

ENSC 214. Soil and Water Chemistry Laboratory (2) Laboratory, 6 hours. Prerequisite(s): concurrent enrollment in ENSC 104/SWSC 104 or consent of instructor. A series of advanced laboratory exercises involving modern analytical methods for soils, sediments, and surface waters. Topics include trace metal speciation, isotope exchange kinetics, mineral solubility, adsorption isotherms, redox couples, and partitioning and biodegradation of organic contaminants. Cross-listed with SWSC 214. **Parker**

ENSC 217. Vadose Zone Processes (4) W, Even Years Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): MATH 009B or MATH 09HB, ENSC 107/SWSC 107; or consent of instructor. A study of physical and mathematical descriptions of transient flow and transport processes in the vadose zone. Emphasis is on numerical solutions to equations describing the movement of water, gas, contaminants and heat, including chemical and biological reactions. Explores mathematical models for direct and inverse solutions, spatial heterogeneity, and determination of soil hydraulic properties. Cross-listed with SWSC 217. **Simunek**

ENSC 218. Isotopes in Ecology and Environmental Science (4) F, Odd Years Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): graduate standing; both CHEM 001C and CHEM 01LC or both CHEM 01HC and CHEM 1HLC. Explores the principles and techniques of isotope tracer fractionation and mixing commonly used in ecology and environmental science. Introduces isotope notation, mixing models, and kinetic and equilibrium fractionation concepts. Includes case studies involving stable- and radioisotopes of carbon, nitrogen, oxygen, and sulfur. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor. Course is repeatable to a maximum of 4 units. **Sickman**

ENSC 227. Global Change and the Earth System (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): graduate standing or consent of instructor; ENSC 232/SWSC 232 is recommended. Examines the fundamental principles of earth system science in the context of global change. Emphasizes contemporary research on the relationship between humans and the Earth's environment. Topics include the earth system prior to human influence; the Anthropocene era (1850 to present); the responses of the Earth's support machinery to human activities; consequences of global change for human well-being; and pathways towards global sustainability. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor.

ENSC 232. Biogeochemistry (4) W, Odd Years Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): graduate standing; consent of instructor. A study of the biogeochemical cycling and exchange of carbon and important nutrients (N, S, base cations) between the lithosphere, hydrosphere, and atmosphere. Quantitatively describes processes at scales ranging from local to global. Addresses modern concerns about water and atmospheric quality, including global climate change. Cross-listed with SWSC 232. **Parker**

ENSC 265. Special Topics in Earth and Environmental Sciences (1-3) F, W, S Seminar, 1-3 hours. Prerequisite(s): graduate standing. Involves oral presentations and small-group discussions of selected topics in the areas of biogeochemistry, global climate change, geomicrobiology, earth surface processes, and interplanetary life. Graded Satisfactory (S) or No Credit (NC). Course is repeatable as content changes to a maximum of 10 units. Cross-listed with GEO 265.

ENSC 275. Research Seminar in Environmental Sciences (1) Seminar, 1 hour. Prerequisite(s): graduate standing or consent of instructor. Involves seminars by faculty, visiting scholars, environmental professionals, and advanced graduate students on current research topics in Environmental Sciences. Graded Satisfactory (S) or No Credit (NC). Course is repeatable.

ENSC 290. Directed Studies (1-6) Consultation, 1-3 hours; individual study, 1-15 hours. Prerequisite(s): graduate standing; consent of instructor and graduate advisor. Individual study of selected topics in Environmental Sciences under faculty direction. Graded Satisfactory (S) or No Credit (NC). Course is repeatable.

ENSC 297. Directed Research (1-6) Outside research, 3-18 hours. Prerequisite(s): graduate standing; consent of instructor. Research performed under the direction of a faculty member. Graded Satisfactory (S) or No Credit (NC). Course is repeatable.

ENSC 299. Research for the Thesis or Dissertation (1-12) Outside research, 3-36 hours. Prerequisite(s): graduate standing; consent of instructor. Research in environmental sciences for the M.S. thesis or Ph.D. dissertation. Graded Satisfactory (S) or No Credit (NC). Course is repeatable.

