Section 1

Instructor, Course Information & Objectives

Advanced Academic Programs Zanvyl Krieger School of Arts and Sciences Johns Hopkins University

ECOTOXICOLOGY (Online) – AS420.622.81

Instructor Information

Instructor:	Michael Ciarlo
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Office Hours:	Office hours can be arranged by appointment at the contact information above. Questions or comments can be posted to the course message boards. I am typically able to respond within 24 to 48 hours.

Course Description

This course covers fundamental of ecotoxicology, including chemical action on plants, wildlife, and ecosystems. Coursework explores toxic effects of pollutants and other stressors at multiple levels of function ranging from cellular and organ systems to populations, communities, and ecosystem functions. Students will learn essential concepts governing fate, exposure, and toxic mechanisms of chemicals as well as basic mathematical models used to investigate biological uptake, bioaccumulation, and dose-response effects. Course includes lessons on application of ecotoxicology, including standard procedures for toxicity testing, risk assessment, and measuring exposures and impacts in the field. Topics are covered in a framework of basic biology and ecology, including cellular/organismal functions, trophic structure, foodweb dynamics, population biology and community ecology. Offered every other year. Prerequisite: 420.611 Principles and Methods of Ecology, equivalent course, or experience.

Course Overview

Through lectures and assignments, this course presents fundamental concepts of ecotoxicology in the context of environmental policy applications. Topics include review of key types of chemical stressors, their fate and transport; environmental exposures and bioaccumulation; modes of toxic action at the cellular, physiological, organismal, population, community, and ecosystem levels; and major examples and case studies that illustrate these concepts. The course also provides an overview of applications of ecotoxicology, including methods for field investigation, risk assessment, and role in major environmental regulations.

Course Goals & Learning Objectives

By the end of this course, you will be able to:

- Identify key types of environmental toxicant, identify the major factors affecting their fate and transport.
- Solve basic problems related to fate and transport mechanisms.
- Identify the major routes of exposure to chemical toxicants.
- Solve basic problems to quantify organismal exposures to a substance based on concentrations in environmental media.
- Identify mechanisms of and solve basic problems related to bioaccumulation, biomagnification, and bioconcentration.
- Define the principles of toxicology and the action of selected toxic materials at the cellular, physiological, organismal, population, community and ecosystem level.
- Describe the role of ecotoxicology in major environmental regulations/decision-making frameworks.
- Describe typical ecotoxicological field investigation, lab testing/toxicity testing, and risk assessment methodologies and identify their applicability to example problems.
- Calculate screening level estimates of ecological risk.

Section 2

Course Materials

Textbook

Walker, C.H., S.P. Hopkin, R. M. Sibley, and D.P. Peakall. 2012. Principles of Ecotoxicology, Fourth Edition. Boca Raton, FL: CRC Press.

ISBN -13: 978-1-4398-6266-7 (soft cover) **Other**

Readings

Newman, M.C. 2014. Fundamentals of Toxicology. 4th Edition. Boca Raton, FL: CRC Press. (Selected Chapters)

Newman, M.C. & W.H. Clements. 2008. Ecotoxicology: A Comprehensive Treatment. Boca Raton, FL: CRC Press. (Selected Chapters)

Pennings, S.C. and M. D. Bertness. 2001. Salt Marsh Communities. In: *Marine Community Ecology*. M. D. Bertness, S.D. Gaines, and M. Hay (Editors). Sinauer Associates, Sunderland Massachusetts.

U.S. Environmental Protection Agency (USEPA). 1993. Wildlife Exposure Factors Handbook. EPA/600/R-93/187. URL: https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=2799

USEPA. 1997. Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments - Interim Final (PDF). URL: http://semspub.epa.gov/src/document/HQ/157941

Other Online Databases & Web Resources

National Library of Medicine. 2016. TOXNET. URL: https://toxnet.nlm.nih.gov/.

ATSDR. 2016. ToxProfiles. URL: http://www.atsdr.cdc.gov/toxprofiles/index.asp.

U.S. EPA. 2016. ECOTOX Knowledgebase. URL: https://cfpub.epa.gov/ecotox/.

U.S. Army Corps of Engineers. 2016. Environmental Residue Effects Database (ERED). URL: https://ered.el.erdc.dren.mil/.

DOE Oak Ridge National Labs. 2016. Ecological Risk Analysis: Guidance, Tools, and Applications. URL: http://www.esd.ornl.gov/programs/ecorisk/ecorisk.html.

U.S. EPA. 2016. Wildlife Exposure Factors Handbook. URL: https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=2799.

U.S. EPA. 2016. EcoSSL Guidance. URL: https://www.epa.gov/chemical-research/interimecological-soil-screening-level-documents.

