THE OHIO STATE UNIVERSITY
COLLEGE OF PUBLIC HEALTH

PUBHEHS 7365 – Environmental and Human Health Risk Assessment (3 credit hours)
Spring, 2020

Instructor:
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TA
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Course Time and Location: Mondays, 2:15PM-5:00PM at 028 University Hall (except on February 3 when class will be in 160 Cunz Hall at 2:15-2:45 pm and 230 Cunz Hall at 2:45-5:00 pm)
Instructor's Office Hours: By appointment
TA Office Hours: Tuesday and Thursday, 3:00PM-4:00PM

TA responsibilities: The TA assigned to the course will hold regular office hours and assist students who need help with class material. The TA may assist with scoring homework, presentations, quizzes and exams; however, final grades will be assigned by the professor. Any questions regarding grading should be directed to the professor and not the TA.

Course description and content: Risk assessment is a framework for evaluating scientific information for the assessment of the nature and probability of adverse effects of exposures to toxic agents in human and ecological receptors. Risk assessment is used to inform policy decisions and is the scientific basis for the majority of environmental regulations in the United States. The *Environmental and Human Health Risk Assessment* course is designed to provide students with a working knowledge of the risk assessment process and an appreciation of the underlying science. Students will learn about the development of the formal risk assessment process, its role in environmental and public health regulation in the United States, and the four fundamental steps in a risk assessment (hazard identification, toxicity assessment, exposure assessment, and risk characterization) during the first half of the course. Students will learn about the interface between the risk assessment and risk management process. They will be introduced to special risk assessment topics including ecological risk assessment, quantitative microbial risk assessment, cumulative risk assessment and risk assessment for chemical mixtures during the second half of the course. Students will be introduced to various risk assessment related federal resources, and will be offered the opportunity to work through the risk assessment process using these resources and available data in class using a case study that is focused on a current topic and on group course projects.

The content of the course necessarily reinforces the Environmental Health Science (EHS) model (Figure 1). The characterization of exposure to toxic agents is a necessary step for quantifying the risk of resulting adverse effects in human receptors. Risk assessment requires a comprehensive knowledge of the release of toxic agents, their distribution and fate within the environment, and their interactions with biological targets. As a formal framework that was developed to assess risks to human health, risk assessment is a useful tool for informing decisions related to controls to reduce environmental exposures. Consequently, the conduct of risk assessment requires knowledge of the exposure continuum from source to disease, and it is an integral part of the societal response to address exposures to environmental contaminants.

Course Format: Sessions will consist of classroom and web-based materials, discussions, in-class case studies/practice exercises, assignments, and group course projects. The course content will introduce, reinforce and complement the required reading relating to the topic. Group course projects will be used to reinforce the principles of risk assessment that are taught in class.