Professional Course

ENSC 302. Teaching Practicum (1-4) Practicum, 3-12 hours. Prerequisite(s): graduate standing. Supervised teaching in Environmental Sciences or related courses. Required of all teaching assistants in Environmental Sciences. Graded Satisfactory (S) or No Credit (NC). Course is repeatable.

Environmental Toxicology

Subject abbreviation: ENTX
College of Natural and Agricultural Sciences

Yinsheng Wang, Ph.D.,
Chair and Program Director
Program Office, 1001 Batchelor Hall North
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Professors

Michael E. Adams, Ph.D. *Neurosciences*
(Entomology/Cell Biology and Neuroscience)
Michael F. Allen, Ph.D. *Plant Pathology/Biology*
(Plant Pathology)
Janet T. Arey, Ph.D. *Atmospheric Chemistry*
(Environmental Sciences)
Roger Atkinson, Ph.D. *Atmospheric Chemistry*
(Environmental Sciences)
Nancy E. Beckage, Ph.D. *Biochemistry and Endocrinology*
(Entomology/Cell Biology and Neuroscience)
Wilfred Chen, Ph.D., *Chemical Engineering*
(Chemical and Environmental Engineering)
Carl F. Cranor, Ph.D. *Regulation of Toxic Substances*
(Philosophy)
David E. Crowley, Ph.D. *Environmental Microbiology*
(Environmental Sciences)
David A. Eastmond, Ph.D. *Toxicology*
(Cell Biology and Neuroscience)

Jianying "Jay" Gan, Ph.D. *Water Quality*
(Environmental Sciences)
Sarjeet S. Gill, Ph.D. *Toxicology*
(Cell Biology and Neuroscience)
Cynthia K. Larive, Ph.D. *Analytical Chemistry*
(Chemistry)
Xuan Liu, Ph.D. *Transcription Regulation*
(Biochemistry)
Ernest Martinez, Ph.D. *Molecular Biology*
(Biochemistry)
Ashok K. Mulchandani, Ph.D. *Biosensors*
(Chemical and Environmental Engineering)
David R. Parker, Ph.D. *Biogeochemistry*
(Environmental Sciences)
Daniel Schlenk, Ph.D. *Aquatic Ecotoxicology*
(Environmental Sciences)
Frances M. Sladek, Ph.D. *Transcriptional Regulation*
(Cell Biology and Neuroscience)
Prudence Talbot, Ph.D. *Cell Biology*
(Cell Biology and Neuroscience)
Yinsheng Wang, Ph.D. *Biological Mass Spectrometry*
(Chemistry)
Yushan Yan, Ph.D. *Environmental Engineering*
(Chemical and Environmental Engineering)
Marylynn V. Yates, Ph.D. *Environmental Microbiology*
(Environmental Sciences)
Paul J. Ziemann, Ph.D. *Atmospheric Chemistry*
(Environmental Sciences)

Associate Professors

Quan "Jason" Cheng, Ph.D. *Analytical Materials*
(Chemistry)
Margarita C. Currás-Collazo, Ph.D. *Neurosciences*
(Cell Biology and Neuroscience)
Mihri Ozkan, Ph.D. *Nanoelectronics and Nanoprobes*
(Electric Engineering)

Assistant Professors

Jeffrey B. Bachant, Ph.D. *Chromosome Segregation*
(Cell Biology and Neuroscience)
Constance Nugent, Ph.D. *Telomere Replication*
(Cell Biology and Neuroscience)
Sharon Walker, Ph.D. *Environmental Engineering*
(Chemical and Environmental Engineering)
Nicole I. zur Nieden, Ph.D. *Embryonic Stem Cells*
(Cell Biology and Neuroscience)
Wenwan Zhong, Ph.D. *Analytical Chemistry*
(Chemistry)

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Lecturer

Robert Krieger, Ph.D. *Pesticide Toxicology*
(Entomology)

Graduate Program

The program offers the M.S. and Ph.D. degrees in Environmental Toxicology.

