology-related degree. Students need a strong background in math through integral calculus, physics, biochemistry, inorganic and organic chemistry. All students seeking admission into the Ph.D. Program will be required to take the Graduate Record Exam (GRE) and submit scores in verbal, quantitative, and analytical areas. Scores in specialty areas are optional, but very helpful. International students must submit TOEFL scores. Applications are submitted on-line via the OSU Graduate School website (http://oregonstate.edu/admissions/graduate.php). Admission to the Ph.D. and MS Programs in Toxicology is determined by the EMT Graduate Program Committee. Information on other OSU graduate programs is available from (http://oregonstate.edu/dept/grad_school/)**.**

Transfer Credit Students who wish to transfer graduate credits from other schools must provide transcripts for courses already completed to the Graduate School prior to the submission of a study program. If a student undertakes a transfer course after his or her study program has been approved, the student must provide the Graduate School with a transcript of this course prior to the final examination. The Graduate School does not assume responsibility for obtaining transcripts from other institutions.

Courses to be transferred **must be graduate level**, taken after the completion of a four-year baccalaureate degree (or equivalent), with grades of "B" (3.00 or equivalent) or better. No more than 5 years can have passed from the time of completion of graduate requirements and entry into the Toxicology Graduate Program. Up to 15 hours of graduate credit may be transferred into the M.S. Program. Graduate courses to be transferred to the Ph.D. Program in Toxicology can be courses that were used to satisfy the graduate course requirements for a graduate certificate or a master's degree (or equivalent) with similar stipulations. There is no limit on transfer credit toward the doctoral degree as long as the doctoral residence requirement is satisfied (see http://catalog.oregonstate.edu/ChapterDetail.aspx?key=258 for additional information). All transfer credit courses must be approved by the EMT Graduate Program Committee. Graduate courses to be transferred to an OSU master's degree must not have been used to satisfy the requirements for a master's degree (or equivalent) or a doctoral degree from another institution.

Student Advisement

Graduate Program Committee The *Graduate Program Committee* consists of a subset of the full-time graduate faculty members of the Toxicology Program. This committee has responsibilities for establishing requirements for the Toxicology Program, evaluating applicants to the program and monitoring the progress of students through graduation. Some administrative functions of the *Graduate Program Committee* are delegated to the Chair. The committee (generally acting through the Chair) serves to advise students in their first year of study prior to selection of a major professor. In this role, the Committee will help the student plan a schedule and provide orientation for the Program and its requirements. The student should confer with the Committee as necessary before the start of each term to plan course schedules and to keep the Committee informed of progress in course work and in selecting a major professor.

Major Professor Students will select a major professor (mentor) who will be responsible for guiding the student's work and chairing the student's Thesis/Dissertation Committee. Full-time M.S. students typically select their major professor prior to beginning their first term of enrollment. Non-thesis or part-time M.S. students will be assigned an advisor/major professor after consultation with the Graduate Program Committee and/or the EMT Department Head. For Ph.D. students, this selection should occur prior to the completion of the student's first year in the Program, typically after the completion of the first year rotations. However, the faculty member selected must also agree to be a student's major professor, and may decline to do so without providing justification. Major professors are responsible for the financial support of students they accept. Full time Ph.D. students in good academic standing and making adequate progress on their research are typically provided full financial support. Financial support of MS students is at the discretion of the major professor. MS students, especially part-time students, are not guaranteed support.

Thesis/Dissertation Committee The purpose of the Dissertation/Thesis Committee is to develop the student's Plan of Study, to guide research, to review progress towards a degree and to review and approve the final Dissertation/Thesis. All Committee members must sign and approve (or disapprove) the student's Dissertation/Thesis before it may be submitted to the Office of Graduate Studies.

The Ph.D. Thesis/Dissertation Committee will consist of no less than five members: the student's major professor, *at least* one other full-time faculty member from EMT, *at least* one graduate faculty member from outside EMT, and a Graduate Council Representative (GCR) (required for all graduate thesis committees). The Committee is constituted by the student in consultation with the major professor, and should take into account the planned thesis research project. Similarly, the M.S. Thesis Committee will consist of no less than three members: the student's major professor, *at least* one other full-time faculty member from EMT, *at least* one graduate faculty member from outside the Program and a Graduate Council Representative (GCR).

Student Attendance and Participation

Graduate Appointments Graduate teaching and research assistantships are awarded by departments and programs to graduate students with superior records in their undergraduate and/or graduate work. To qualify for appointment as a graduate assistant the student must:

1. Be a regularly admitted, conditionally admitted, or provisionally admitted graduate student at Oregon State University (i.e., not a graduate nondegree-seeking, post baccalaureate student, or PharmD or DVM student).

2. Be enrolled as a full-time degree-seeking graduate student at Oregon State University, completing a minimum of 12 credits of instruction each Fall, Winter and Spring term, and 3 credits during summer session. EMT students have additional requirements listed below; see **Registration Requirements**. Audit registrations and enrollment in OSU Extended Campus may not be used to satisfy these minimum enrollment requirements.

3. Be making satisfactory progress toward an advanced degree.

Toxicology Graduate Research Assistants (GRA) generally will be appointed on a full-year basis (12 months) at a .49 FTE. No appointment can be for less than .20 FTE or more than .49 FTE per term. A graduate assistant on less than .49 FTE may take on extra duties; however, **the total stipend plus salary from all sources within the Oregon University System shall not exceed the equivalent of .49 FTE for any term.** For example, a student seeking additional teaching experience may be appointed at a .20 FTE as a Graduate Teaching Assistant. During that term, the same student would also be appointed at a .29 FTE GRA so that the total appointment does not exceed .49 FTE.

Students appointed as Toxicology GRAs at .49 FTE receive a stipend to cover living expenses and are eligible to participate in graduate student health insurance program. Minimum stipend levels are set by Department policy. Tuition and fee remission also generally are covered, either paid directly from a research grant or by the student from his/her stipend.

Some graduate assistants may be represented by the Coalition of Graduate Employees, American Federation of Teachers Local 6069. For these graduate assistants, terms and conditions of employment for service not performed as a requirement for their degrees are prescribed in the Collective Bargaining Agreement between OSU, OUS, and the Coalition of Graduate Employees, American Federation of Teachers Local 6069.

Schedule and Release Time All major professors should be given a copy of the student's schedule at the beginning of each semester (including summer term), and a local address and phone number (home and/or work) where they may be reached. Students will be provided keys to laboratories and work areas and after-hour permits so that they can access areas after hours. Students should check their mail boxes and email accounts daily for mail and messages. Students are expected to work during term breaks and summer terms in their selected laboratories and should coordinate with their major professor regarding their schedules. Students must have approval from their major professor for time off during the period of their appointment, except for official University Holidays.

Full-Time Students The .49 FTE Graduate Research Assistant appointment is considered “full-time”. It is expected that full-time students pursuing a thesis degree will spend their time during normal working hours in residence at EMT, *plus as much additional time as their research and classroom activities require*. (Exceptions may be granted to students attending class or conducting research activities at another site.) As noted below (see ***Review of Student Progress***), the most critical measure of success as a graduate student is adequate progress in reaching research and programmatic goals. The time and effort required for maintaining adequate progress will differ among individual students. Students should maintain good lines of communication with their major professor and Thesis/Dissertation Committee to ensure realistic goals are set and adequate progress can be maintained.