OECD. 2016. EchemPortal. URL: http://www.echemportal.org/echemportal/index?pageID=0&request_locale=en

USEPA. 2016. National Recommended Water Quality Criteria. URL: https://www.epa.gov/wqc/national-recommended-water-quality-criteria NOAA. 2016. Screening Quick Reference Tables (SQuiRTs). URL: http://response.restoration.noaa.gov/environmental-restoration/environmental-assessmenttools/squirt-cards.html

Specific Technology Requirements & Skills for this Course

Learning online requires some basic knowledge of computer technology. At a minimum, you need to be able to:

- Navigate in and use Blackboard; the Blackboard Student Orientation course on your "My Institution" page
- Create and save MS Word documents; see MS Word training and tutorials for PC users (all versions); Word Help for Mac users
- Find basic resources on the Internet
- Create and organize files & folders on your computer
- Send, receive, and manage email

The course 420.611 Principles and Methods of Ecology or equivalent is a prerequisite for this course. While this course is a basic overview of the subject, it does require much reading and work. Please review the syllabus carefully and call or e-mail with any questions or concerns. You will need to use algebra and basic math skills. You will not be required to use calculus. The chemistry associated with ecotoxicology is emphasized in the course, and consequently chemistry terminology will be used. You must be able to use spreadsheets to perform mathematical calculations. You will be required to write well and clearly. Access to online library resources will be necessary.

Section 3

About Your Course

What To Expect in this Course

This course is 16 weeks in length and includes individual, group, and whole group activities in a weekly cycle of instruction. With the exception of the first week, each week begins on a Monday and ends on the following Sunday. Please review the course syllabus thoroughly to learn about specific course outcomes and requirements.

For this course, there will be no synchronous events. Each week, you will complete readings and watch multimedia presentations. Some weeks, you may use web-based resources and articles from professional journals. A reading may be integrated within an activity during the week or provide some key information to assist your learning.

The course also includes a term paper and exam which require long term planning and performance.

In this course, you will also experience online learning activities, which include discussion boards, group work, and online multimedia presentations. Be sure to refer to the

Checklist each week, which provides a week-at-a-glance and shows targeted dates for the completion of activities.

Course Structure

At the heart of ecotoxicology is the relationship between an organism and chemicals in its environment. Chemicals originate from (in this case) man-made sources, are transported into and through environmental media, travel to and into organisms by exposure pathways, and once there, cause effects. The course is laid out to reflect this sequence. Lesson 1 presents an overview. Lessons 2 through 4 present important chemicals sources, transport, and exposure pathways. Lessons 5, 7, 8, 9, 11, and 12 present toxic effects at each level of biological complexity. Interspersed among these conceptual lessons are lessons 6, 10, 13, 14, and 15 on topics in applied ecotoxicology to help you apply what you have learned. Assignments for technical lessons focus on short answer questions and problem solving to reinforce and assess what you have learned. Assignments for applied sections focus more on threaded discussions to help you explore how to use what you are learning.

Directions for Students

Next Steps: Carefully review the remaining sections of the syllabus before beginning the **Lesson 1** activities, which are located in the **Lessons** folder in your online course.

- Once you feel that you are ready to dive into the first week's activities, click on the **Lessons** button on the left-side navigation menu. Then, click on **Lesson 1** to begin with the Introduction and Objectives.

Course Topics

Lesson 1: Introduction to Ecotoxicology

In this module you will be introduced to the course policies, administration, and basic format. We will examine the origins and scope of ecotoxicology as a science and review key general concepts.

By the end of the module, you will be able to:

- Identify policies, grading criteria, and expectations
- Describe the origins and scope of toxicology
- Define major concepts and terminology describing the relationship between environmental stressors and ecological receptors
- Identify the levels of ecological complexity that will be evaluated in the course
- Explain how dynamics in a salt marsh demonstrate toxicological concepts

Students will view audio/visual presentation materials created by the instructor that will

- review the course policies, grading, and format;
- review major ecotoxicological terms and concepts, using salt marsh ecology as an example
- review the levels of ecological complexity as they are relevant to toxicology.

Students will read the following:

Course Textbook:

Introduction. Walker, Sibly, Hopkin & Peakall. Principles of Ecotoxicology, 4th Edition.

Reserved Readings:
Pennings, S.C. and M. D. Bertness. 2001. Salt Marsh Communities. In: Marine Community Ecology.
Assignment #1: Students will respond to the graded Threaded Discussion topic "Complexity: You Choose."