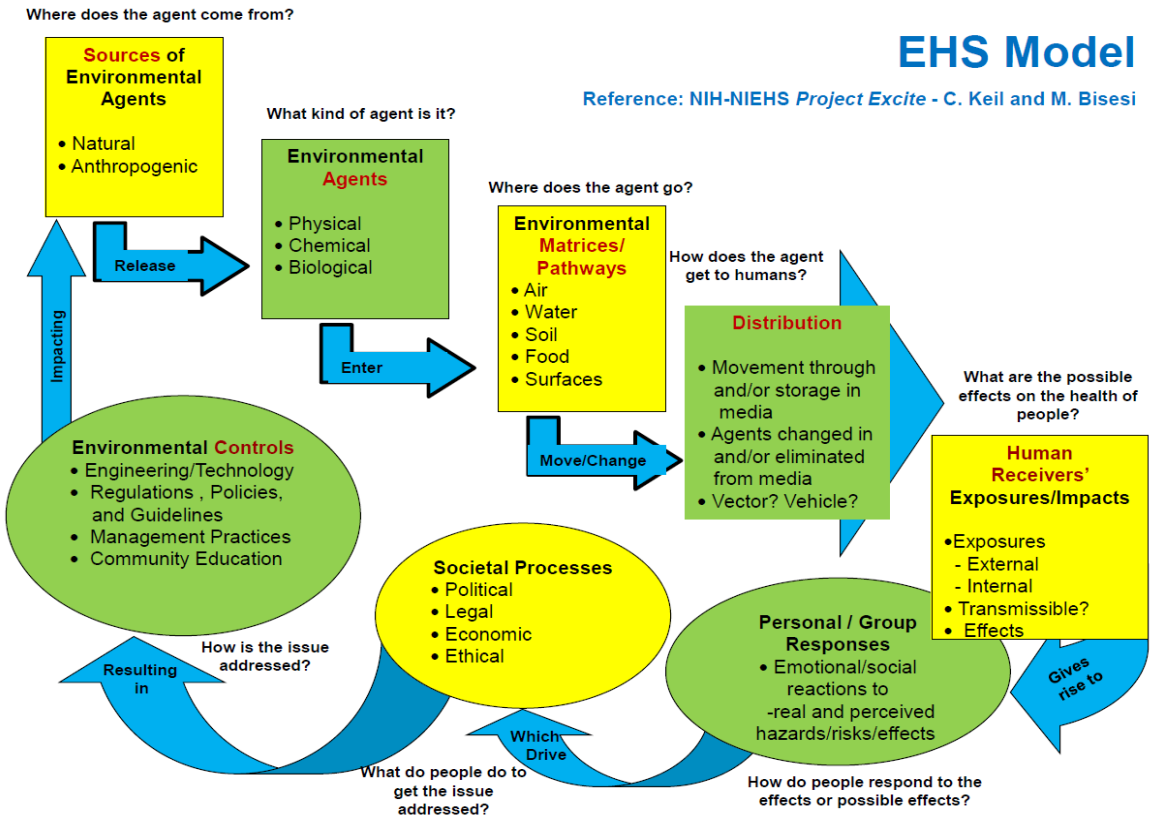

Figure 1. EHS model: components of the EHS model either inform or are informed by the risk assessment process

Course Objectives: Upon completion of the course, students will be able to:

1. Describe the role of risk assessment at the interface of science and public health policy, and the historical development of the formal risk assessment process as the basis for environmental and public health regulation.
2. Describe the fundamental steps of the human health and ecological risk assessment processes.
3. Use available resources and guidance documents for conducting human health risk assessment and ecological risk assessment.
4. Apply knowledge from different disciplines such as Toxicology, Epidemiology, Exposure Science and Statistics inform the development and conduct of risk assessment.
5. Conduct a simple screening level risk assessment and calculations necessary for risk characterization.
6. Critically review a human health risk assessment.
7. Describe and apply current and likely future developments in human health risk assessment.

Applicable Foundational Public Health Knowledge Objectives for All Graduate Degrees

1. Explain Public health history, philosophy and values
3. Explain the role of quantitative and qualitative methods and sciences in describing and assessing a population's health
6. Explain the critical importance of evidence in advancing public health knowledge
7. Explain the effects of environmental factors on a population's health
8. Explain biological and genetic factors that affect a population's health

Applicable MPH Degree Foundational Public Health Competencies

2. Select the quantitative and qualitative data collection methods appropriate for a given public health context

3. Analyze quantitative and qualitative data using biostatistics, informatics, computer-based programming and software, as appropriate
4. Interpret results of data analysis for public health research, policy or practice
12. Discuss multiple dimensions of the policy-making process, including the roles of ethics and evidence
19. Communicate audience-appropriate public health content, both in writing and through oral presentation

Applicable MPH EHS Specialization Competencies

Upon completion of the course, MPH degree students with specialization in environmental health sciences should also be able to:

1. Explain the significance of the community and workplace environment to public health.
2. Outline the health threat that natural and anthropogenic contaminants in the environment can pose to population health.
3. Explain the physiological factors that influence human exposure and the uptake of chemical and biological environmental agents.
4. Identify and explain individual and community susceptibility factors that heighten the risk for populations for adverse health outcomes from environmental hazards.
5. Apply various risk assessment, risk management and risk communication approaches for environmental hazards.
7. Describe federal and state regulatory programs, guidelines and authorities relevant to environmental and occupational health.
8. Access state, federal, and local resources for assessing the environmental and occupational health.
9. Compare the principle components and influencing factors in the exposure continuum from source to disease.
10. Determine the role of exposure assessment in environmental and occupational health.