Part-Time Students Part-time students should work out an appropriate schedule detailing the amount of time that the student will be present during each semester for instructional and research activities, and have it approved by their advisor/major professor. It is required that part-time students give their advisor/major professor a copy of their schedule each term AND summer and maintain regular contact with them. These schedules constitute a formal long-range plan for completion of the students selected degree program.

Outside Employment Full-time students receiving financial aid through EMT, EHSC, the EMT Training Grant, or other CAS sources are generally not permitted to have outside employment. It is expected students will devote all their time to their studies and research projects. In special cases, full-time students may petition to have a work schedule and hours spent in outside employment approved at the beginning of each semester by the Chair of the *Graduate Program Committee* and by their major professor. Engaging in outside employment without approval is grounds for dismissal from the Program.

Leave of Absence
On-leave status is available to students who need to suspend their program of study for good cause. Students who desire a leave of absence will work with their major professor, program administrator, and the Graduate School to arrange authorized leave. Additional details can be found on the Graduate School website:
http://catalog.oregonstate.edu/ChapterDetail.aspx?key=38#Section1804

Registration Requirements Full-time status as a graduate student is defined by the Oregon University System as enrollment in 9 credits per term. The maximum load for a full-time graduate student is 16 credits. A student may exceed this limit only with the approval of the Graduate School. Students receiving approval to exceed 16 credits will be assessed a per-credit overload fee. Full-time status (i.e., a minimum of 9 credits per term) may be sufficient to qualify for purposes of veterans' benefits, visa requirements, external fellowships, and federal financial aid. To assure full compliance with visa regulations, international students should consult with the Office of International Student and Faculty Services for additional information about registration requirements.

In addition to the above registration requirements, the following requirements apply to graduate teaching assistants (GTA) and graduate research assistants (GRA). As a condition of their academic appointments, graduate teaching and research assistants are required to register for three credits above the minimum full-time load (i.e., a minimum of 12 credits) each term of the appointment during the academic year (fall, winter, and spring.) During summer session, a minimum registration of 9 credits is required for graduate assistants. *Audit registrations and enrollment in OSU Extended Campus courses may not be used to satisfy enrollment requirements for graduate assistant salary/stipend, tuition remission, salary supplement or health insurance benefits.*

Full-time students in the Toxicology Graduate Program appointed as Graduate Research Assistants should be registered for 16 credits each term of the academic year and for 9 credits during the summer session. Students should use research credits (TOX 501/601) or thesis credits (TOX 503/603) as appropriate to fill their schedules.

Grade Requirement A grade-point average of 3.00 (a "B" average) is required: 1) for all courses

taken as a degree-seeking graduate student (i.e. the cumulative GPA for all classes taken as a graduate student), and 2) for courses included in the graduate degree or graduate certificate program of study (i.e. the cumulative GPA for all classes included on the Program of Study). Grades below "C" (2.00) cannot be used on a graduate program of study. A cumulative grade-point average of 3.00 is required before the final oral or written exam may be undertaken.

Review of Student Progress First year students in the Toxicology Program without a major professor will be evaluated by the Graduate Program Committee at the end of each term. Following selection of the major professor, that professor and the student's Thesis/Dissertation Committee will take over as the progress assessment team. The Thesis/Dissertation Committee will meet at least once per calendar year to assess student progress and to complete and review the Annual Report. *It is the responsibility of the individual student to arrange for these meetings and document their progress. Registration holds may be placed on student registration at the discretion of the EMT Department Head in consultation with the Chair of the Graduate Program Committee and the student's major professor to ensure that these meetings occur.*

The appropriate team will help the student to assess progress and set goals for completion of various aspects of the Program. Lack of progress in the Toxicology Program is grounds for dismissal from the Program. Lack of progress may include lack of research productivity and/or poor grades in academic coursework. A grade lower than a B^- in *any* course will be considered a failing grade for Toxicology graduate students. A student receiving a grade lower than a B^- may be granted a single opportunity to repeat that course to obtain a passing grade. A student receiving a cumulative total of two or more grades lower than B^- may be subject to dismissal from the Program.

Research

All students are expected to be engaged in research in each term in which they are enrolled. Such research would include laboratory rotations for first-year students, research leading to the student's thesis for M.S. and Ph.D. students, and research in-lieu of thesis as required for non-thesis M.S. students. The specific number of credits and course number used for research taken each term will depend on where a student is in their course of study and what other electives are concurrently taken as described below (see Curriculum and sample plans of study). Research typically requires work after hours and on weekends, whether in the laboratory or in the field. Work schedules generally are dictated by the needs of the experiments in progress. Research includes the goal setting and planning required to successfully perform experiments, the specific experimental manipulations, as well as consistent literature review to keep abreast of research developments and discoveries in Toxicology and the basic sciences.

Laboratory Rotations The purpose of laboratory rotations is twofold: firstly, for the student to be exposed to a diversity of research fields and techniques and provide some breadth to their research training, and secondly, to assist the student in identifying an area of research interest and subsequently aid in his/her selection of a research mentor. Rotations (TOX 501) will be performed until a major professor has been selected. The suggested length of each rotation is one academic quarter and constitutes 80-100 hours of "hands-on" experience in each host laboratory. Prior to initiating each rotation, the student should meet with the host laboratory mentor to establish the specific dates of the rotation, the specific training activities to be conducted during the rotation, the schedule of hours the student will be expected to maintain during the rotation, and other activities expected of the student during the rotation, such as attendance at lab meetings, journal clubs, seminars or participation in other host laboratory functions or activities. It is the responsibility of the student to balance time

commitments to rotation research and activities against the demands of the didactic curriculum, so as not to compromise progress in didactic coursework. Toxicology Graduate students also enroll in TOX 501/601 *after* mentor selection to obtain additional credits for thesis research and lab work performed prior to being admitted to degree candidacy. After admission to candidacy, mentor-directed research falls under TOX 603 (Ph.D.).

Thesis/Dissertation Research Students should keep all Thesis/Dissertation Committee members apprised of their progress and should solicit input regularly from the members, in addition to the annual meetings of the Dissertation Committee. Any disputes among the committee members regarding the course of action for a student shall be resolved by the student working with his/her Major Professor.

Funding for Research Students wishing to seek outside funds for thesis or dissertation projects must apply for these funds through their Major Professor and the OSU Office of Research. Under some special circumstances where funding agencies provide support directly to students, students may have funds awarded to them through OSU. Students are strongly encouraged to apply for external funding in the form of grants, fellowships, etc.

Research Data and Notebooks All students are responsible for maintaining orderly and legible research notebooks, the format of which is to be determined by the major professor supervising their research. All research data and laboratory notebooks generated during graduate study are the property of OSU, the faculty member under whose direction the work was conducted and/or the appropriate funding agency. No data or laboratory notebooks may be removed from the laboratory or work area without the expressed written permission of the appropriate faculty member. Only copies of data and notebooks should be removed from the laboratory to prevent accidental loss or damage.

Research Compliance All research, teaching and testing activities at Oregon State University are regulated to ensure compliance with federal, state and local regulations and policies. Students are required to obtain appropriate training and certification in research compliance areas prior to initiation of regulated activities. The Office of Research Integrity works with OSU faculty, staff, and students to help assure proper conduct of research in areas pertaining to the use of human subjects, and non-human vertebrate animals. The office also works with faculty and Academic Affairs to identify and appropriately manage issues that could be perceived to present financial conflicts of interest. OSU manages the wide array of regulated activities through a number of compliance committees, including Animal Care and Use, Occupational Health and Safety, Chemical Safety, Conflict of Interest, Diving Control Board, Institutional Review Board (for human subjects research), Radiation Safety and Scientific and Scholarly Misconduct. Students should be aware that non-compliance can result in severe penalties to the institution, and, in some instances, to the individuals involved. It is the responsibility of all members of the university community to be familiar with OSU policies as related to these research compliance areas. Information regarding the specific training needed for different compliance areas can be found at the website for the Office of Research Integrity (http://oregonstate.edu/research/ori/index.htm).