Lesson 2: Pollutant Sources, Important Chemical Classes, Fate and Transport
In this module we will review the major classes of anthropogenic environmental toxicants and discuss the factors that affect their fate and transport. We will review key aspects of environmental chemistry and ways of expressing concentrations in the environment By the end of the module, you will be able to:

- Identify major classes and sources of environmental toxicants
- Identify key properties off environmental media that affect chemical behavior
- Identify key factors affecting chemical transport in soil, water, air, and sediment
- Express chemical concentration in environmental media and solve simple equations defining chemical fate

Students will view audio/visual presentation materials created by the instructor that will

- review major chemical classes
- review the different factors affecting fate and transport of metals; organic compounds; and nutrients
- review basic expression of concentrations and concentration changes mathematically, including simple problem solving.

Students will read the following: Course Textbook:
Chapters 1, 2 and 3. Walker, Sibly, Hopkin & Peakall. Principles of Ecotoxicology, 4th Edition.
Assignment #2: Students will complete a graded exercise including both short answer questions and sample problems.

Lesson 3: Fate, Transport, and Exposure
In this module we will review factors affecting chemical fate and transport; learn about exposure pathways as they apply to different organism life histories; learn how to construct a conceptual site model; and learn how to perform simple exposure calculations By the end of the module, you will be able to:

- Identify key factors affecting chemical fate and transport in soil, water, air, and sediment
- Solve simple equations defining chemical fate and transport
- Identify the key exposure and uptake pathways applicable for different types of organisms and how life history affects exposure
- Use simple models to calculate exposure

Students will view audio/visual presentation materials created by the instructor that will

- Review major and exposure pathways
- Demonstrate calculation of chemical exposures.

Students will read the following: Course Textbook:
Chapters 4 & 5. Walker, Sibly, Hopkin & Peakall. Principles of Ecotoxicology, 4th Edition. Public Online Resources:
U.S. Environmental Protection Agency (USEPA). 1993. Wildlife Exposure Factors Handbook. EPA/600/R-93/187.
Assignment #3:

- Students will complete a graded exercise including both short answer questions and sample problems.
- Students will submit their term paper topic before the lesson is ended (ungraded)

Lesson 4: Bioavailability, Bioaccumulation, and Conceptual Site Models
In this module, we will review how chemicals are taken up and absorbed into the body, where and how they may accumulate, and how they may biomagnify up the food chain. We will learn the concept of bioavailability and introduce the concept of metabolic tolerance. We will learn about conceptual site models and how to construct them.
By the end of the module, you will be able to:

- Define uptake and explain how it is different than exposure
- Explain how bioavailability affects the uptake of chemicals into organisms
- Explain the role of depuration and excretion in metabolic tolerance
- Describe where and how chemicals may bioaccumulate
- Describe how chemicals may bioaccumulate in food webs
- Perform simple mathematical modeling of bioaccumulation
- Construct a conceptual site model to show chemical exposure

Students will view audio/visual presentation materials created by the instructor that will

- Define uptake as distinct from exposure
- Describe factors that affect bioavailability and the role of excretion and depuration in uptake
- Explain the mechanisms of bioaccumulation and biomagnification Demonstrate calculation ofbioaccumulation.
- Discuss and demonstrate preparation of a conceptual site model

Students will read the following: Course
Textbook:
Chapters 4 & 5. Walker, Sibly, Hopkin & Peakall. Principles of Ecotoxicology, 4th Edition.
Reserved Readings:
Chapter 3. Newman. 2014. Fundamentals of Toxicology. 4th Edition.
Assignment #4: Students will complete a graded exercise including both short answer questions and sample problems.

Lesson 5: Whole Organism Toxicology
In this module, we will review the major concepts and terms associated with whole organism toxicology, including lethal versus sublethal effects, dose response relationships, and adaptation
By the end of the module, you will be able to:

- Explain the difference between lethal effects and various sublethal effects
- Define the terminology used to define severity and magnitude of effects based on different exposure routes and durations
- Express quantitatively the relationship between dose and response, how this information is gained, and how this information can be used to understand comparative toxicity between chemicals and organisms
- Define hormesis; explain why adaptation of tolerance has a cost

Students will view audio/visual presentation materials created by the instructor that will

- Review the terms used to describe severity of effect, effect endpoint, duration of exposure, and exposure route

- Review a dose response curve and perform a walk-through of a scientific paper to show how results are reported
- Define hormesis explain the concept of cost-benefit as it relates to tolerance.

Students will read the following:
Course Textbook:
Chapters 6, 8 & 9. Walker, Sibly, Hopkin & Peakall. Principles of Ecotoxicology, 4th Edition.
Reserved Readings:
Chapter 8. Newman. 2014. Fundamentals of Toxicology. 4th Edition.
Assignment #5: Students will complete a graded exercise including both short answer questions and sample problems.