Applicable MS Competencies

Upon completion of the course, MS students should also be able to:

4. Conduct a research project using appropriate research methods and ethical approaches.
6. Communicate in writing and orally a research project's methods, results, limitations, conclusions and public health relevance.
7. Explain individual and community susceptibility and vulnerability factors that heighten the risk for populations for adverse health outcomes from environmental hazards.
8. Apply the environmental health paradigm (i.e. EHS model) to characterizing hazardous physical, chemical and biological agents relative to sources, categories, exposure matrices/pathways, distribution, human exposures, responses, societal/regulatory actions, and technological controls.
9. Work with various stakeholders and other professions to proactively and reactively address environmental and occupational regulatory policy and human health issues and concerns.

Applicable PhD Competencies

Upon completion of the course, MS students should also be able to:

4. Formulate hypotheses, plan and conduct a research study using appropriate research methods and ethical approaches.
6. Communicate in writing and orally a research project's purpose, methods, results, limitations, conclusions and public health relevance to both informed and lay audiences.
7. Explain individual and community susceptibility and vulnerability factors that heighten the risk for populations for adverse health outcomes from environmental hazards.
8. Apply the environmental health paradigm (i.e. EHS model) to characterizing hazardous physical, chemical and biological agents relative to sources, categories, exposure matrices/pathways, distribution, human exposures, responses, societal/regulatory actions, and technological controls.
9. Work with various stakeholders and other professions to proactively and reactively address environmental and occupational regulatory policy and human health issues and concerns.

Text/Readings: There is no textbook for this course. Readings are listed in the course outline below and will be posted on Carmen (www.carmen.osu.edu).

Grading: Grades will be assigned for in-class mini-quizzes, course project and exams as follows:

Activity	Undergraduate Points Total (100%)
Assignments	15
Mini-Quizzes	10
Mid-Term Exam	15
Project Report	20
Project Presentation	5
Final Exam	25
Class Participation (In-Class Discussion of Case Study Materials)	5
In-Class Practice Questions	5

Final grades will be assigned according to the **OSU Standard Grade Scheme.**

Class attendance and participation will be monitored and contribute towards final grades as noted above. Full attendance (except for reasons noted in the attendance policy below) and meaningful participation will guarantee a full score for this assessment activity. Mid-semester and final exams will be graded according to the points allocated to each questions in the exams. Students will be awarded the points for each question if it is answered correctly. The features of the group project presentation and report that are listed and described in the exams section below will be graded against the following 10-point scale:

Score	Criteria
10	Exceptional work. . . thorough, complete, and correct; beyond expectation. This is a rare and exceptional grade.
9	Outstanding work. . . thorough, complete, and correct; virtually no error. This is a rare and exceptional grade.
8	Excellent . . . thorough, complete and correct with only very few minor errors or omissions
7	Very good . . . adequately covers the major facets of the topic with respect to the major course content or assignment guidelines; has numerous minor errors or weaknesses.
6	Good. . . adequately covers most of the major facets of the topic with respect to the major course content or assignment guidelines but lacks rigor and completeness with respect to details; has some moderate errors or weaknesses.
5	Satisfactory . . . covers correctly and completely some of the with respect to the major course content or assignment guidelines but with some major omissions. Report is incomplete and carelessly prepared; has a few major errors or weaknesses
<5	Poor. . . incomplete and incorrect; replete with major errors or weaknesses.

Exams:

The **mid-term and final exams** will be proctored, closed book and will be given in class at the times shown on the class schedule. Questions will include multiple choice and short essays/problems. Students are encouraged to be present and take their exams on the date and time that it is given. Make-up exams will only be given if the instructor is informed about an inability to take exams on the schedule dates at least 48 hours before the exam. Otherwise, allowance will only be given in case of personal emergencies or *extenuating* circumstance (e.g. unforeseen medical issues, death in

the family, etc.) that will preclude the student from informing the professor about the inability to take the exam on the scheduled date.

