

Environmental Epigenetics and Public Health, EHS 660

Meeting in M1170 SPHII

1:00-3:00 pm Th

2 credits

Professor: Dr. Dana Dolinoy
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Office Hours: by appointment.

Course Description: This course examines the principles and applications of epigenetics and epigenomics as they relate to human nutrition, toxicology, and disease etiology. Course lectures will address gene transcription, epigenetic mechanisms, environmental epigenomics, and policy implications, including risk assessment. Examples and case studies will evaluate these processes using both animal and human examples drawn from the primary literature. Students will also be introduced to current laboratory methods and emerging technologies for examining epigenetics and epigenomics. Policy, media, and ethical considerations for epigenetic research will also be explored.

Course Materials: A *Canvas* site is maintained for this course and can be accessed via the gateway site at <https://umich.instructure.com/courses/200>.

The schedule for the course is maintained on the *Canvas* site, with supplemental readings, lecture slides and handouts. Announcements of changes or additions to the course schedule, readings and assignments will be made in class and posted to the *Canvas* site. Seminars of interest to this topic will be posted on *Canvas*.

There are two suggested texts for this course. Readings will also be drawn from the primary literature and available on *Canvas*. Use texts and readings as resources to clarify material covered in lectures and to deepen your own appreciation of topics of interest. You may find it useful to review the pages recommended on the syllabus before coming to class, particularly if your background is weak in a particular area. Studying the figures and summaries is an efficient way to review. You will then want to consult the texts after lecture, using the index and glossaries as a guide. Some topics are covered in both texts. You will only be held accountable for materials covered in lectures. Selected chapters from the following textbooks and peer reviewed literature:

- 1) Human Molecular Genetics 4. Tom Strachen and Andrew P. Read (2010). Hard and paperback copies of this book are available. Either is appropriate.

- 2) Epigenetics. Editors: C. David Allis, Thomas Jenuwein, and Danny Reinberg (2007). Hard and paperback copies of this book are available. Either is appropriate.
We will make 1-2 copies of these texts available through the Library Reserves System; Assigned portions of Chapters available on Canvas.
- 3) Selected chapters from the texts above and primary readings from the peer-reviewed literature (available on *Canvas* site).

Pre-requisites: Graduate status and **college-level biology, genetics or biochemistry. Please see the Course Instructor if you have questions about prerequisites.**

Course Goals: In this course, we aim to explore the major components of genetic and epigenetic gene regulation. Throughout the course we will emphasize the processes of scientific discovery and analysis that are essential to our modern understanding of molecular biology and genetics.

Learning objective #	Learning objective	Level of knowledge Expected
The students taking this class are expected to learn about:		
L1	The central dogma, including DNA, RNA, and proteins	Advanced
L2	The relevance of epigenetic mechanisms to human health	Advanced
L3	Epigenetics and epigenomics as they relate to toxicology	Intermediate
L4	Epigenetics and epigenomics as they relate to nutrition, including nutrient-toxicant interactions	Intermediate
L5	Epigenetic mechanisms involved in early development and aging	Intermediate
L6	Practical options for evaluating epigenetic processes as they relate to human health and disease in populations	Intermediate
L7	Implications of epigenetic gene regulation on risk assessment, policy, and ethics	Intermediate

Competencies:

Competency #	Competency	Level of competency expected
The students that have taken this class are expected to be able to:		
C1	Recognize key figures and significant discoveries in the field of epigenetic gene regulation and environmental epigenetics	Advanced
C2	Understand the difference between genetic and epigenetic influences on gene expression	Advanced
C3	Describe key epigenetic phenomena, mechanisms, and health implications	Advanced
C4	Evaluate and critically review epigenetic research in the primary literature, including toxicological, nutritional, and epidemiological sciences	Intermediate
C5	Design and conceptualize experiments involving epigenetic mechanisms, including the use of in vitro methods, animal models, and human population approaches	Intermediate
C6	Access information from the Human Epigenome Mapping projects and apply it to toxicological, nutritional, and epidemiological sciences	Basic
C7	Articulate potential policy and risk assessment ramifications	Intermediate

Course Requirements: Your grades will be based on five elements: 1 exam, 1 seminar review, 1 group Journal Club presentation, 1 article review, and class attendance/participation.