Student Conduct Regulations and Academic Dishonesty

Graduate students enrolled at Oregon State University are expected to conform to basic regulations and policies developed to govern the behavior of students as members of the university community. The regulations have been formulated by the Student Conduct Committee, the Student

Activities Committee, the University Administration, and the State Board of Higher Education. Violations of the regulations subject a student to appropriate disciplinary or judicial action. The regulations and the procedures for disciplinary action and appeal are available via the Office of Student Conduct and Community Standards Website at http://oregonstate.edu/admin/stucon/, http://oregonstate.edu/admin/stucon/philosophy.htm.

Research Ethics Toxicology Program Graduate Students, like their faculty mentors, must to adhere to the highest standards of professional and scientific ethics in the conduct and reporting of their research and professional efforts. Guidelines for such ethical conduct to be adhered to are outlined in a number of milieus, and it is the personal responsibility of all graduate students to familiarize themselves with this code of ethics and adhere strictly to them. Deviations from these principles are cause for immediate dismissal from the Graduate Program.

http://www.niehs.nih.gov/research/resources/bioethics/
http://www1.od.nih.gov/oir/sourcebook/ethic-conduct/Conduct%20Research%206-11-07.pdf
http://ethics.od.nih.gov/train.htm
http://www1.od.nih.gov/oir/sourcebook/comm-adv/ethic-forum.htm
http://www1.od.nih.gov/oir/sourcebook/index.htm
http://www.nhgri.nih.gov/About_NHGRI/Dir/Ethics/message.html

Toxicology Graduate Student Representation

Student Grievance Students should initially seek out their advisor and/or major professor to discuss and resolve grievances. If unable to resolve problems by working with his/her major professor, the student may request a meeting with the student's Thesis/Dissertation Committee or the Toxicology Graduate Program Committee to resolve grievances. Problems not resolved within either committee shall be brought to the Head of EMT and if necessary, subsequently to the CAS Dean. The OSU Dean of Graduate Studies will be available to discuss irresolvable grievance issues, and ultimately the Faculty Senate Graduate Committee rules on student grievances that are not resolved elsewhere. All students desiring to appeal matters relating to their graduate education should request a copy of Grievance Procedures for Graduate Students at Oregon State University from the Graduate School. These procedures are also available on the Web at http://oregonstate.edu/dept/grad_school/current/grievance.html. Graduate assistants who are not represented by the Coalition of Graduate Employees, American Federation of Teachers Local 6069 who wish to appeal terms and conditions of their employment should also refer to these procedures. Graduate assistants whose terms and conditions of employment are prescribed by the Collective Bargaining Agreement between OSU, OUS, and the Coalition of Graduate Employees, American Federation of Teachers Local 6069 should also refer to that document.

TEAM Tox

Mission: TEAM Tox is an organization open to all graduate and post graduate trainees working in EMT laboratories. The primary mission of TEAM Tox is to enhance and diversify the educational experience of all EMT graduate and post graduate trainees, provide opportunities for professional development above and beyond the formal EMT curriculum, enhance interactions between both EMT trainees and between EMT trainees and faculty, and provide a mechanism for representation of trainees issues and concerns to the EMT faculty and administration. Such activities will include, but not be limited to, participation and planning for student recruiting events, departmental

seminars, departmental research days, departmental social events, departmental newsletters and year book, alumni and community outreach events. Additional information, including the current bylaws can be found by following the appropriate link on the EMT website: http://emt.oregonstate.edu/currentgraduates

III Program Curriculum

The curriculum provides students with a fundamental knowledge of toxicology that prepares them for responsible positions in research and development, academia, government, or professional services. The curriculum is broadly organized around two concentration areas: **Environmental Chemistry and Ecotoxicology** and **Molecular and Cellular Toxicology**, and is designed to strengthen the student's training in the basic sciences, provide a broad-based, solid background in toxicology as well as advanced training in a specialized area. All students are required to take a core curriculum plus elective courses connected with their particular area of specialization. In addition, all students must enroll in a seminar course each term (TOX 507/607). All graduate student programs of study submitted to the Graduate School must consist of, at a minimum, 50% graduate stand-alone courses. The remaining credits may be the 500 component of 400/500 slash courses. Specific course requirements and sample plans of study are detailed below.

Environmental Chemistry and Ecotoxicology Environmental chemists study how molecular interactions and macroscopic transport phenomena determine the spatial and temporal distribution of chemicals in the environment. It is the environmental distribution and concentration of contaminants that ultimately determine the dose to humans and other organisms. Ecotoxicologists study the transport, fate, and effects of toxic substances in ecosystems so as to improve our understanding of exposure and stress (hazards) to both individuals and populations. This requires interdisciplinary approaches that draw heavily on chemistry, toxicology, and ecology.

Molecular and Cellular Toxicology The curriculum in Molecular and Cellular Toxicology is designed to provide the student with a broad base of knowledge and expertise in the discipline of Toxicology. Molecular and cellular toxicologists study the mechanisms and regulation of biological responses to environmental and endogenous chemicals at the molecular, cellular and whole animal level, with an emphasis on elucidating the molecular pathways by which such chemicals cause biological effects including toxicity and disease.

Learning Outcomes for the MS and PhD Degree Programs

The graduate programs of the Department of Environmental & Molecular Toxicology (EMT) include thesis and non-thesis M.S. degrees and the Ph.D. degree in Toxicology. Our goal is to educate students in the toxicological sciences, in particular focused on development of the trans-disciplinary skill sets needed to address and understand the effects of chemicals and other agents on humans and the environment, and to create, disseminate and apply new knowledge to enhance the treatment and prevention of human disease and to ensure the protection of the environment and public health. Integrated educational experiences focused on issues relevant to the environmental health sciences are constructed from individualized biomedical and non-biomedical didactic training, combined with experiential learning opportunities. Such an approach is

complimented with both formal and informal opportunities for students in science communication and outreach activities. Our trans-disciplinary programs prepare students to better understand the broad and complex challenges in the environmental health sciences and position them for future careers in academic, industrial and environmental regulatory positions.

As a result of successfully completing the requirements toward the Ph.D., students shall: (a) produce and defend an original significant contribution to knowledge, (b) demonstrate mastery of subject material, and (c) be able to conduct scholarly activities in an ethical manner.

As a result of successfully completing the requirements toward the M.S., students shall: (a) conduct research or produce some other form of creative work, (b) demonstrate mastery of subject material, and (c) be able to conduct scholarly or professional activities in an ethical manner

These general program outcomes are further delineated with the following specific Student Learning Outcomes (SLO).