Two mini-quizzes will be given during the course as outlined in the course schedule. Each mini-quiz will include **ten** multiple choice or short answer questions. Make-up quizzes will only be given based on the criteria set for the mid-term and final exams.

Students will work in groups of two to three to conduct a risk assessment that will be **submitted as a complete report to the instructor/TA and presented to the class** at the end of the course at the due time specified in the course schedule. Drafts of different sections of the report will also be **due for submission to the instructor/TA** for review during the semester on the dates specified in the class schedule accompanying the syllabus. Students will have the choice of conducting the risk assessment with scenarios and data provided by the instructor or data chosen by the student with the approval of the instructor. The following criteria will be used to evaluate the project (report and presentation):

- General content: framing of the problem, relevance of information and its sources to the topic and environmental health – weighting for scoring is 3
- Clarity and organization – weighting for scoring is 2
- Proper application of risk assessment principles and resources – weighting for scoring is 3
- Identification and description of issues (discussion of findings within the context of the scenario associated with the data, and also the limitations of the assessment that is conducted) – weighting for scoring is 2

Please note that take-home exams will not be given in this course.

Assignments

In addition to the course project, students will be assigned **two** group or independent home-works that are designed to emphasize some of the concepts that will be learned during the duration of the course. These will be designed to contribute towards the completion of the group project work.

In-Class Activities

Some readings as noted in the syllabus will form the basis of in-class discussions or exercises, and active participation of students in the associated in-class activities will form part of the final grade as a component of points awarded for class participation. In-class practice questions will be assigned as specified in the class schedule accompanying the syllabus.

Carmen

The syllabus, class schedule, class readings (or links to class materials) and lecture slides will be posted on the Carmen/Canvas site for the course.

Attendance Policy

To achieve the objectives of this course and to become a public health professional, attendance is expected in all scheduled classes. If a student has an *extenuating* circumstance (e.g. unforeseen medical issues, death in the family, etc.) that prevents them from attending class, they should notify the instructor *before* class.

Additional Course Policies

Please note that students are discouraged from using mobile devices while in class, and that the use of computers is only allowed if such use is related to class activities.

Office of Student Life: Disability Services

Any student who feels s/he may need an accommodation based on the impact of a disability should contact me privately to discuss your specific needs. Please contact the Office of Student Life: Disability Services at 614-292-3307 in

Room 098 Baker Hall to coordinate reasonable accommodations for students with documented disabilities (http://www.ods.ohio-state.edu/).

Student Support

A recent American College Health Survey found stress, sleep problems, anxiety, depression, interpersonal concerns, death of a significant other and alcohol use among the top ten health impediments to academic performance. Students experiencing personal problems or situational crises during the semester are encouraged to contact OSU Counseling and Consultation Services (292-5766; http://www.ccs.ohio-state.edu) for assistance, support and advocacy. This service is free to students and is confidential.

Mental Health Services

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. The Ohio State University offers services to assist you with addressing these and other concerns you may be experiencing. If you or someone you know are suffering from any of the aforementioned conditions, you can learn more about the broad range of confidential mental health services available on campus via the Office of Student Life's Counseling and Consultation Service (CCS) by visiting ccs.osu.edu or calling 614-292-5766. CCS is located on the 4th Floor of the Younkin Success Center and 10th Floor of Lincoln Tower. You can reach an on call counselor when CCS is closed at 614-292-5766 and 24 hour emergency help is also available through the 24/7 National Suicide Prevention Hotline at 1-800-273-TALK or at suicidepreventionlifeline.org.

