

Environmental Toxicology



Course: 11:375:407
Spring Semester 2021
Cook/Douglass Campus
Department of Environmental Sciences

Instructor: Dr. Sean M. Bugel

E-mail: sean.bugel@rutgers.edu

Office Hours: Remotely by appointment

Classes: Wednesday 5:35-8:35 PM

Remote instruction: Canvas and Zoom

Zoom: <https://rutgers.zoom.us/j/98092939388?pwd=Y2x0OTdKZENORMdTcXkvOGZsZUF3dz09>

Course Description, Goals and Objectives:

This course includes the principles and methods of biological testing for toxicity and health effects, risk assessment, and the impact of pollutants on groundwater, surface waters and ecosystems. Weekly material will cover the different classes of environmental chemicals, ecotoxicological effects on wildlife, human exposures and health effects, basic mechanisms of toxicity, environmental epidemiology, and methods for the remediation of contaminated sites.

The goal of this course is to introduce the student to the field of Environmental Toxicology where the basic principles of toxicology are applied to environmental problems. Basic concepts will be covered including chemical and physical disease causing agents, fate and transport of xenobiotics in the environment, mechanisms by which xenobiotics interact with the biosphere, dose-response relationships, toxicity testing, pharmacokinetics and metabolism of xenobiotics, adverse effects associated with exposures and risk assessment. This course will include case

studies and some of the most common methods of remediation used to clean-up contaminated sites in New Jersey.

Students completing this program will be able to:

1. Apply the knowledge obtained from this course to evaluating exposure and solving problems associated with environmental contaminants.
2. Use the skills, techniques and tools necessary for a successful career in the field of environmental toxicology.
3. Conduct assessments of the environment, analyze data and evaluate health impacts from exposure to contamination.
4. Understand professional ethical responsibilities.
5. Understand contemporary environmental issues and the impact of environmental toxicology in a global and societal context.
6. Understand the need, and have the ability, to engage in lifelong learning and to participate in professional organizations.

This course is divided into 3 units, with 3-5 weekly modules each.

Unit 1: Fundamentals of Toxicology and the Dose-Response Relationship

Principles of Environmental Toxicology and the Dose-Response Relationship
Toxicity Testing, and ADME I (Absorption, Distribution, Metabolism and Excretion)
ADME II (Toxicokinetics and Metabolism), and Classes of Environmental Chemicals
Biochemical Effects and Mechanisms of Toxicity of Pollutants

Unit 2: Environmental Toxicology

Environmental Fate and Sources of Pollutants
Ecotoxicology, Biomarkers and Biomonitoring
Developmental Origins of Disease and Endocrine Disruption
Carcinogenic & Genotoxicity Pollutants and Their Effects

Unit 3: Specialized Toxicology and Case Studies

Ecological and Human Health Risk Assessment
Neurotoxicological Effects of Environmental Pollutants
Case Studies

Remote Instruction

Weekly meetings will be held via zoom, weekly links to connect will be provided through the canvas course calendar. Audio and video will be required for class participation. The class will meet once a week for 3 hours, and instruction will include lecture, open discussion, and powerpoint presentations by students. The syllabus, course material, weekly powerpoints, and assignments will be posted to canvas. Recorded lectures will be posted to either canvas or youtube. Assignments must be submitted through canvas. Be sure to check and mute your cell phone before you join the class.

Course Materials (provided in Canvas):

1. Readings and reference materials (provided PDFs of texts and reviews)
2. Coursework assignments (weekly assignments, term paper and presentation, etc.)
3. Calendar of class lecture topics and examination dates
4. PowerPoint slides used in lecture

Online and provided textbooks (on canvas):

1. *Principles of Ecotoxicology*. 2nd edition. Walker CH, Hopkin SP, Sibly RM, Peakall DB. Taylor & Francis Group, 2001.
2. *Casarett & Doull's Essentials of Toxicology*. 3rd edition. Klaassen CD, Watkins JB. McGraw Hill, 2015. Also available on libraries.rutgers.edu (via accespharm) at <https://bit.ly/3o0TasX>

Grading:

Grading is based on the timely and correct submission of assignments, class participation as well as performance on two examinations and a comprehensive final. While the exams cover recent information, the final exam is cumulative and includes all information covered in class lectures, the text and the additional required readings. This also includes potential questions from student powerpoint presentations.

Weekly assignments: 10% of the final grade

Class participation and attendance: 10 % of final grade

Term paper and short presentation: 20% of final grade (15% paper, 5% presentation)

Two mid-semester exams: 40% of final grade (20% each)

Cumulative final exam: 20% of final grade

Range	Grade
100 – 90	A
89.9 – 85	B+
84.9 – 80	B
79.9 – 75	C+
74.9 – 70	C
69.9 – 60	D

Guidelines for Assignments

Weekly homework assignments must be prepared electronically and submitted as an MS-WORD (.doc, .docx) or PDF document with a 12-point font, 1-inch margins (all around) and 1.25 line spacing.