The interdepartmental graduate program in Environmental Toxicology has participating faculty from the departments of Biochemistry, Cell Biology and Neuroscience, Chemical and Environmental Engineering, Chemistry, Entomology, Environmental Sciences, Philosophy, Plant Pathology and Microbiology, as well as scientists from the Air Pollution Research Center.

The goal of the program is to train toxicologists capable of directing research in areas of environmental toxicology. Areas of specialization include biochemical toxicology and chemical toxicology. To attain this goal, a three-tiered curriculum has been designed whereby students must complete

274 / Programs and Courses

1. A core of courses in environmental toxicology: ENSC 200/ENTX 200/CHEM 246, ENTX 201, ENTX 201L, ENTX 202, ENTX 270
2. A selection of elective courses in environmental toxicology and other relevant fields chosen in consultation with the student's major professor and the Guidance Committee to develop depth in particular areas of specialization
3. Research training in specific areas of environmental toxicology

The program stresses the importance of innovative and independent laboratory research as the major component of the student's education.

Admission Students must have a B.A. or B.S. degree from an accredited institution and an academic record that satisfies the minimum admission standards established by the UCR Graduate Division. In addition, results from the GRE General Test (verbal, quantitative, analytical) must be submitted at the time of application. Although no specific undergraduate degree specialization is required, applicants should have adequate backgrounds in the basic physical sciences such as chemistry, physics, and mathematics as well as in the biological sciences.

Course Work Normally, students admitted to regular standing have satisfied all prerequisite course work. Under special circumstances, students who have not completed all undergraduate requirements may be admitted provided that these deficiencies are corrected early in their graduate studies. Deficiencies must be corrected by taking the appropriate course work if undergraduate or other previous training has not included equivalent courses to the following:

BIOL 005A, BIOL 05LA, BIOL 005B
 BCH 100 or both BCH 110A and BCH 110B; BCH 110C or BIOL 107A
 CHEM 001A, CHEM 001B, CHEM 001C, CHEM 011A, CHEM 011B, CHEM 011C, CHEM 005, CHEM 112A, CHEM 112B, CHEM 112C
 CHEM 109 or CHEM 110A; CHEM 110B or CHEM 109; and BCH 184 (exceptions depend on biochemical or chemical emphasis)
 MATH 008B or MATH 009A, MATH 009B
 PHYS 002A, PHYS 002B, PHYS 002C
 STAT 100A and STAT 100B

Students who meet all the undergraduate entrance requirements should be able to complete the core Environmental Toxicology requirements in the first year and most electives by the end of the second year.

Laboratory Rotation All students participate in laboratory rotation through enrollment in ENTX 201L. Students spend time in one laboratory per quarter familiarizing themselves with research techniques utilized in the laboratory of an Environmental Toxicology faculty member. Rotation laboratories are chosen in consultation with the graduate advisor and individual faculty

members. Students may enroll in up to three quarters of laboratory rotation before declaring a major professor. Students who wish to declare a major professor after one quarter are not required to enroll for additional laboratory rotation. The major professor serves as chair of the student's Guidance and Dissertation committees.

Guidance Committee Each graduate student establishes a guidance committee which participates in the annual student progress evaluation procedure and advises the student on curriculum and research. The committee consists of the major professor plus at least two other faculty, one of whom must be a member of the Environmental Toxicology Program. Each student, in consultation with the major professor, nominates the members of the guidance committee. The committee must be named by the end of the quarter in which the student selects a major professor. The composition of the guidance committee must be approved by the curriculum and student affairs committee.

Master's Degree

The program offers the M.S. degree in Environmental Toxicology.

Students enrolling in the master's degree program must meet the requirements for the Plan I of the UCR Graduate Council, take core courses as described above, and submit an acceptable thesis.

Plan I (Thesis) Thirty-six (36) units, of which 24 must be in graduate-level courses, are required. No more than 12 units of ENTX 290, ENTX 297, and ENTX 299 may be used to satisfy the unit requirement. All students must enroll in the Environmental Toxicology seminar (ENTX 270 and ENTX 271) each quarter offered, although no more than 3 units from seminar courses can be accrued towards degree credit. A final draft of the thesis is to be given to the thesis committee two weeks before the final oral examination. A final oral examination consists of an open research seminar, presented by the candidate and advertised to all the students and faculty in the Environmental Toxicology Program. Following the seminar, the student is questioned by the guidance committee on the thesis research and on matters related to the general field of the thesis research.