Outcome 1: **Substantive Knowledge in Environmental and Molecular Toxicology.** Students will acquire substantive general knowledge of current understanding, emerging issues and trends within the fields of environmental chemistry, ecotoxicology and molecular toxicology. **(Applies to non-thesis MS, thesis MS and PhD.)**

Outcome 2: **Analysis of Scientific Literature.** Students will acquire the skills necessary to thoroughly research a discipline-specific topic within the published scientific literature, including: **(A)** the ability to identify important hypotheses, theories, controversies, and seminal works describing the current state-of-the science on a specific topic, and **(B)** critically analyze scientific methods, results and conclusions. **(Applies to non-thesis MS, thesis MS and PhD.)**

(C) In addition, students will be able to identify knowledge gaps and potential future research needed to advance a specific discipline. **(Applies to PhD.)**

Outcome 3: **Communication Skills.** Students will be able to clearly communicate scientific concepts, hypotheses, results and interpretations in both written **(A)** and oral **(B)** form. **(Applies to non-thesis MS, thesis MS and PhD.)**

Outcome 4: **Capstone/Thesis Project.** Students will demonstrate **(A)** the ability to design discipline-specific scientific research that if implemented would produce valid, tangible results. **(Applies to non-thesis MS, thesis MS and PhD.)**

Students will **(B)** complete independent, original, discipline-specific scientific research that produces valid, tangible results, and **(C)** accurately interpret the results from this research. **(Applies to thesis MS and PhD.)**

Students will **(D)** complete a high-quality thematic research paper (non-thesis). **(Applies to non-thesis MS.)**

Students will complete and successfully defend a high-quality **(E) (Applies to thesis MS.)** or publication-quality **(F) (Applies to PhD.)** thesis describing the research conducted by the student.

Outcome 5: **Ethics and Responsible Conduct.** Students will demonstrate high ethical and professional standards and responsible conduct in research, including fulfilling all requirements for human subjects, use of animals in research, conflict of interest, data processing, and data reporting. **(A)**. **(Applies to non-thesis MS, thesis MS and PhD.)**

Masters Program in Toxicology

Requirements Both the Thesis and non-Thesis M.S. degree programs in Toxicology require a minimum of 45 graduate credits including thesis (6 to 12 credits) or research-in-lieu-of-thesis (3 to 6 credits). Students must enroll in a seminar course each term (TOX 507); 3 credits of TOX 507 are included on the program of study and count towards the degree total.

Graduate Study Program Programs of study must be filed with the Graduate School before completing 18 graduate credits. If a minor is declared, approximately two-thirds of the work (30 graduate credits) should be listed in the major field and one-third (15 graduate credits) in the minor field. In such cases, the student's advisory committee must include a member representing the minor department.

The program is developed under the guidance of the major professor, and minor professor when a minor is included, and signed by those professors and the EMT Department Head before filing in the Graduate School. Each candidate's program should include substantial work with at least three faculty members offering graduate instruction. Changes in the program may be made by submitting a Petition for Change Form, available in the Graduate School.

Doctoral Program in Toxicology

Requirements The doctor of philosophy degree is granted primarily for creative attainments. There is no rigid credit requirement; however, the equivalent of at least three years of full-time graduate work beyond the bachelor's degree (at least 108 graduate credits) is required. After admission into the doctoral program, a minimum of one full-time academic year (at least 36 graduate credits) should be devoted to the preparation of the thesis. The equivalent of one full-time academic year of regular non-blanket course work (at least 36 graduate credits) must be included on a doctoral program.

Graduate Study Program The student's doctoral study program is formulated and approved at a formal meeting of his or her Thesis/Dissertation committee, which consists of a minimum of five members of the graduate faculty, including two from the major department and a representative of the Graduate Council. If a minor is declared, it must consist of at least 18 credits (15 credits for an integrated minor) and the committee must include a member representing the minor department. All committee members must be on the graduate faculty with appropriate authorization to serve on the student's committee.

The student must be registered for a minimum of 3 credits for the term in which the program meeting is held. When the program is approved by the doctoral committee, the departmental chair, and the dean of the Graduate School, it becomes the obligation of the student to complete the

requirements as formulated. Changes in the program may be made by submitting a Petition for Change Form available in the Graduate School.

No more than 15 credits of blanket-numbered courses, other than thesis, may be included in the minimum 108-credit program.

A regular graduate student who holds a master's degree must file a study program with the Graduate School by the end of one calendar year of enrollment as a doctoral student.

A regular graduate student who does not hold a master's degree must file a study program with the Graduate School by the end of the fifth quarter of enrollment as a doctoral student.

A student who does not file a program within the specified deadline will not be allowed to register for the next term. A registration hold also will be placed on graduate students whose programs of study are not approved after initial evaluation by the Graduate School and until appropriate action is taken to bring the program of study into compliance with Graduate Council policy.

Academic Requirements
The curriculum described below provides students with core courses in toxicology, biochemistry, environmental chemistry, statistics and scientific ethics. Students receive training in their first year in areas of fundamental sciences (biochemistry, environmental chemistry and statistics) necessary for advanced training in molecular and environmental toxicology. Electives are selected by students and their Thesis/Dissertation committee to complement graduate research in environmental chemistry, ecotoxicology or molecular toxicology.

Seminar Students must enroll for credit in Toxicology Seminar TOX 507/607 during *every term that it is offered* for the entire period in which they are enrolled in the Toxicology Program; TOX 507 for M.S. students and TOX 607 for Ph.D. students. Grades (or pass/no pass) will be assigned each term by the instructor based upon student performance, attendance and participation.

The Toxicology Seminars are designed to provide students an opportunity to learn how to prepare and present information on a chosen topic of toxicology. A secondary purpose is to disseminate up-to-date research progress in the various areas of toxicology and expand the breadth of the students' familiarity with the broad field of Toxicology. Seminars allow the faculty an opportunity to assist students in developing a seminar style, to judge a student's ability to think on his/her feet and for students to gain speaking confidence in a friendly environment. The seminar program may also be used for students to present their Thesis/Dissertation Proposals and to present their final results in the form of a Thesis/Dissertation Defense.

Graduate Program Required Courses			
Course No.	Course Title	Ph.D. Credits	M.S. Credits
BB 590 - 592	Biochemistry	9	9
Tox 507/607	Toxicology Seminar Series	6	3
Tox 530	Chemical Behavior in the Environment	3	3

IST 520*	Responsible Conduct of Research*	1	1
ST 511	Methods of Data Analysis	3	3
Tox 512 and Tox 513	Molecular and Environmental Toxicology I and II	8	8
Electives	Determined by Thesis/Dissertation Committee	6-X	9-12
Tox 603	Thesis	variable	6-12 (min)
Tox 501/601	Research	variable	3-6 for non-thesis MS
TOTAL (min. req'd)		108	45

***** *Students may substitute MCB 557 Scientific Skills and Ethics in place of IST 520*

Ph.D. PROGRAM - SAMPLE PLAN OF STUDY

Year 1

Term 1	**Term 2**	**Term 3**	**Summer**
BB 590 (3)	BB 591 (3)	BB 592 (3)	
TOX 530 (3)	Elective (3)	Elective (3)	
ST 511 (3)			
TOX 601 (6)	TOX 601 (9)	TOX 601 (9)	
TOX 607 (1)	TOX 607 (1)	TOX 607 (1)	TOX 601/603 (3)
TOTAL (16)	TOTAL (16)	Total (16)	Total (3)

By the end of the summer Year 1: Select major professor, Thesis Committee, hold first Committee meeting to review/approve Program of Study.

Year 2

Term 1	Term 2	Term 3	Summer
TOX 512 (4)	TOX 513 (4)		
IST 520 (1)			
Elective (3)	Elective (3)	Elective (3)	
TOX 607 (1)	TOX 607 (1)	TOX 607 (1)	
TOX 603 (7)	TOX 603 (8)	TOX 603 (12)	TOX 603 (3)
TOTAL (16)	TOTAL (16)	Total (16)	Total (3)

By the end of the summer Year 2: Propose, write and defend preliminary exam.