The assignment must be complete, correct, and submitted on time (“on time” means the assignment is turned in by the start of the class period when it is due). Weekly assignments won’t be accepted late.

Examinations

Examinations will be performed on zoom. All scheduling conflicts must be discussed at least 1 week prior to the scheduled date of the exam. In the event of an emergency or illness on the day of an exam, you must notify me before the exam. If requested, students must provide verification of the absence in order to schedule a make-up exam. Students who do not make alternate arrangements prior to the exam will be given a grade of “0” for that exam.

There will be three exams total (20% each for 60% of the final grade). Two exams will be mid-semester that will cover the current content to-date. The final examination will be comprehensive and may include questions on material from student presentations.

<u>Date</u>	<u>Coursework and Material</u>
Jan 20	<p>Introduction to Environmental Toxicology course</p> <p>Discussion of syllabus, coursework, introductions, interests and career goals and options in toxicology. General overview of environmental toxicology applications and relevance and the scope of the course.</p> <p>Optional reading: <i>Casarett & Doull's Essentials of Toxicology</i> Chapter 1 (History and Scope of Toxicology)</p>
Jan 27	<p>Principles of Environmental Toxicology and the Dose-Response Relationship</p> <p>Discussion of the fundamentals of toxicology and role of the environment and chemical exposures in health. Review of general terminology. Discussion of different types of chemical and concentration-dependent responses and interpreting dose-response data.</p> <p>Readings: <i>Casarett & Doull's Essentials of Toxicology</i> Chapter 2 (Principles of Toxicology); <i>Principles of Ecotoxicology</i> Chapter 9 (Interactive Effects of Pollutants)</p> <p>Weekly assignment: Evaluation of dose-response curves and toxicity data (Due Feb 3).</p>
Feb 3	<p>Toxicity Testing, and ADME I (Absorption, Distribution, Metabolism and Excretion)</p> <p>Continuation of how to define the toxicity of a chemical and dose-response study considerations. Second half of lecture explores the factors that influence a chemicals disposition in the body, focusing on uptake and elimination.</p> <p>Principles of Ecotoxicology Chapter 6 (Toxicity Testing); <i>Casarett & Doull's Essentials of Toxicology</i> Chapter 5 (Absorption, Distribution, and Excretion of Toxicants)</p> <p>Weekly assignment: TBD (Due Feb 10)</p>

Feb 10 **ADME II (Toxicokinetics and Metabolism), and Classes of Environmental Chemicals**

Review of toxicokinetics, major metabolic processes, and xeno-biotic biotransformation. The second half of lecture reviews the major classes of historical and emerging pollutants.

Discussion of Term Paper assignment and potential topics

Reading: *Casarett & Doull's Essentials of Toxicology* Chapter 6 (Biotransformation of Xenobiotics); *Principles of Ecotoxicology* Chapter 1 (Major Classes of Pollutants)

Weekly assignment: TBD (Due Feb 17)

Feb 17 **Biochemical Effects and Mechanisms of Toxicity of Pollutants**

Topics will cover chemical effects on biochemical and molecular pathways and the interaction of chemicals with the major classes of biomolecules.

Reading: *Principles of Ecotoxicology* Chapter 7 (Biochemical effects of pollutants); *Principles of Ecotoxicology* Chapter 8 (Physiological Effects of Pollutants)

Weekly assignment: none

Feb 24 ***EXAM 1***

Due: Term paper topic selection

Mar 3 **Environmental Fate and Sources of Pollutants**

Review of the physical and chemical processes that influence how a chemical moves in the environment.

Reading: *Principles of Ecotoxicology* Chapter 2 (Routes by Which Pollutants Enter Ecosystems); *Principles of Ecotoxicology* Chapter 5 (The Fate of Organic Pollutants in Individuals and in Ecosystems)

Mar 10 Ecotoxicology, Biomarkers and Biomonitoring

Overview of the chemical impacts on ecosystems and populations of sensitive species. Adverse outcome pathway framework and how a chemical exerts toxicity and manifests effects. Review of different strategies for determining toxicity of a chemical and how biomonitoring is used to evaluate environmental health *in situ*.

Reading: *Casarett & Doull's Essentials of Toxicology* Chapter 30 (Ecotoxicology); *Principles of Ecotoxicology* Chapter 10 (Biomarkers)

Mar 17 -----SPRING BREAK-----

Mar 24 Developmental and Reproductive Origins of Disease

Introduction to the role chemicals play in the developmental origins of disease in both humans and sensitive species. Discussion of the Barker Hypothesis and how development and reproduction is a major target for early-life stage toxicity.

Reading: *Casarett & Doull's Essentials of Toxicology* Chapter 10 (Developmental Toxicology); *Casarett & Doull's Essentials of Toxicology* Chapter 20 (Reproductive Toxicology)

Other: Term Paper Thread started on discussion board for you to claim presentation date (first-come first-serve basis)

Mar 31 Carcinogenic Effects of Pollutants

Review of environmental toxicants and their mechanisms of carcinogenesis, mutagenesis, and different pathologies.