Academic integrity

Academic integrity is essential to maintaining an environment that fosters excellence in teaching, research, and other educational and scholarly activities. Thus, The Ohio State University, the College of Public Health, and the Committee on Academic Misconduct (COAM) expect that all students have read and understood the University's *Code of Student Conduct* and the School's *Student Handbook*, and that all students will complete all academic and scholarly assignments with fairness and honesty. The *Code of Student Conduct* and other information on academic integrity and academic misconduct can be found at the COAM web pages (https://oaa.osu.edu/academic-integrity-and-misconduct). Students must recognize that failure to follow the rules and guidelines established in the University's *Code of Student Conduct*, the *Student Handbook*, and in the syllabi for their courses may constitute "Academic Misconduct."

The Ohio State University's *Code of Student Conduct* (Section 3335-23-04) defines academic misconduct as: *"Any activity that tends to compromise the academic integrity of the University, or subvert the educational process." Examples of academic misconduct include (but are not limited to) plagiarism, collusion (unauthorized collaboration), copying the work of another student, and possession of unauthorized materials during an examination. Please note that the use of material from the Internet without appropriate acknowledgement and complete citation is plagiarism just as it would be if the source were printed material. Further examples are found in the Student Handbook. Ignorance of the Code of Student Conduct and the Student Handbook is never considered an "excuse" for academic misconduct.*

If I suspect a student of academic misconduct in a course, I am obligated by University Rules to report these suspicions to the University's Committee on Academic Misconduct. If COAM determines that the student has violated the University's *Code of Student Conduct* (i.e., committed academic misconduct), the sanctions for the misconduct could include a failing grade in the course and suspension or dismissal from the University. If you have any questions about the above policy or what constitutes academic misconduct in this course, please contact me.

Course Schedule

Please note that highlighted assignments (bold) are mandatory readings or websites to explore. Those in red font will form basis of class discussions or exercises.

Week No.	Session Dates (Lecturer) Location	Topics	Aligned Course Learning Objective(s)	Aligned Foundational Public Health Knowledge	Aligned Foundational and Specialization Competencies	Readings/ Other Assignments	Student Evaluation Activity for Assessment
1	Jan 6 (Dr. Adetona) 028 University Hall	Introduction – Understanding Risk	1, 4	1, 3, 6, 7	Foundational Graduate Degrees – 4 MPH EHS – 1, 2		Exam In-Class Participation: general discussion of the concept of risk
		Precautionary Principles	1	1, 6	Foundational Graduate Degrees – 12 MPH EHS – 1, 2	• The Problems with Precaution: A Principle without Principle. May 25, 2011. (aei.org/articles/the-problems-with-precaution-a-principle-without-principle/) • Video (https://www.youtube.com/watch?v=3RC7EGDtOYM) • **Paper: Diffey B. New Sunscreens and the Precautionary Principle. 2016. Journal of the American Medical Association 152(5):511-512**	Case Study/In-class Participation: in-class discussion of the application of precautionary principle to the problem that is the topic of the third (very short) reading assignments
		Components of a Human Health Risk Assessment	1, 2, 4	1, 3, 6	Foundational Graduate Degrees – 2, 12 MPH EHS – 1, 2	• **Visit this website: (www.epa.gov/risk) and read through contents under the "Human Health Risk Assessments" link**	Exam, group project report, group project presentations
		Project and Project Group Assigned					
2	Jan 13 (Dr. Adetona) 028 University Hall	Epidemiology in Human Health Risk Assessment	4, 6, 7	3, 6, 7	Foundational Graduate Degrees – 2, 12 MPH EHS – 4, 9, 10 MS EHS – 4, 7, 9 PhD EHS – 4, 7, 9	• **Paper: The Use of Epidemiology in Risk Assessment: Challenges and Opportunities. Christensen K et al., 2015; Human and Ecological Risk Assessment 21:1644-1663** • **Paper: Serum Perfluorooctanoate (PFOA) and Perfluorooctane Sulfonate (PFOS) Concentration and Liver Function Biomarkers in a Population with Elevated PFOA Exposure. Gallo V et al., 2012; Environmental Health Perspectives 120(5):655-660** • **Paper: Association between Plasma PFOA and PFOS Levels and Total Cholesterol in a Middle-Aged Danish Population. Eriksen KT et al., 2013; PLoSOne 8(2):e56969**	Exam Case Study/In-class Participation: in class discussion of the application of epidemiology to assigned case study
		Toxicology in Human Health Risk Assessment	4, 6, 7	3, 6, 7, 8	Foundational Graduate Degrees –	• https://toxtutor.nlm.nih.gov/index.html and read the following links: "Introduction to Toxicology", "Dose and	