Lesson 6: Sources for Ecotoxicological Data
In this module, we will review publicly data sources and discuss the form, format, and usability of data associated with each
By the end of the module, you will be able to:

- Identify reliable, peer review literature sources and authoritative guidance
- Identify key sources for exposure and effects data and demonstrate the ability to collect and present it
- Explain the advantages and disadvantages of data from a specific source in terms of defensibility, reliability, transparency, and regulatory consistency

Students will view audio/visual presentation materials created by the instructor that will

- Discuss the factors affecting data defensibility, reliability, transparency, and regulatory consistency
- Review major sources of effects data
- Review major sources of exposure data

Students will read the following:
Please skim these Public Online Resources:
National Library of Medicine: TOXNET (https://toxnet.nlm.nih.gov/)
ATSDR: ToxProfiles (http://www.atsdr.cdc.gov/toxprofiles/index.asp)
U.S. EPA: ECOTOX Knowledgebase (https://cfpub.epa.gov/ecotox/)
U.S. Army Corps of Engineers: Environmental Residue Effects Database (ERED) (https://ered.el.erdc.dren.mil/)
DOE Oak Ridge National Labs: Ecological Risk Analysis: Guidance, Tools, and Applications (http://www.esd.ornl.gov/programs/ecorisk/ecorisk.html)
U.S. EPA: Wildlife Exposure Factors Handbook (https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=2799)
U.S. EPA: EcoSSL Guidance (https://www.epa.gov/chemical-research/interim-ecological-soilscreening-level-documents)
OECD: EchemPortal (http://www.echemportal.org/echemportal/index?pageID=0&request_locale=en)
USEPA: National Recommended Water Quality Criteria, (https://www.epa.gov/wqc/nationalrecommended-water-quality-criteria)
NOAA. Screening Quick Reference Tables (SQuiRTs) (http://response.restoration.noaa.gov/environmental-restoration/environmental-assessmenttools/squirt-cards.html)
Assignment #6: Students will respond to the graded Threaded Discussion topic “Hazard Data Hunt” where they must find and briefly defend a toxicity value.

Lesson 7: Cell and Molecular Ecotoxicology: Part 1
In this module, we will review cellular level responses to chemical exposures, mechanisms of tolerance, Phase I and II metabolism and their role in both mitigating and causing effects, and carcinogenicity.
By the end of the module, you will be able to:

- Explain and diagram Phase I and II metabolism
- Identify key mechanisms of detoxification for metals and organic compounds at the cellular level
- Explain why effects on DNA cause cancer

Students will view audio/visual presentation materials created by the instructor that will

- Review mechanisms of tolerance.
- Review Phase I & II metabolism and its implications.
- Explain the relationship between DNA effects and cancer

Students will read the following:
Course Textbook:
Chapter 7. Walker, Sibly, Hopkin & Peakall. Principles of Ecotoxicology, 4th Edition. Reserved Readings:
Chapter 6. Newman. 2014. Fundamentals of Toxicology. 4thEdition.
Assignment #7: Students will complete a graded exercise including short answer questions.

Lesson 8: Cell and Molecular Ecotoxicology: Part 2
In this module, we will review key concepts of cell and molecular level toxic effects, including review of cell components, discussion of effects on cell membranes and concentration gradients, effects on DNA, and effects on enzymes. We will review key examples of nervous system function.
By the end of the module, you will be able to:

- Explain the basis of normal cell function
- Describe the basic mechanisms of cellular toxicity associated with membrane disruption, enzyme disruption, effects on osmotic balance, DNA damage, and inter-cell communication
- Diagram key examples of toxicant effects on nerve cell function
- Diagram key examples of effects on enzyme function

Students will view audio/visual presentation materials created by the instructor that will

- Review cell components and function
- Review cellular mechanisms of toxicity
- Review case studies and diagrams

Students will read the following:
Course Textbook:
Chapter 7. Walker, Sibly, Hopkin & Peakall. Principles of Ecotoxicology, 4th Edition. Reserved Readings:
Chapter 6. Newman. 2014. Fundamentals of Toxicology. 4thEdition.
Assignment #8: Students will complete a graded exercise including short answer questions.

Lesson 9: Organ and System Level Ecotoxicology
In this module, we will review the basic organ systems for birds, mammals, fish, and plants. We will discuss effects on plants. We will examine examples of toxic effects for different organ

systems, including effects on nerves, bones, endocrine/reproduction, muscles, and effects on systems specific to fish and invertebrates. We will also review radiological effects.
By the end of the module, you will be able to:

- Identify types of effects associated with disruption by specific toxicants on the nervous, muscular, endocrine, and skeletal systems
- Define agonism and antagonism
- Describe endocrine related effects on development, immune system, and reproduction and how they may be triggered
- Describe effects on physiological function
- Describe radiation as an ecological stressor

Students will view audio/visual presentation materials created by the instructor that will

- Review toxic effects by system and for overall physiological function
- Present major case studies for each system
- Present case studies on endocrine disruption and discuss immune effects Review the physiological effects of radiation.