Reading: *Casarett & Doull's Essentials of Toxicology* Chapter 8 (Chemical Carcinogenesis); *Casarett & Doull's Essentials of Toxicology* Chapter 9 (Genetic Toxicology)

Apr 7	*EXAM 2*
Apr 14	Ecological and Human Health Risk Assessment Topic will be focused on the application of toxicology towards human health and ecological risk assessment, including determining safe exposure levels for environmental chemicals.
	Reading: <i>Casarett & Doull's Essentials of Toxicology</i> Chapter 4 (Risk Assessment)
Apr 21	Topic: TBD Student presentations
Apr 28	Student presentations Course material review
May 5	Reading Days (no meeting) Term Paper Due
May 12	*FINAL EXAM*

Academic Integrity

The university's policy on Academic Integrity is available at

<http://academicintegrity.rutgers.edu/academic-integrity-policy>. The principles of academic integrity require that a student:

- Properly acknowledge and cite all use of the ideas, results, or words of others.
- Properly acknowledge all contributors to a given piece of work.
- Make sure that all work submitted as his or her own in a course or other academic activity is produced without the aid of impermissible materials or impermissible collaboration.
- Obtain all data or results by ethical means and report them accurately without suppressing any results inconsistent with his or her interpretation or conclusions.
- Treat all other students in an ethical manner, respecting their integrity and right to pursue their educational goals without interference. This requires that a student neither facilitate academic dishonesty by others nor obstruct their academic progress.
- Uphold the canons of the ethical or professional code of the profession for which he or she is preparing.
- Adherence to these principles is necessary in order to ensure that
- Everyone is given proper credit for his or her ideas, words, results, and other scholarly accomplishments.
- All student work is fairly evaluated and no student has an inappropriate advantage over others.
- The academic and ethical development of all students is fostered.
- The reputation of the University for integrity in its teaching, research, and scholarship is maintained and enhanced.

Failure to uphold these principles of academic integrity threatens both the reputation of the University and the value of the degrees awarded to its students. Every member of the University community therefore bears a responsibility for ensuring that the highest standards of academic integrity are upheld. Any evidence of academic misconduct, including cheating, failure to cite sources, plagiarism, stealing ideas, or deliberately slanting research results will result in appropriate action as dictated by Rutgers University. Please note that taking information from an Internet site and placing it into text without proper citation is plagiarism and students are subject to the same consequences as they would face for copying information from a text or journal article without proper citation. If you are unsure of the rules of citation,

please ask! Rutgers provides a wealth of resources to help students understand proper citation format and coping with the pressures of academic life.

Absence Policy

Students are expected to attend all classes; if you expect to miss one or two classes, please use the University absence reporting website <https://sims.rutgers.edu/ssra/> to indicate the date and reason for your absence. An email is automatically sent to me. If you miss a class, you are responsible for all materials, including announcements. Arrange (now!) with a classmate to pick up any handouts and take notes for you.

Student Wellness Services

Access helpful mental health information and resources for yourself or a friend in a mental health crisis on your smartphone or tablet and easily contact CAPS or RUPD.

Counseling, ADAP & Psychiatric Services (CAPS)

(848) 932-7884 / 17 Senior Street, New Brunswick, NJ 08901 / <http://health.rutgers.edu/>
CAPS is a University mental health support service that includes counseling, alcohol and other drug assistance, and psychiatric services staffed by a team of professionals within Rutgers Health services to support students' efforts to succeed at Rutgers University. CAPS offers a variety of services that include: individual therapy, group therapy and workshops, crisis intervention, referral to specialists in the community and consultation and collaboration with campus partners.

Violence Prevention & Victim Assistance (VPVA)

(848) 932-1181 / 3 Bartlett Street, New Brunswick, NJ 08901 / www.vpva.rutgers.edu/
The Office for Violence Prevention and Victim Assistance provides confidential crisis intervention, counseling and advocacy for victims of sexual and relationship violence and stalking to students, staff and faculty. To reach staff during office hours when the university is open or to reach an advocate after hours, call 848-932-1181.

Disability Services

(848) 445-6800 / Lucy Stone Hall, Suite A145, Livingston Campus, 54 Joyce Kilmer Avenue, Piscataway, NJ 08854 / <https://ods.rutgers.edu/>

Rutgers University welcomes students with disabilities into all of the University's educational programs. In order to receive consideration for reasonable accommodations, a student with a disability must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentation:

<https://ods.rutgers.edu/students/documentation-guidelines>. If the documentation supports your request for reasonable accommodations, your campus's disability services office will provide you with a Letter of Accommodations. Please share this letter with your instructors and discuss the accommodations with them as early in your courses as possible. To begin this process, please complete the Registration form on the ODS web site at:

<https://ods.rutgers.edu/students/registration-form>.