Normative Time to Degree 6 quarters

Doctoral Degree

The program offers the Ph.D. degree in Environmental Toxicology.

Students must meet general university requirements of the Graduate Division as found in the Graduate Studies section of this catalog.

Course Work Beyond the required core sequence, all students must enroll in the Environmental Toxicology seminar (ENTX 270 and ENTX 271) each quarter offered, and complete a program of courses to be approved by the guidance committee. All course work schedules are submitted to the graduate advisor for approval. The Ph.D. degree is awarded

when the student passes the preliminary and qualifying examinations and demonstrates an ability to do original research by preparation and submission of an acceptable dissertation.

Preliminary Examination The preliminary examination is a standardized, written test generally offered once a year prior to the beginning of the fall quarter. Students normally take it following the completion of the core curriculum. The examination must be satisfactorily completed in order to enroll for the seventh academic quarter in the Ph.D. program. The examination consists of questions related to environmental, organismal and suborganismal aspects of toxicology. These questions are designed to test the student's ability to synthesize and integrate concepts in toxicology, rather than merely reiterate the material covered in the Environmental Toxicology core curriculum. The examination is administered by a committee consisting of the faculty members involved in teaching the core curriculum. On the basis of the results of this examination, the committee recommends appointment of a faculty qualifying committee, additional course work in specific area(s) of weakness, transfer to a terminal master's program, or withdrawal from the program. In exceptional circumstances, the preliminary examination can be taken a second time.

Oral Qualifying Examination The qualifying examination is an oral examination conducted by the qualifying committee. The qualifying committee, appointed by the graduate dean from nominations made by the faculty, is composed of the student's major professor and four additional members, one of whom must be from outside the Graduate Environmental Toxicology group. It covers the student's area of specialization and research field as well as general subjects at the discretion of the qualifying committee. The qualifying examination must be successfully completed by the end of the ninth quarter of full-time enrollment in the Ph.D. program. Under exceptional circumstances, the qualifying examination may be taken a second time. Upon successful completion of the qualifying examination, the student is advanced to candidacy.

Dissertation and Final Oral Examination A dissertation committee composed of at least three members is appointed by the graduate dean shortly after advancement to candidacy. Students must submit a dissertation based on independent, original research acceptable to all dissertation committee members. A final draft of the dissertation is to be given to the committee two weeks before the dissertation defense seminar.

Before approval of the dissertation, students must present their research orally at a thesis defense seminar. The seminar must be advertised to the campus community and is open to all who wish to attend. Following the seminar, the student is questioned by the dissertation committee on the thesis research and on matters related to the general field of the thesis research.

Normative Time to Degree 15 quarters

Upper-Division Courses

ENTX 200. Fate and Transport of Chemicals in the Environment (4) W, Even Years

Lecture, 4 hours. Prerequisite(s): CHEM 109 or CHEM 110B; CHEM 112A, CHEM 112B, CHEM 112C; or consent of instructor. Covers the Identification of toxicants and their source in the environment; equilibrium partitioning of chemicals in the environment (between air, water, soil, sediment, and biota) using physicochemical properties; and the transport and chemical transformations of chemical compounds in air, water, and soil media. Includes case studies of fate and transport of selected toxic chemicals. Cross-listed with CHEM 246 and ENSC 200. **Atkinson**

ENTX 200L. Analysis and Identification of Environmental Toxicants (3) W, Odd Years

Lecture, 1 hour; laboratory, 6 hours. Prerequisite(s): CHEM 125 (lecture portion only), CHEM 246/ENSC 200/ENTX 200; or consent of instructor. Provides laboratory experience in specialized methods of identification and analysis of toxic organic compounds in gaseous, aqueous, and soil media. Methods of sample collection and extraction are presented. Students utilize both gas and liquid chromatographic techniques. Toxicant analysis by gas chromatography (GC), GC/mass spectrometry, and GC/Fourier transform infrared spectroscopy is emphasized. **Arey**