Students will read the following:
Reserved Readings:
Chapter 5. Newman. 2008. Ecotoxicology: A Comprehensive Treatment.
Assignment #9: Students will complete a graded exercise including short answer questions.

Lesson 10: Field and Lab Methods for Evaluating Exposure, Bioaccumulation, Whole Organism and Sub-Organismal effects
In this module, we will review the methods for collecting data to characterize chemical concentrations in the environment, to measure exposure and uptake, and to estimate bioaccumulation. We will also review methods for assessing organismal and toxicological effects.
By the end of the module, you will be able to:

- Identify an array of standard methods for investigating environmental concentrations of chemicals
- Identify several standard methods for assessing the bioaccumulative potential, bioavailability, and toxicity
- Apply these methods to an example problem with an understanding of their advantages and disadvantages

Students will view audio/visual presentation materials created by the instructor that will

- Review standard methods of investigating chemicals in the field
- Review standard methods of investigating chemical toxicity and bioaccumulation at the cellular, physiological, and organismal level
- Discuss advantages and disadvantages of different methods

Students will read the following:
Course Textbook:
Chapters 8, 9 & 10. Walker, Sibly, Hopkin & Peakall. Principles of Ecotoxicology, 4th Edition.
Assignment #10: Students will participate in a graded Threaded Discussion “Chemical vs Ingredient” where they must choose one of three approaches for assessing a chemical’s toxicity and defend their answer

Lesson 11: Population Level Effects of Toxicants
In this module we will review key concepts in population biology. We will review how individual effects translate to changes in population phenotype and demographics. We will discuss

evolution of resistance and resilience and learn to calculate simple impacts on growth and phenotypic equilibrium.
By the end of the module, you will be able to:

- Explain how impacts at the organismal level influence population and phenotypic change
- Re-state specific examples of toxicant impacts on populations
- Explain basic concepts behind population-level changes in abundance, spatial dynamics and evolution of tolerance
- Describe how populations adapt via evolved resistance and resilience
- Solve simple equations predicting impacts on population growth and phenotypic equilibrium based on changes in mortality

Students will view audio/visual presentation materials created by the instructor that will

- Review population biology concepts
- Review population-level changes in phenotype and demographics, including evolution of tolerance/resistance/resilience
- Present case studies of population-level effects
- Provide example calculations of changes in population growth and phenotypic equilibrium

Students will read the following: Course
Textbook:
Chapters 12 & 13. Walker, Sibly, Hopkin & Peakall. Principles of Ecotoxicology, 4th Edition.
Assignment #11: Students will complete a graded exercise including both short answer questions and sample problems.

Lesson 12: Community & Ecosystem Level Effects of Toxicants
In this module, we will review key community ecology concepts and discuss toxicant impacts on community level dynamics such as predation, competition, diversity, abundance, and presence of invasive species. We will discuss ecosystem level effects on net productivity.
By the end of the module, you will be able to:

- Describe how exposure to toxicants may change competition and predation dynamics
- Explain how toxicants may change diversity, abundance, and presence of invasive species
- Explain how impacts at the community level can translate to the ecosystem level
- Re-state specific examples of toxicant impacts on communities
- Describe ecosystem level impacts on net productivity, decreased diversity, and changes in spatial patterns

Students will view audio/visual presentation materials created by the instructor that will

- Review community biology concepts
- Review how toxic effects on organisms and populations may change competition and predation dynamics, diversity, abundance, and species composition
- Present case studies of community-level effects
- Review ecosystem level effects on productivity and function

Students will read the following:
Reserved Readings:
Chapters 25 and 31. Newman. 2008. Ecotoxicology: A Comprehensive Treatment.
Assignment #12: Students will complete a graded exercise including short answer questions.

Lesson 13: Field Methods for Population, Community, and Ecosystem-Level Impacts
In this module, we will review the methods for collecting data to characterize impacts of toxicants on populations, communities, and ecosystems. We will also perform an exercise in selecting appropriate methods.
By the end of the module, you will be able to:

- Identify an array of standard methods for investigating environmental population, community, and ecosystem level impacts
- Apply these methods to an example problem with an understanding of their advantages and disadvantages

Students will view audio/visual presentation materials created by the instructor that will

- Review standard methods of investigating population, community, and ecosystem level impacts
- Discuss advantages and disadvantages of different methods

Students will read the following: Course
Textbook:
Chapters 11 & 15. Walker, Sibly, Hopkin & Peakall. Principles of Ecotoxicology, 4th Edition.