Year 3-

Term 1	Term 2	Term 3	Summer
TOX 607 (1)	TOX 607 (1)	TOX 607 (1)	
TOX 603 (15)	TOX 603 (15)	TOX 603 (15)	TOX 603 (3)

TOTAL (16) TOTAL (16) Total (16) Total (3)

Other additional advanced coursework outside TOX Program complimentary to research project may be required or appropriate.

Topics Courses/Advanced Electives

Toxicology Graduate students must take advanced elective courses as directed by their Thesis/Dissertation Committee. Some of these may be courses taught within the Toxicology Program, however many may be taken from other Departments at OSU. Some advanced elective courses may be offered as 'Topics' courses (TOX 599), as special or one-time offerings that address a particular topic of interest. Typically, these courses are used to supplement the curriculum by offering in-depth information on a very focused topic of emerging scientific interest. These courses will be offered on a regular basis in a small group discussion atmosphere to study a particular specialty area by doing special readings and participating in group discussions.

Blanket-Numbered Courses

Blanket-numbered courses have a zero middle digit. Those that carry graduate credit may be repeated up to the maximum totals indicated below.

- **Research** (501 or 601) is for research that is not part of the thesis. Data obtained from such research should not be incorporated into the thesis.
- **Thesis** (503 or 603) covers the thesis research and writing. A student may register for thesis credit each term.
- **Reading and Conference** (505 or 605) and **Projects** (506 or 606) are used for special work not given under a formal course number.
- **Seminar** (507 or 607) is used both for departmental seminars and for special group work not given in a formal course.
- **Workshop** (508 or 608) is usually a special, short-term course covering a variety of topics.
- **Practicum** (509) is used for courses whose emphasis is the application of academic theory to the work environment.

No more than 9 credits of blanket-numbered courses, other than thesis (or research-in-lieu-of-thesis for non-thesis programs), may be applied toward the minimum 45-credit master's degree. While internship credit (510) is not considered a blanket-numbered course, no more than 6 credits of internship may be applied toward a 45-credit master's degree. The internship credit limit is in addition to the 9-credit blanket-hour limit.

No more than 15 blanket-numbered credits may be applied toward the minimum 108-credit doctoral program.

COURSE DESCRIPTIONS

TOX 511: Fundamentals of Toxicology (3 cr.)

Introduction to the basic principles of toxicology, mechanisms of toxicology and major organ systems toxicology. Topics covered include: Introduction, History, Scope, Principles, Mechanisms of toxicology, ADME, Toxicokinetics, Biotransformation, Target Organ Toxicity, Bioactivation/chemical carcinogenesis, Pesticides, Food Toxicology and Animal/Plant Toxins.

TOX 512/513: Environmental and Molecular Toxicology (4 each)
This is a sequential two-term graduate level course series covering advanced topics in environmental and molecular toxicology. Classes are presented as a combination of didactic lectures coupled with student based learning and presentations in a modular format, with each module focused on a different specific molecule, class of molecule or physical agent with toxic/biological effects. The current state of knowledge concerning the effects of each toxicant is presented with an emphasis on how the global (environmental fate and transport and routes of exposure of individuals and populations) and molecular (biotransformation and mechanisms of effects) aspects influence biological effects and risk assessment.

TOX 507/607: Toxicology Seminar (1)
Seminar course meeting weekly - Invited speakers in current topics in Toxicology. Presentations by outside speakers and students enrolled in course. Also forum for Tox Program student thesis proposal presentations and final Dissertation Defenses.

TOX 501/601: Problems in Toxicology (1-3)
Laboratory research conducted in Tox Program faculty laboratories, either during Rotations or after rotations but prior to certification for Dissertation Research

TOX 603: Dissertation Research Laboratory research conducted in Tox Program faculty laboratories, after certification for Dissertation Research

TOX 529 TOXIC SUBSTANCES IN FOOD (3)
Toxicology and epidemiology of human exposures to pesticides and food toxicants. PREREQS: BB 350 or BB 450 or BB 490.

TOX 530 CHEMICAL BEHAVIOR IN THE ENVIRONMENT (3)
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. PREREQS: CH 106, CH 331, graduate standing.

TOX 554 GENOME ORGANIZATION, STRUCTURE, AND MAINTENANCE (4)
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 GEN 554 and MCB 554. PREREQS: BI 311 (genetics or equivalent), BB 450, BB 451, BB 452 or BB 490, BB 491, BB 492 (biochemistry) or equivalent.

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

TOX 575 ADVANCED XENOBIOTIC METABOLISM (3)
Familiarizes students with basic principles of drug/xenobiotic metabolism. Concepts addressed include: how foreign chemicals or xenobiotics are absorbed, distributed, and metabolized; induction and inhibition of metabolism; effect of age, species, hormones, and disease on metabolism; genetic polymorphisms; effect of diet and environment; experimental techniques in xenobiotic metabolism; and regulatory issues (FDA and EPA). PREREQS: Graduate or professional pharmacy student standing.

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

TOX 599 SPECIAL TOPICS (1-16)

TOX 601 RESEARCH (1-16)

TOX 603 THESIS (1-16)

TOX 611 TESTING FOR GENOTOXICITY (4)
A lab-based course geared toward toxicology, biochemistry, biology, food science, nutrition, and pharmacy 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 short-duration, intensive lab/lecture class runs Mon-Fri, two weeks prior to the start of fall term. Each day includes laboratory work starting at 8 a.m., and a 2-hour lecture covering basic principles of the assays, as well as technical details of the experiment for the day. PREREQS: TOX 514 and BB 400 series, prior course work on DNA repair and mutagenesis, and/or instructor approval.

TOX 656 DNA REPAIR AND MUTAGENESIS (3)
Biochemical pathways by which cells maintain genomic stability by avoiding DNA mutation and breakage, including repair of DNA damage, DNA replication fidelity and replication error-correction processes, and bypass replication of damaged DNA. CROSSLISTED as BB 656. PREREQS: MCB 554 and MCB 555 and BB 492 or equivalent.

TOX 675 HUMAN CARCINOGENESIS (3)
Familiarizes students with the basic principles of molecular carcinogenesis with an emphasis on the current molecular understanding of cancer development in humans, and how such understanding influences diagnosis, treatment, and prevention strategies. PREREQS: TOX 514 and (MCB 555 or GEN 555) or BB 592 and Graduate or professional pharmacy standing.

TOX 699 SPECIAL TOPICS (1-16)

Partial Listing of Elective Courses*

*****Partial listing of elective courses that may be counted toward the MS and Ph.D. Degree in Toxicology; other electives may also be acceptable; students must receive approval from the Toxicology Graduate Program Committee on Studies and have their program approved before scheduling any elective courses

List of Recommended Courses

MB 668 - BIOINFORMATICS AND GENOMICS (4)
This course is divided into two 2-credit modules. First module teaches both the theory and practice of basic informatics techniques-including sequence alignment, sequence searching, and the evolution of protein families- and their applications at a genome-wide level (comparative genomics and functional genomics). Second module introduces the fundamental tools of bioinformatics (Linux, Perl) and bioinformatics algorithms necessary to process and analyze large datasets generated from high-throughput genomics experiments. The second module is structured in three sections: Programming Concepts (PC), Biological Applications (BA) and Biological Projects (BP). Programming Concepts lays the foundation for the later two sections. PC teaches students to work within a Linux operating system in a client/server environment. Students learn to create programs in Perl scripting language, which permeates modern bioinformatics applications. Relevant programming concepts are presented and code examples illustrated using biological data. BA builds on the PC foundation to provide "snapshots" of common bioinformatics methods.