ENTX 201. Principles of Toxicology (4) F Lecture, 3 hours; seminar, 1 hour. Prerequisite(s): BCH 110A, BCH 110B; or consent of instructor. The structure-activity and dose-response relationships of environmental toxicants; their absorption, distribution, metabolism, and excretion; and evaluation of their toxicity and factors that influence toxicity. Quantitative methods in measuring acute and chronic toxicity. **Eastmond**

ENTX 201L. Laboratory Rotation (2) F, W, S Laboratory, 6 hours. Prerequisite(s): graduate standing in Environmental Toxicology. Introduction to research techniques in biochemical and chemical toxicology. Students will spend time in a laboratory to familiarize themselves with research topics and techniques. Graded Satisfactory (S) or No Credit (NC). Course is repeatable. **Eastmond, Wang**

ENTX 202. Mechanisms of Toxicity (4) W Lecture, 3 hours; seminar, 1 hour. Prerequisite(s): BCH 110C or BIOL 107A; ENTX 201; or consent of instructor. Biochemical and physiology mechanisms underlying the toxicity of environmental toxicants. The interaction of toxicants with subcellular components and macromolecules with emphasis on mechanism of action, in particular neurotoxicity of pesticides, chemical carcinogenesis, mutagenesis, and teratogenicity. **Gill**

ENTX 204. Genome Maintenance and Stability (4) S

Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): BCH 110C or BIOL 107A; BIOL 113 or BIOL 114 or CBNS 101; BIOL 102 is strongly recommended. Emphasizes chromosome-based processes that maintain genome integrity and ensure accurate genome transmission during cell division. Topics are drawn from the primary literature and include chromatin structure and composition, DNA repair and recombination, telomere function and chromosome maintenance, mitotic chromosome segregation, and checkpoint surveillance mechanisms. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor. Cross-listed with BCH 204 and CMDB 204.

ENTX 205. Biotransformation of Organic Chemicals (4) S

Lecture, 4 hours. Prerequisite(s): CHEM 112A; CHEM 112B; BCH 110A, BCH 110B, BCH 110C, or equivalents; or consent of instructor. Explores the cat-

alytic activities and regulatory pathways of Phase I (e.g., cytochromes P450) and Phase II (e.g., Uridine Diphosphate Glucuronosyl-Transferase) enzymes involved in organic chemical biotransformation. Demonstrates the contribution of biotransformation in toxicology. **Schlenk**

ENTX 208. Ecotoxicology (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): BIOL 005A, BIOL 005B, CHEM 112A, CHEM 112B; or consent of instructor. Introduction to the impact of chemicals upon ecological systems. Examination of the fate and effects of environmental chemicals in various hierarchies of biological organization to learn how to carry out precise and accurate assessments of ecological risk. Cross-listed with ENSC 208 and SWSC 208. **Schlenk**

ENTX 211. Environmental and Molecular Carcinogenesis (3)

Lecture, 3 hours. Prerequisite(s): BIOL 107A or equivalent or consent of instructor. Molecular genetics of human cell response to environmental carcinogens. Discussions of DNA repair, mutagenesis, oncogenes, and tumor suppressors. Following presentation of introductory material, emphasis will be placed on student discussion of recent literature.

ENTX 244. Airborne Toxic Chemicals (3) Lecture, 3 hours. Prerequisite(s): CHEM 109 or CHEM 110A, and CHEM 110B, CHEM 135/ENSC 135/ENTX 135; or consent of instructor. Atmospheric chemistry of airborne chemicals. Intermedia partitioning. Structure of the atmosphere. Gas-particle distributions of chemicals, and wet and dry deposition of gases and particles. Atmospheric reactions of organic compounds, with emphasis on toxics. Theoretical and experimental methods for the determination of atmospheric lifetimes and products of chemicals. Cross-listed with CHEM 244. **Atkinson**

ENTX 245. Chemistry and Physics of Aerosols (3) F, Odd Years Lecture, 3 hours. Prerequisite(s): CHEM 109, CHEM 110B; or consent of instructor. Fundamentals of chemical and physical processes controlling behavior and properties of airborne particles. Topics include particle mechanics; electrical, optical, and thermodynamic properties; nucleation; surface and aqueous-phase chemistry; gas-particle partitioning; sampling; size and chemical analysis; atmospheric aerosols; and environmental effects. Cross-listed with CHEM 245 and SWSC 245. **Ziemann**