Additional Readings:
Atkinson, S.F., D.R. Johnson, B.J. Venables, J.L. Slye, J.R. Kennedy, S.D. Dyer, B.B. Price, M. Ciarlo, K. Stanton, H. Sanderson, A. Nielsen. 2009. Use of watershed factors to predict consumer surfactant risk, water quality, and habitat quality in the upper Trinity River, Texas. Science of the Total Environment 407 (2009) 4028–4037.
Assignment #13: Students will participate in a graded Threaded Discussion "Design a Study of Chemical Spill Site Z" where they must adopt specific roles and reach consensus on a study design.

Lesson 14: Ecological Risk Assessment
In this module we will review the process for performing ecological risk assessment, including discussion of the hazard assessment/exposure assessment/risk characterization paradigm; the difference between screening level and baseline risk assessment, and the use of weight of evidence.
By the end of the module, you will be able to:

- Define ecological risk assessment and the different types of risk assessment
- Explain the risk assessment paradigm of hazard assessment, exposure assessment, and risk characterization
- Describe a weight of evidence approach
- Identify the steps of a risk assessment, including dose modeling and comparison to benchmarks
- Calculate screening-level estimates of risk

Students will view audio/visual presentation materials created by the instructor that will:

- Define ecological risk assessment and the different types of risk assessment
- Define hazard assessment, exposure assessment, and risk characterization
- Provide examples of a weight of evidence approach
- Provide case studies of ecological risk assessment
- Review methods for and demonstrate calculation of screening-level estimates of risk

Students will read the following:
Additional Readings:

Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments
Assignment #14: Students will complete a graded exercise including sample problems.

Lesson 15: Applied Ecotoxicology: Regulatory Frameworks & Emerging Issues
In this module we will review the role of ecotoxicology as a part of major guidance frameworks, including CERCLA and RCRA; dredged material management guidance; NEPA; FIFRA; FDA; CWA, CAA, and REACH. We will also discuss emerging topics in ecotoxicology.
By the end of the module, you will be able to:

- Identify the major U.S. regulatory frameworks that rely on ecotoxicology
- Explain the overall process for incorporating ecotoxicology specific to each guidance
- Evaluate the advantages and disadvantages associated with different ecotoxicological approaches
- Identify emerging topics in ecotoxicology

Students will view audio/visual presentation materials created by the instructor that will:

- Identify the major U.S. regulatory frameworks that rely on ecotoxicology
- Explain the overall process for incorporating ecotoxicology specific to each guidance
- Review some of the advantages and disadvantages associated with different ecotoxicological approaches
- Review 3 emerging topics in ecotoxicology

Students will read the following: Reserved
Readings:
Newman, M.C. 2014. Appendix 3 in Fundamentals of Toxicology. 4th Edition. Boca Raton, FL: CRC Press. Pp. 433-446.
ECHA. 2009. Guidance in a Nutshell: Chemical Safety Assessment. URL: https://echa.europa.eu/documents/10162/13632/nutshell_guidance_csa_en.pdf

Assignment #15:

- Students will participate in a graded Threaded Discussion “Framework Hot Seat” where they must select a specific regulatory framework and defend its approach.

Assignment #16:

- Students will submit their exams by 11:59PM 17 December 2016.

Assignment #17:

- Students will submit the final term paper prior to the end of the last lesson (Lesson 15)

Section 4

Assessments and Grading Policy

Assignments for

Assignments	Due Dates	Points Possible
Assignment 1: Threaded Discussion - Students will respond to the graded Threaded Discussion topic “Pick your toxicant.”	4 Sep 2016	3
Assignment 2: Short Answer/Sample Problems - Students will complete a graded exercise including both short answer questions and sample problems.	11 Sep 2016	3
Assignment 3: Short Answer/Sample Problems - Students will complete a graded exercise including both short answer questions and sample problems.	18 Sep 2016	3
Assignment (Ungraded): Submit term paper topics.	18 Sep 2016	NA
Assignment 4: Short Answer/Sample Problems - Students will complete a graded exercise including both short answer questions and sample problems.	25 Sep 2016	3
Assignment 5: Short Answer/Sample Problems - Students will complete a graded exercise including both short answer questions and sample problems.	2 Oct 2016	3
Assignment 6: Threaded Discussion - Students will respond to the graded Threaded Discussion topic “Hazard Data Hunt” where they must find and briefly defend a toxicity value.	9 Oct 2016	3
Assignment 7: Short Answer/Sample Problems - Students will complete a graded exercise including short answer questions.	16 Oct 2016	3
Assignment 8: Short Answer/Sample Problems - Students will complete a graded exercise including short answer questions.	23 Oct 16	3