MCB 525 - TECHNIQUES IN MOLECULAR AND CELLULAR BIOLOGY (3)
An intensive laboratory course introducing modern methods for the manipulation of cellular macromolecules. Recombinant DNA technology, protein chemistry, and in situ hybridization methods presented in a format that emphasizes experimental continuity. The course requires two weeks of intensive full-time involvement.

MCB 553 - STRUCTURE AND FUNCTION OF EUKARYOTIC CELLS (3)
Examination of structural elements in eukaryotic cells and their relationship to function. Topics include methods for cellular analysis, membranes, organelles, intracellular sorting, cell signaling, and cell cycles.

MCB 555 – GENOME EXPRESSION AND REGULATION (4)
Prokaryotic and eukaryotic systems will be used to describe recent advances in understanding transcriptional and posttranscriptional control mechanisms. Topics include: microbial, yeast and mouse model systems; transcriptional control mechanisms; RNA processing, silencing and microRNAs; protein synthesis and posttranslational modification; microarray- and mass spectrometry-based expression genomics.

MCB 556 - CELL AND DEVELOPMENTAL BIOLOGY (3)
Examination of molecular and structural elements in eukaryotic cells and their relationship to function and development. Topics include nuclear organization, membranes, organelles, intracellular sorting, cell energetics, cell signaling, cell motility, cell division cycle, and developmental processes of selected model organisms. Critical reading and writing skills will be emphasized. CROSSLISTED as GEN 556.

MCB 557 - SCIENTIFIC SKILLS AND ETHICS (3)
Students receive training in the preparation and presentation of scientific seminars. This course

also offers instruction and discussions of ethics relevant to scientists.

MCB 668 - GENOMICS AND CELLULAR EVOLUTION (4)
Key ideas from the genomics and bioinformatics revolution. Current topics in molecular phylogeny and comparative genomics are covered, including the identification of gene superfamilies, early cellular evolution, Environmental genomics, and enzyme evolution. Analytical concepts in gene sequence analysis and their applications are conveyed through a combination of lectures and laboratory exercises, with emphasis on independent student projects.

BB 581 - MOLECULAR THERMODYNAMICS (3)
Basic concepts of biological macromolecules, and molecular thermodynamics and statistical mechanics methods for understanding macromolecular structure.

BB 582 - SPECTROSCOPY (3)
Basic concepts of quantum mechanics and spectroscopy, absorption and emission spectroscopy, linear and circular dichroism, and nuclear magnetic resonance spectroscopy.

BB 583 - MACROMOLECULAR STRUCTURE AND BEHAVIOR (3)
Methods for determining macromolecular structure (X-ray diffraction, NMR) and behavior of macromolecules in solution.

BB 650 - CELL CYCLE AND CANCER (3)
The first seven weeks of lectures will be followed by three weeks of student presentations and panel meetings. In covering oncoproteins, tumor suppressor proteins, checkpoint systems, and apoptosis systems, the course will stress the importance of cell cycle control mechanisms in preserving genome stability. For each topic, I will summarize "What we know?" and then describe "How we know it?". The course objective is to identify significant contemporary questions concerning the molecular biology of cancer and to design rational approaches to study them.

BB 651 - SINGLE-MOLECULE BIOCHEMISTRY (3)
Some of the most exciting recent technologies to emerge in biology are those that study the structure and function of single molecules. This course covers the principles of how single-molecule studies work, how they are designed, and how the results are interpreted, using recent publications that highlight the application of such methods in understanding fundamental biological processes.

BB 650 - SELECTED TOPICS IN BIOCHEMISTRY AND BIOPHYSICS (3).
Nonsequence courses designed to acquaint student with current research in biochemistry and biophysics. Courses include enzyme kinetics, cell cycle and cancer, neurochemistry, oxidative stress, cell adhesion and motility.

BB 654 - PROTEINS (3)
Levels of protein structure, amino acid sequence determination, protein isolation and purification, chemical modification of proteins, spectroscopic approaches to protein structure, detection of protein-protein interactions, post-translational protein modification, and proteomics.

BB 662 - HORMONE ACTION (3)

Current information about the biochemical and molecular characteristics of the mechanism of action of various peptide and steroid hormones is presented. Special emphasis is given to receptor structure, second messengers and downstream signal transduction events that culminate in the characteristic response of the target cell to the hormone. Guest lecturers will introduce subjects of plant hormones and hormonal aspects of human diseases such as cancer.

PHAR 735 - FOUNDATIONS OF DRUG ACTION (4)
Introductory course into actions of chemicals on physiological systems. Concepts encompass drug absorption and distribution, drug design and characterization of drug interactions with specialized cellular components, drug activation of biological response via biochemical or molecular transduction mechanisms, drug-induced toxicities and drug biotransformation or excretion.

PHAR 564 - RECEPTORS AND SIGNAL TRANSDUCTION (3)
Advanced concepts and recent developments in receptor pharmacology. Topics include receptor theory and regulation and signal transduction pathways and functions

PHAR 591 - PHARMACOLOGY I (5)
Principles of pharmacology; molecular, cellular, and physiologic mechanisms of drug action; pharmacological rationale for therapeutic and toxicologic treatment outcomes.

PHAR 592 - PHARMACOLOGY II (5)
Principles of pharmacology; molecular, cellular, and physiologic mechanisms of drug action; pharmacological rationale for therapeutic and toxicologic treatment outcomes.

PHAR 593 - PHARMACOLOGY III (5)
Principles of pharmacology; molecular, cellular, and physiologic mechanisms of drug action; pharmacological rationale for therapeutic and toxicologic treatment outcomes.

PHAR 537 - BIOORGANIC CHEMISTRY(3)
A contemporary treatment of the chemistry, enzymology and molecular genetics techniques used in studying major natural products biosynthesis pathways in nature.

PHAR 585 - DRUG DESIGN (3)
Chemical and biochemical concepts and their application in the rational design of drugs and other biologically active molecules.

VMB 630 MECHANISMS OF DISEASE (3).
Cellular and molecular events that contribute to the pathogenesis of disease in animals, including humans. Host interactions with infectious agents and the environment.

III. Preliminary and Final Examinations and Thesis Requirements

Ph.D. Preliminary Exam

Objective

The overall objective of the preliminary examination for advancement to Ph.D. candidacy should assess whether a graduate student has the capacity and potential:

i) to understand the basic science of Environmental and Molecular Toxicology, relative to the students' approved program
ii) to be a creative and critical thinker;
iii) to understand the scientific literature;
iv) to conduct original and independent research; and
v) to communicate the ideas and results of experiments.

Thus, the ideal examination format would select for these characteristics and prepare the student for the selective pressures that will be encountered upon completing the Environmental and Molecular Toxicology Ph.D. 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 8th academic term after entering the program (including summer terms). Any delay in scheduling the examination must be approved by the student's Thesis/Dissertation Committee. In most cases, the student would schedule the exam in the Spring or Summer term of the second year of residency, 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. 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. Since the student would have completed most, if not all, of the required coursework prior to scheduling the preliminary exam, the student's general knowledge of environmental and molecular toxicology should also be evaluated.