					2, 12 MPH EHS – 3, 4, 9, 10 MS EHS – 4, 7, 9 PhD EHS – 4, 7, 9	Dose Response", "Toxic Effects", "Interactions", "Toxicity Testing Methods"	
		Home Work 1 Assigned					
3	Jan 20	Martin Luther King Holiday	No classes				
4	Jan 27 (Dr. Adetona) 028 University Hall	Toxicology Concepts for Risk Assessment	4, 6, 7	3, 6, 7, 8	Foundational Graduate Degrees – 2, 12 MPH EHS – 3, 4, 9, 10 MS EHS – 7, 9 PhD EHS – 7, 9	• https://toxtutor.nlm.nih.gov/index.html and read the following links: "Dose and Dose Response", "Toxic Effects", "Interactions", "Toxicity Testing Method • **Paper: Subchronic Toxicity Studies on Perfluorooctanesulfonate Potassium Salt in Cynomolgus Monkey. Seacat AM et al., 2002; Toxicological Sciences 68:249-264**	Exam Case Study/In-class Participation: in class discussion of the application of toxicology to assigned case study
		Hazard Identification	2, 3, 4, 6	3, 6, 7	Foundational Graduate Degrees – 2, 4, 12 MPH EHS – 2, 5, 7, 8 MS EHS – 4, 7, 9 PhD EHS – 4, 7, 9	• **Textbook Chapter: Hazard Identification by Bredfeldt T and Arrieta DE (in textbook: Toxicological Risk Assessment for Beginners. Eds Torres JA and Bobst S, 2015; Springer, New York) – available for free online at the Library at OSU**	Exam, group project report, group project presentations In-class Participation: is wildland fire smoke a health risk (discuss based on evidence gathered from literature search assignment)?
		Mini-Quiz in Class					
5	Feb 3 (Dr. Pennell 160 Cunz (2:15-2:45) 230 Cunz (2:45-5:00)	Dose-Response/Toxicology Assessment and Introduction to the Benchmark Modeling Dose Software	2, 3, 4, 6, 7	3, 6	Foundational Graduate Degrees – 2, 3, 4 MPH EHS – 2, 5, 7, 8 MS EHS – 4, 7, 9 PhD EHS – 4, 7, 9	• Benchmark Dose Technical Guidance. 2012 (Posted on Canvas)	Exam, group project report, group project presentations In-class Practice Questions: applied towards potency factors
		Home Work 1 Due **Home Work 2 Assigned**					
6	Feb 10 (Dr. Adetona)	Dealing with Uncertainty in Establishing Potency Factors	2, 4, 6	3, 6, 8	Foundational Graduate Degrees – 2, 4, 12 MPH EHS – 3, 5 MS EHS – 9 PhD EHS – 9	• **Paper: Guideline Levels for PFOA and PFOS in Drinking Water: the Role of Scientific Uncertainty, Risk Assessment Decisions, and Social Factors. Cordner A et al., 2019. Journal of Exposure Science and Environmental Epidemiology 29:157-171**	Exam, group project report, group project presentations In-class Practice Questions: applied towards potency factors and conceptual models In-class Participation: discuss uncertainty associated with the potency factor in the
		Exposure Assessment: Concept and Approaches	2, 4, 6, 7	3, 6	Foundational Graduate Degrees – 2 MPH EHS – 3, 9, 10 MS EHS – 4, 8 PhD EHS – 4, 8	• **Guidelines for Human Exposure Assessment. 2016. Read Chapters 2 and 4 (Posted on Canvas)** • Links to "Direct Measurement", "Indirect Estimation" and Expo Reconstruction" and the sub-links under these links in the USEPA ExpoBox: https://www.epa.gov/expobox/exposure-assessment-	