Assignment 9: Short Answer/Sample Problems - Students will complete a graded exercise including short answer questions.	30 Oct 2016	3
Assignment 10: Threaded Discussion - Students will participate in a graded Threaded Discussion “Design a Study of Chemical X” where they must choose one of three approaches for assessing a chemical’s toxicity and defend their answer	6 Nov 2016	3
Assignment 11: - Students will complete a graded exercise including both short answer questions and sample problems.	13 Nov 2016	3
Assignment 12: Short Answer/Sample Problems - Students will complete a graded exercise including short answer questions.	20 Nov 2016	3
Assignment 13: Threaded Discussion - Students will participate in a graded Threaded Discussion “Design a Study of Chemical Spill Site Z” where they must adopt specific roles and reach consensus on a study design.	27 Nov 2016	3
Assignment 14: Short Answer/Sample Problems - Students will complete a graded exercise including sample problems.	4 Dec 2016	3
Assignment 15: Threaded Discussion - Students will participate in a graded Threaded Discussion “Framework Hot Seat” where they must select a specific regulatory framework and defend its approach.	11 Dec 2016	3
Final Exam: Students will complete a graded open book exam which includes short answer, sample problem, and diagraming questions.	17 Dec 2016	30
Term Paper: Students will complete a graded 12-20 page term paper on a relevant topic. Topics will be subject to approval by the instructor.	11 Dec 2016	25
Total		**100**

Grading & Assignment Guidelines

The weekly directions will indicate where assignments will be posted (e.g. to an assignment submission link within the Lessons area). If submitting documents for an assignment or discussion forum, please specify the assignment name in the document title and/or the discussion thread. When creating files, include your name and the name of the assignment in the file title. Also, please be sure to only include one period in file names. The period should be between the file name and the extension. For example: mmentzer_assignment1.doc

Short Answer and Sample Problems: Each set of short answer questions and/or sample problems will be graded based on accuracy and completeness of answers with a point value assigned to each question. These may require calculations, diagrams or drawings.

Threaded discussion grading policies: Threaded discussions will be initiated by the instructor with a question, example problem, or request for response on a lesson-related issue. Each student is required to provide at least 3 posts to the thread for full credit: 1 original post and 2 posts in response to other students. Posts should address the topic at hand and provide constructive technical support for viewpoints. Debate is highly encouraged; however, all posts should be professional, respectful, and courteous in nature. Original post is worth 70% of the assignment value and 2 responses are worth 30% of the assignment value (15% each).

Term Paper: A term paper will be required, with topic to be provided before the first lesson. Your topic must be coordinated with the instructor to ensure it is appropriate and feasible; a discussion thread will be made available for this purpose. Your information must be obtained from at least five sources - more if appropriate. Use refereed journal articles, technical level books, or information provided for the class. Encyclopedias and Wikipedia are not permitted as resources. The paper must be no fewer than 12 and no more than 20 pages in length, 2.0 spaced with 1-inch margins, 10 – 12 point font. Content is more important than length. Figures, diagrams, and tables are additional and should be used as appropriate. Please submit your paper as an **MS WORD or PDF** document**.**

Term Paper Format:

Title page
Table of Contents
Introduction
Body of the paper organized by headings
Conclusions

References (no fewer than 10, from no fewer than 5 separate sources)

Be sure to footnote properly. Parenthetical footnotes are preferred. If footnotes are used, they should be arranged numerically at the end of the paper, not at the bottom of the page. If you use diagrams, figures, and/or tables verbatim from a source, you must footnote the figure or table itself. Include a reference section at the end of the paper using proper format:
Example journal/book format:

- Smith, R.L., 1996. Rates of Uptake of Methyl Mercury by *Vallisenaria americana* in Miles River and Chester River. Estuaries 44, pp. 139-146.

Example online source format:

- Hazardous Substances Data Bank. 2012. HSDB: Cadmium Compounds. Last updated on 10 April 2010. Accessed 4 June 2015. Available from: http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB. Bethesda (MD): National Library of Medicine (US).

Paper will be graded on the following basis:

 Content: 85%

- Accurate and appropriate references: 10%
  Format/grammar/typos: 5%

Points from each assignment will be summed for a total potential score of 100%. The following letter grades will be assigned based on the numeric score:

Letter Grade	Percentage
A+	98% to 100%
A	94% and less than 98%
A-	90% and less than 94%
B+	88% and less than 90%
B	84% and less than 88%
B-	80% and less than 84%
C	70% and less than 80%
F	0% and less than 70%

Assignment Guidelines

How should assignments be submitted?

All assignments will be submitted through the Blackboard Learning Management System.

When will assignments be due?

Assignment and activity due dates are listed in this syllabus and the weekly checklists. In general, the assignment for a lesson is due the end of the day before the next lesson begins (Sunday at midnight EST). The instructor will announce changes via an announcement in your online classroom. The term paper will be a semester-long endeavor due two weeks before semester end. The exam will take 2 weeks and be due on the date of the last class.

When will completed assignments be returned?