Procedural Outline

Research Proposal (written/oral)

1. Student submits an outline description (required elements listed below) for a potential research project. The subject of the 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 project cannot be taken directly from their mentors published or

unpublished content (i.e. manuscripts, abstracts, database of funded projects, submitted grant applications, etc.). Proposed projects however can be related to the thesis research of the student.

Project outlines (limited to 1 page) 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 is responsible for the review and approval of the topic to be developed into a full written proposal. Approval of the topic would occur within one week after the outline is submitted if it is deemed of high originality, quality, potential significance and likely to contribute meaningfully to the student's education and training. During this period the outline would be returned to the student, and the student would receive feedback from the committee concerning the quality and design of the outlined project. Major strengths and weaknesses in the experimental design or rationale would be identified at this stage. Students may be required to modify their proposal topics and/or develop new topics if the original submission is deemed unacceptable.

3. 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 4 weeks after the topic was approved. The scope of the project would be equivalent to that of a proposal expected to take approximately 2-3 years of research time. The proposal is limited in length to 10 pages of single-spaced text (11 point Arial 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. **Limit 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. **Limit to seven pages**.

D. Literature Cited. In text citations should use a numbered format. The student is strongly encouraged to use Endnote or similar reference management software to insert the references. The literature citation list at the end of the proposal does not count towards the 10 page limit.

E. Appendix. Students may include additional figures in an appendix, limited to 5 pages. The appendix may not be used to circumvent the page limits of the proposal.

4. Timeline: must be completed by the end of the 8th academic term including summers. Lab personnel cannot contribute to the work. The oral exam should be scheduled within 2 weeks of completion of the written proposal. This deadline can be extended only by unanimous approval of the student's graduate committee.

5. During the exam the student would present the proposed research plan and defend the experimental approach. Presentation would involve a seminar format with slides/overheads and would be expected to last no longer than 30 min. 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 2 hours, and is limited in length to 3 hours.

Examination Committee:

The examination committee is the graduate student's Thesis/Dissertation Committee. The committee consists of a minimum of five members of the graduate faculty, including at least two members from the major department and a representative of the Graduate Council Representative (GCR). 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 and will ensure that the student independently answers the questions. The GCR chairs the evaluation of the student's performance. The decision concerning whether the student merits advancement to Ph.D. 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 have passed. If there are two

or more negative votes on this question, the student has not passed.

If the committee decision is that the student has not passed the examination, the committee must then decide whether or not to allow the student to take a re-examination. If the majority of the committee votes in favor of a re-examination, the recommendation for re-examination should be recorded. In addition, the committee must set a time interval that must elapse before the re-examination is permitted. If the majority of the committee votes against a re-examination, the recommendation to terminate the student's work toward this degree should be recorded.

Final Oral Examinations

Master's Degree Final Oral Exam

Successful completion of a final oral examination is required for both thesis and non-thesis option master's degrees in Toxicology.

Non-thesis M.S. Non-thesis option master's students in Toxicology are required to prepare and defend a final report. This report may describe research undertaken by the student, or may be a position paper based on the student's literature review and independent analysis of a current issue in toxicology. The final examination will consist of an oral presentation and defense of the research paper/report by the student to their committee. Not more than half of the examination period should be devoted to the presentation of the research project/final report; the remaining time can be spent on questions relating to the student's knowledge of the major field, and minor field if one is included in the program. For non-thesis master's degree programs, the major professor is responsible for directing and assigning a final grade for the research or culminating project. Other members of the non-thesis committee will assess the student's defense of the project in the final oral examination, as well as the student's knowledge of his or her field, and vote to pass or fail the student. The examining committee consists of three members of the graduate faculty—two in the major field and one in the minor field if a minor is included. When a minor is not included, the third member may be from the graduate faculty at large.

Thesis M.S. The oral exam given to thesis option students will be administered by the student's Dissertation Committee and will be based upon the student's thesis research and general areas of toxicology and appropriate fields related to the student's research project. The student will schedule their oral exam in the form of a public seminar on the OSU main campus presenting and defending their thesis research, with an emphasis on the background and significance of the problem, and the results of the studies conducted to test their hypotheses. Following the public seminar, the student and their Dissertation Committee will meet in closed session to continue the examination. The exam may consist of questions from core areas of toxicology, supporting sciences, and areas in which the student has received specialty training (e.g., elective coursework, as well as questions relating to the student's thesis research. Typically, the oral examination will take 1-2 hours. The oral examination may not be scheduled until the student has received approval from their Thesis Committee.

For thesis option master's candidates, not more than half of the examination period should be devoted to the presentation and defense of the thesis; the remaining time can be spent on questions relating to the student's knowledge of the major field, and minor field if a minor is included in the program of study. Graduate faculty serving on thesis-oriented master's degree

programs may contribute to the direction of the student's thesis, will assess the student's thesis and his or her defense of it in the final oral examination, will vote to pass or fail the student, and may sign the thesis when it is in acceptable final form. The examining committee consists of at least four members of the graduate faculty—two in the major field, one in the minor field if a minor is included, and a Graduate Council representative. When a minor is not included, the fourth member may be from the graduate faculty at large. All members of the student's graduate committee must approve the scheduling of the final examination.

Students writing a thesis must have a Graduate Council representative on their committee. It is the student's responsibility to obtain his or her own Graduate Council representative from a list provided by the Graduate School. This must be done prior to scheduling the final exam.

Master's Thesis Requirements

The results from studies conducted using human subjects without obtaining Institutional Review Board approval shall not be used to satisfy master's thesis or doctoral dissertation requirements. For complete details, please refer to http://oregonstate.edu/research/osprc/rc/humansubjects.htm.

When scheduling their final oral examinations, thesis option master's students are required to submit the pretext pages of their thesis to the Graduate School at least one week prior to the final oral examination. Pretext pages include the abstract, copyright (optional), title page, approval page, acknowledgment page, contribution of authors, table of contents, list of figures, tables, appendices, dedication (optional), and preface (optional). It is expected that students will distribute examination copies to all their committee members, including the Graduate Council Representative, sufficiently early to permit thorough review of the thesis prior to the student's final oral examination.

Within six weeks after the final oral examination, one printed and one electronic final copy of the thesis, including copies of the abstract, must be submitted to the Graduate School office. If these copies are submitted after the initial six-week period, the student may be subject to re-examination. Please refer to the Graduate School's Web site for complete details (http://oregonstate.edu/dept/grad_school/current/thesis.html).

The student must obtain on the thesis approval page the original signatures of the major professor and the head of the major department. The required Graduate School signature will be obtained by the Graduate School. The thesis will not be accepted for graduation requirements until it has received approval by the graduate dean.

Full information concerning the prescribed style for theses is given in the booklet, Preparing a Thesis or Dissertation at OSU: A Graduate Student Guide, available on the Web at http://oregonstate.edu/Dept/grad_school/.

Doctoral Thesis/Dissertation Requirements

Each candidate for the PhD degree must submit a thesis embodying the results of research and giving evidence of originality and ability in independent investigation. The thesis must be a real contribution to knowledge, based on the candidate's own investigation. It must show a mastery of

the literature of the subject and be written in creditable literary form. The booklet, Preparing a Thesis or Dissertation at OSU: A Graduate Student's Guide, is available electronically on the Web at http://oregonstate.edu/Dept/grad_school/.