ENTX 252. Special Topics in Environmental Toxicology (1-3) F, W, S

Seminar, 1-3 hours. Prerequisite(s): graduate standing. Involves oral presentations and intensive small-group discussions of selected topics in the area of special competence of each participant Graded Satisfactory (S) or No Credit (NC). Course is repeatable as content changes to a maximum of 20 units.

ENTX 270. Seminar in Environmental Toxicology (1) F, W, S Seminar, 1 hour. Prerequisite(s): graduate status in Environmental Toxicology. Lectures by visiting scholars and staff on current research topics in Environmental Toxicology. Graded Satisfactory (S) or No Credit (NC). May be repeated for credit. **Eastmond**

ENTX 271. Seminar in Environmental Toxicology (2) S Seminar, 15 hours per quarter; individual study, 15-20 hours per quarter. Prerequisite(s): graduate standing in Environmental Toxicology. An interdisciplinary seminar consisting of student presentations of original research and discussion of current research topics in environmental toxicology. Graded Satisfactory (S) or No Credit (NC). Course is repeatable as content changes to a maximum of 12 units.

ENTX 290. Directed Studies (1-6) F, W, S Outside research, 3-18 hours. Prerequisite(s): graduate status in Environmental Toxicology. Literature or research topics under direction of the staff. Graded Satisfactory (S) or No Credit (NC). May be repeated for credit.

ENTX 297. Directed Research (1-6) F, W, S Outside research, 3-18 hours. Prerequisite(s): graduate status in Environmental Toxicology. Directed research performed towards the development of a dissertation problem or other research performed under the direction of staff. Graded Satisfactory (S) or No Credit (NC). May be repeated for credit.

ENTX 299. Research for Thesis or Dissertation (1-12)

Outside research, 3-36 hours. Prerequisite(s): graduate status in Environmental Toxicology. Research performed under the direction of a faculty member towards a thesis or dissertation. Graded Satisfactory (S) or No Credit (NC). May be repeated for credit.

Ethnic Studies

Subject abbreviation: ETST

College of Humanities, Arts, and Social Sciences

Dylan Rodriguez, Ph.D., Chair
Department Office, 4033 INTN
(951) 827-4707; ethnicstudies.ucr.edu

Professors

Edward T. Chang, Ph.D. Asian American Studies
Alfredo M. Mirandé, Ph.D. Chicano Studies
(Ethnic Studies/Sociology)
Armando Navarro, Ph.D. Chicano Studies

Professor Emerita

Edna M. Bonacich, Ph.D. Race, Class, and Gender
(Ethnic Studies/Sociology)

Associate Professor

Ralph L. Crowder, Ph.D. African American Studies
Paul Green, Ph.D. Race, Education, and Law
Anthony Macias, Ph.D. Chicano Studies
Dylan Rodriguez, Ph.D. Filipino American
Studies/Prison Industrial Complex

Assistant Professors

Victoria Bomberly, Ph.D. Native American Studies
Jayna Brown, Ph.D. African American Studies
Jodi Kim, Ph.D. Asian American Studies
Jennifer Najera, Ph.D. Chicano Studies
Robert Perez, Ph.D. Native American Studies

Majors

Ethnic Studies is the systematic and comparative study of the social construction of race, racism, and racial or ethnic subordination, and the history, culture, and contemporary experiences of racial or ethnic groups who have not been fully incorporated into U.S. society. The Department of Ethnic Studies focuses on the experiences of four racial or ethnic groups (African Americans, Asian Americans, Chicana/o and Latinas/os, and Native Americans) whose histories, cultures, and experiences have been neglected by traditional disciplines. Ethnic studies students examine inter- and intra-group differences and commonalities in history, culture, racism, the impact of law, and social inequality in contemporary society. Also examined are conflicts, tensions, and the building of effective inter-group coalitions and alliances among racially subordinated groups.