The instructor will aim to return assignments to you within 5-7 days following the due date, depending on the length of the assignment. You will receive feedback under the My Grades link in the left-hand menu of your course.

What is the policy for late assignments?

You are expected to contact your instructor in advance if you think you cannot meet an assignment deadline. However, if an assignment is late and prior arrangements have not been made with the instructor, the assignment score will be decreased by 1.5% for each day late. Thus a perfectly completed problem set worth 3 points would be worth 2.69 after 7 days.

What happens if I cannot participate in a synchronous session?

No synchronous sessions are planned.

Time Management Expectations

What is the time demand and schedule of the course?

Because this is a graduate-level course that is offered in a condensed format, the rigor and time commitment is higher than a traditional 15-week semester course. It is expected that you look ahead to schedule your time. Plan to complete coursework across several days of the week rather than all in one day. Be sure to consider how group activities impact your schedule as well.

Some assignments require that you work on them for multiple weeks. Be sure to review the assignment directions at the beginning of the course so that you can plan your time accordingly. Please seek help before becoming frustrated and spending a significant amount of time to resolve an issue. Of special note are the term paper and exam, which require prior preparation.

Section 5

Course Participation & Communication Policy

Participation

What are the participation requirements?

You are expected to log into Blackboard **at least three** times a week, though a daily check-in is recommended. It is your responsibility to read all announcements and discussion postings within your assigned forums. You should revisit the discussion multiple times over the week to contribute to the dialogue.

As discussed above, 3 substantive posts are required for each Threaded Discussion assignment in the designated discussion board before the due date.

Network Etiquette (i.e. “Netiquette”)

In this course, online discussion will be primarily take place in our online discussion board. In all textual online communication it’s important to follow proper rules of netiquette.

What is netiquette? Simply stated, it's network etiquette -- that is, the etiquette of cyberspace. And "etiquette" means the social and cultural norms of communicating with others in a proper and respectful way. In other words, netiquette is a set of rules for behaving and interacting properly online.

The Netiquette “Core Rules” linked below are a set of general guidelines for cyberspace behavior. They probably won't cover all situations, but they should give you some basic principles to use in communicating online.

For Netiquette Core Rules visit The Core Rules of Netiquette web page.

Contacting the Instructor

The instructor for this course is *Michael Ciarlo (mciarlo1@jhu.edu / mciarlo@eaest.com).* Feel free to contact your instructor with comments, questions, and concerns. You will receive a response within 24-48 hours. For brief course content related questions and comments, it is recommended that you use the designated discussion boards. For administrative questions, discussion of course format or assignment delivery, it is recommended that you contact the instructor by email.

Section 6

Course Protocols

Course Protocols

How will I know about changes to the course?

Frequently, you will find new announcements posted in the Announcements, which contain information about current course activities that you are working on and any changes to the course. Please check announcements every time that you log into your online course.

How should I communicate with others in this course?

You should communicate often with your classmates and with your instructor. The majority of communication will take place within the Discussion forums. When you have a question about an assignment or a question about the course, please contact your instructor, or post your question in the course's "Syllabus & Assignment Question" forum.

Are there any requirements for sending e-mail messages?

When you send an e-mail message to the instructor or to another participant in the course, please observe the following guidelines:

- Include the title of the course in the subject field (e.g., JHU Ecotoxicology).
- Keep messages concise, and check spelling and grammar.
- Send longer messages as attachments.
- Sign your full name (the sender's email is not always obvious).

Section 8

University Policies

General

This course adheres to all University policies described in the academic catalog. Please pay close attention to the following policies:

Students with Disabilities

Johns Hopkins University is committed to providing reasonable and appropriate accommodations to students with disabilities. Students with documented disabilities should contact the coordinator listed on the Disability Accommodations page. Further information and a link to the Student Request for Accommodation form can also be found on the Disability Accommodations page.

Ethics & Plagiarism

JHU Ethics Statement: The strength of the university depends on academic and personal integrity. In this course, you must be honest and truthful. Ethical violations include cheating on exams, plagiarism, reuse of assignments, improper use of the Internet and electronic devices, unauthorized collaboration, alteration of graded assignments, forgery and falsification, lying, facilitating academic dishonesty, and unfair competition. Report any violations you witness to the instructor.
Read and adhere to JHU's Notice on Plagiarism.

Dropping the Course

You are responsible for understanding the university's policies and procedures regarding withdrawing from courses found in the current catalog. You should be aware of the current deadlines according to the Academic Calendar.

Getting Help

You have a variety of methods to get help. Please consult the help listed in the "Blackboard Help" link in the online classroom for important information. **If you encounter technical difficulty in completing or submitting any online assessment, please immediately contact the designated help desk listed on the AAP online support page**. Also, contact your instructor at the email address listed atop this syllabus.