						tools-approaches	assigned reading for the first topic
7	Feb 17 (Dr. Adetona)	Exposure Factors	2, 3, 4, 5	3, 6	Foundational Graduate Degrees – 2 MPH EHS – 3, 4, 5, 8, 9, 10 MS EHS – 4, 7, 8 PhD EHS – 4, 7, 8	• Exposure Factors Handbook. 2011 (Posted on Canvas)	Exam, group project report, group project presentations Homework: applied towards exposure factors In-class Practice Questions: applied towards dose calculations In-class Participation: identification and discussion of exposure factors relevant to case study based on papers handed out at the Feb 11 class meeting
		Estimation of Environmental Quantification and Intake	2, 3, 4, 5, 7	3, 6	Foundational Graduate Degrees – 4 MS EHS – 4, 7, 8 PhD EHS – 4, 7, 8	• **Guidelines for Exposure Assessment. 1992. Read Chapters 1 and 2 (Posted on Canvas)**	
		Food Diary Assigned					
8	Feb 24 (Dr. Weir)	Mechanistic Modeling Methods for Exposure Assessment	2, 3, 4, 7	3, 6	Foundational Graduate Degrees – 2, 3 MPH EHS – 9, 10 MS EHS – 4, 7, 8 PhD EHS – 4, 7, 8	• **Guidelines for Human Exposure Assessment. 2016. Read Chapter 6 (Posted on Canvas)**	Exam In-Class Practice Exercise: towards running a model towards the assessment of exposure to an environmental contaminant that is connected to a contemporary public health issue
		Draft of First Section (Introduction and Hazard Identification) of Assigned Group Project Due					
9	Mar 2 (Dr. Adetona)	**Mid Term Exam**					
		Food Diary Due					
		Home Work 2 Due					
		Towards Risk Screening: ProUCL Software and Environmental Concentrations Benchmark Modeling Dose Software Practice	3, 4	3, 6	Foundational Graduate Degrees – 2, 3 MPH EHS – 8, 9, 10 MS EHS – 8 PhD EHS – 8	• Benchmark Dose Technical Guidance. 2012 (Posted on Canvas) • **Paper: Subchronic Toxicity Studies on Perfluorooctanesulfonate Potassium Salt in Cynomolgus Monkey. Seacat AM et al., 2002; Toxicological Sciences 68:249-264** • **Paper: Sub-Chronic Dietary Toxicity of Potassium Perfluorooctanesulfonate in Rats. Seacat AM et al., 2003; Toxicology 183:117-131**	Assignment Group Project Report Group Project Presentation In class Practice: use data in second assigned reading for practicing Benchmark Modeling Dose

						• **Paper: Serum Perfluorooctanoate (PFOA) and Perfluorooctane Sulfonate (PFOS) Concentration and Liver Function Biomarkers in a Population with Elevated PFOA Exposure. Gallo V et al., 2012; Environmental Health Perspectives 120(5):655-660**	Software
10	Mar 9	Spring Break	No classes				
11	Mar 16 (Dr. Adetona)	Risk Characterization	2, 6	3, 6, 7, 8	Foundational Graduate Degrees – 2, 4 MPH EHS – 2, 5 MS EHS – 8 PhD EHS – 8	• Risk Characterization Handbook. 2000 (Posted on Canvas) • **Class Exercise Based on FDA Analytical Results of PFOS Concentration in Milk Samples from a Farm in North Carolina (Posted on Canvas)**	Exam, group project report, group project presentations In-Class Practice Question: towards computation of risk; also calculate cardiovascular mortality and lung cancer risk due to occupational exposure of wildland firefighters to wildland fire smoke using data gathered from prior reading materials
		Risk Screening and Contaminants in Environmental Matrices	3, 4, 5	3, 6	Foundational Graduate Degrees – 3 MPH EHS – 7, 8, 9, 10 MS EHS – 8 PhD EHS – 8	• USEPA Risk Screening Level User Guide: Visit: https://www.epa.gov/risk/regional-screening-levels-rsls-users-guide-june-2017	In-class practice question using USEPA ProUCL software to compute an exposure point concentrations for contaminated sites and comparisons to USEPA screening levels, regulatory standards and background concentrations
		Draft of Second Section (Dose Response and Exposure Assessments) of Assigned Group Project Due					
12	Mar 23 (Dr. Adetona)	Risk Screening and Risk Characterization (Cont'd)	2, 6	3, 6, 7, 8	Foundational Graduate Degrees – 2, 4 MPH EHS – 2, 5 MS EHS – 8 PhD EHS – 8	• Risk Characterization Handbook. 2000 (Posted on Canvas) • **Paper: Guideline Levels for PFOA and PFOS in Drinking Water: the Role of Scientific Uncertainty, Risk Assessment Decisions, and Social Factors. Cordner A et al., 2019. Journal of Exposure Science and Environmental Epidemiology 29:157-171**	Exam, group project report, group project presentations In-Class Practice Question: towards computation of risk; also calculate cardiovascular mortality and lung cancer risk due to occupational exposure