The results from studies conducted using human subjects without obtaining Institutional Review Board approval shall not be used to satisfy master's thesis or doctoral dissertation requirements. For complete details, please refer to http://oregonstate.edu/research/osprc/rc/humansubjects.htm.

Doctoral Degree Final Oral Exam

The examining committee consists of the student's Thesis/Dissertation committee. The Dissertation/Thesis defense will be scheduled at such a time when all members of the student's Dissertation/Thesis Committee can attend. A Dissertation/Thesis scheduling form must be completed and submitted to OGS *at least 2 weeks* prior to the date of the defense. When scheduling their final oral examinations, doctoral students are required to submit the pretext pages of their thesis to the Graduate School at least two weeks prior to the final oral examination. Pretext pages include the abstract, copyright (optional), title page, approval page, acknowledgment page, contribution of authors, table of contents, list of figures, tables, appendices, dedication (optional), and preface (optional).

An open invitation will be made to all EMT and OSU faculty, students, and guests to invite them to the thesis/ dissertation defense. In preparation for the Dissertation/Thesis defense, it is the responsibility of the student to contact committee members and other faculty members to determine their availability when scheduling the date. The student will provide all Dissertation/Thesis committee members with a copy of his/her final draft of the thesis/ dissertation at least two weeks prior to the scheduled defense.

The final oral examination consists of a public thesis defense on the OSU main campus followed by a closed session of the examining committee with the candidate. The thesis defense portion of the final oral exam will be open to all interested persons and should be limited to one hour. After the open portion of the exam, the examining committee should exclude all other persons and continue with the examination of the candidate's knowledge of his or her field and the evaluation of the candidate's performance. Under normal circumstances, the closed portion of final examination should be scheduled for two hours.

In the oral examination, the candidate is expected to defend the thesis and show a satisfactory knowledge of his or her field. If more than one negative vote is recorded by the examining committee, the candidate will have failed the examination. No more than two re-examinations are permitted by the Graduate School, although academic units may permit fewer re-examinations.

Within six weeks of the final oral examination, one printed and one electronic final copy of the thesis and one extra copy of the abstract and title page must be submitted to the Graduate School. Please refer to the Graduate School's Web site for complete details (http://oregonstate.edu/dept/grad_school/current/thesis.html#library). The final printing and presentation of the Dissertation/Thesis must be in strict adherence to format and style stipulated by the OSU Office of Graduate Studies (OGS). Full information concerning the prescribed style for theses is given in the booklet, Preparing a Thesis or Dissertation at OSU: A Graduate Student Guide, available on the web at http://oregonstate.edu/Dept/grad_school/. The thesis will not be accepted for graduation requirements until it has received approval by the graduate dean.

Switching from MS to PhD Program

Toxicology graduate students may request to switch from a MS to the PhD program.

Overview: The Graduate Admissions Committee (GAC) will review requests generated by a current MS degree-seeking student in good standing prior to completion of the MS final exam. After review, and if the application is viewed favorably, the GAC will forward to the Department Head a recommendation to support the student's application to the Graduate School for Concurrent Enrollment. After approval by the Graduate School of the change in academic program, the student completes the MS degree requirements, including passing the final exam, earns the MS degree, and progresses directly into the PhD program. Classes taken as a MS student count towards the PhD degree requirements. Students in both non-thesis and thesis MS programs may apply to switch programs.

Process for Graduate Admissions Committee review of change in program request:

1. Current MS student in good standing, anytime prior to MS final exam, makes formal request to the GAC for consideration for concurrent enrollment. Required documentation in support includes: a statement of purpose indicating the desire to pursue a PhD, a letter of support from the research mentor, a resume or curriculum vitae, and a current transcript.
2. GAC reviews request (may include an interview or request for additional information) and forwards recommendation to Department Head.
3. With approval of Department Head, student submits *Change of Major* form to Graduate School indicating, "Work on Concurrent Degree".
4. Student passes MS final exam (earning either thesis or non-thesis MS) and is at that point now considered a PhD student. Department deadline for forming the PhD thesis committee, the program meeting (to approve any additional electives) and completing the qualifying (preliminary) exam is one year following successful completion of the MS degree.

ENVIRONMENTAL AND MOLECULAR TOXICOLOGY GRADUATE FACULTY

KIM A. ANDERSON, Associate Professor, Ph.D., Washington State University

- Environmental forensic chemistry involving bioavailability and speciation method development to decipher sources and fate of environmentally and biologically important chemicals.

WILLIAM BAIRD, Professor, Ph.D., University of Wisconsin

- Mechanisms of carcinogenesis by environmental polycyclic aromatic hydrocarbons

SAMUEL BENNETT, Assistant Professor/Sr. Research

- Biochemical and molecular aspects of DNA replication and repair, molecular mechanisms of mutagenesis

ANDREW BUERMEYER, Associate Professor, Ph.D., University of Wisconsin - Madison

- Genetic and environmental cancer risks, DNA mismatch repair, genomic instability and cancer, mouse models of cancer, genetic toxicology

ROD DASHWOOD, Professor, Ph.D., Portsmouth University, U.K.

- Genetic and epigenetic mechanisms of cancer development, and the cancer inhibitory actions of food constituents

JENNIFER FIELD, Professor, Ph.D., Colorado School of Mines

- Environmental fate and transport of organic pollutants in groundwater and municipal wastewater, environmental analytical chemistry.

STACEY HARPER, Assistant Professor, Ph.D., University of Nevada, Las Vegas

- Nanotoxicology, environmental impact of nanomaterials in aquatic systems, ecotoxicology, computational toxicology.

JOHN HAYS, Professor, Ph.D., University of California-San Diego

- Human and plant genomic-stability systems that correct DNA mismatches and repair or tolerate mutagenic DNA damages

JEFFREY JENKINS, Professor, Ph.D., Michigan State University

- Extension environmental chemistry, toxicology, environmental fate, risk assessment

PAUL C. JEPSON, Professor, Director of the Integrated Plant Protection Center, Ph.D., University of Cambridge, UK

- Integrated pest management (IPM), ecotoxicology, ecological risk assessment

NANCY I. KERKVLIET,Professor, Ph.D., Oregon State University

- Extension toxicology, immunotoxicology, flow cytometry

SIVA KUMAR KOLLURI, Assistant Professor, Ph.D.

- Molecular and Cellular Toxicology

CRAIG MARCUS, Department Head, Professor, Ph.D., Madison Wisconsin

- Structure, function and expression of the cytochromes P450 super family of enzyme

STACI SIMONICH, Associate Professor, Ph.D., Indiana University

- Regional and global environmental fate, transport, and deposition of semi-volatile organic compounds in the atmosphere, aquatic, and terrestrial compartments.
- Novel and improved analytical methods and techniques for studying the fate of semi-volatile organic contaminants in the environment.
- Validation of regional and global environmental fate models for semi-volatile organic compounds.

DAVE STONE, Assistant Professor, Ph.D., Oregon State University

- Need description here.

WILLIAM STUBBLEFIELD, Professor, Senior Research, Ph.D. University of Wyoming

- Environmental Toxicology

DANIEL L. SUDAKIN, Associate Professor, M.D., M.P.H., Oregon Health Sciences University

- Medical toxicology, epidemiology, risk assessment and communication

ROBERT TANGUAY, Associate Professor, Ph.D., University of California-Riverside

- Molecular and developmental toxicology, drug and nanomaterial development

DAVID WILLIAMS, Professor, Ph.D., Oregon State University

- Biochemical toxicology, metabolism