							of wildland firefighters to wildland fire smoke using data gathered from prior reading materials
		Biological Markers in Risk Assessment	2, 4, 7	3, 6, 8	Foundational Graduate Degrees – 2, MPH EHS – 3, 4, 9,10 MS EHS – 7, 8 PhD EHS – 7, 8	• **Paper: Lead Levels in Human Milk and Children's Health Risk: a Systematic Review. Koyashiki et al., 2010. Review of Environmental Health 25(3):243-253**	In-class Participation: discuss the potential application of the biomarker in assigned reading to risk assessment and the potential challenges
13	Mar 30 (Dr. Adetona)	Ecological Risk Assessment	2, 4, 7	3, 6, 7	Foundational Graduate Degrees – 2, 4 MPH EHS – 1, 2, 5 MS EHS – 9 PhD EHS – 9	• **Visit this website: (www.epa.gov/risk) and read through contents under the "Ecological Risk Assessments" link** • **Mhadhbi et al. Ecological Risk Assessment of perfluorooctanoic acid (PFOA) and perfluorooctanesulfonate acid (PFOS) in Marine Environment Using *Isochrysis Galbana, Paracentrotus Lividus, Siriella Armata* and *Psetta Maxima*.2012. Journal of Environmental Monitoring 14:1375**	Exam Exam Case Study/In-class Participation: in class discussion of the application of ecological risk assessment in assigned reading – Giesy JP et al.
		Mini-Quiz in Class					
		Draft of Third Section (Risk Characterization, Conclusion, Limitations) of Assigned Group Project Due					
14	Apr 6 (Dr. Adetona)	Mixtures, Multiple Exposures and Cumulative Risk Assessment	2, 4, 6, 7	3, 6, 7	Foundational Graduate Degrees – 2, 4 MPH EHS – 2, 3, 4, 5, 6, 8, 9,10 MS EHS – 7, 8 PhD EHS – 7, 8	• Guidance on Cumulative Risk Assessment of Pesticide Chemicals That Have a Common Mechanism of Toxicity. 2002 (Posted on Canvas)	Exam In-Class Practice Question: towards computation of cumulative risk
15	Apr 13 (Dr. Adetona)	Risk Communication, Risk Management and Their Interface with Risk Assessment	1	3, 6	Foundational Graduate Degrees – 19 MPH EHS – 5 MS EHS – 6, 9 PhD EHS – 6, 9	Considerations in Risk Communication: A Digest of Risk Communication as a Risk Management Tool. (Posted on Canvas)	Exam, in-class participation, group project report, group project presentations
16	Apr 20 (Dr. Adetona)	In-Class Project Presentations	5, 6	3, 6, 7, 8	Foundational Graduate Degrees – 19 MPH EHS – 5, 8 MS EHS – 6, 9 PhD EHS – 6, 9		In-Class Presentation
		Full Completed Project Reports Due					
17	Apr 28	**Final Exam (4:00-5:45 pm on Apr 28 in 028 University Hall)**					