Exam (1.5 hour): 20%

The mid-term exam will test material covered in lecture and up to and including the last lecture before the exam. The exam format will include short essay, multiple choice, and problem-solving formats.

Seminar Review: 20%

During the course of the semester, students will be required to attend a seminar in their area of interest relating to epigenetics and prepare a one-page single spaced summary of the work presented. Suggestions for appropriate seminars will be announced in class and posted on Ctools, but are not limited to these choices. Students should email the instructors their write-ups on the assigned due date. Summary may be turned in via Dropbox in at any time but are Due by: 4/13/2017.

Journal Club Presentation and Article Review: 40% (20% group presentation; 20% individual critique).

During the second half of the semester, students (in groups of 4-5) will be assigned a topic relevant to course subject matter (Twins, Diet/Nutrition, Toxicology, Environmental Health, Behavior, Social Factors). When possible, topic preference of the student will be considered prior to topic assignment. Upon consultation with the Instructor, student groups will select a recent primary literature article to present in Journal Club format during class. During Journal Club, group members will be responsible for summarizing 1) the study motivation/rationale, 2) experimental approach and method, 3) major findings of the article, 4) future directions, and 5) leading class discussion of strengths and limitations.

The Article Review will involve a 2 page single spaced critique of an article presented in class from another student group or a non-presented paper of interest, upon instructor approval. This review will include: a brief background of the research question, summary of the approach, strengths and limitations of the findings and suggestions for future directions. If you would like to select an article of interest that was not reviewed in Journal Club, that is fine, upon consultation with the course instructor.

Student group assignments will be made in late January. Group Paper selection due 2/20/17; Presentation dates in Late March and April are listed on the Syllabus. The Article Review is in lieu of a final and is due 4/20/2017. The Article Review may be turned in via Dropbox or emailed to the instructor.

Class participation and attendance: 20%- This class is taught at a graduate level, and regular attendance and participation in classroom discussion is required.

Classroom Expectations/Etiquette:

Discuss any specific issues/expectations regarding class format, classroom expectations, and etiquette/decorum. This could include expectations regarding class attendance, use of laptops in class, group work, etc.

Academic Integrity:

The faculty and staff of the School of Public Health believe that the conduct of a student registered or taking courses in the School should be consistent with that of a professional person. Courtesy, honesty, and respect should be shown by students toward faculty members, guest lecturers, administrative support staff, community partners, and fellow students. Similarly, students should expect faculty to treat them fairly, showing respect for their ideas and opinions and striving to help them achieve maximum benefits from their experience in the School.

Student academic misconduct refers to behavior that may include plagiarism, cheating, fabrication, falsification of records or official documents, intentional misuse of equipment or materials (including library materials), and aiding and abetting the perpetration of such acts. Please visit <https://sph.umich.edu/student-resources/mph-mhsa.html> for the full Policy on Student Academic Conduct Standards and Procedures.

SPH Writing Lab:

The SPH Writing Lab is located in 5025 SPH II and offers writing support to all SPH students for course papers, manuscripts, grant proposals, dissertations, personal statements, and all other academic writing tasks. The Lab can also help answer questions on academic integrity. To learn more or make an appointment, please visit the SPH writing lab [website](#).

Student Well-Being:

SPH faculty and staff believe it is important to support the physical and emotional well-being of our students. If you have a physical or mental health issue that is affecting your performance or participation in any course, and/or if you need help connecting with University services, please contact the instructor or the Office of Academic Affairs.

Please visit <https://sph.umich.edu/student-life/wellness.html> for information on wellness resources available to you.

Student Accommodations:

Students should speak with their instructors before or during the first week of classes regarding any special needs. Students can also visit the Office of Academic Affairs for assistance in coordinating communications around accommodations.

Students seeking academic accommodations should register with Services for Students with Disabilities (SSD). SSD arranges reasonable and appropriate academic accommodations for students with disabilities. Please visit <https://ssd.umich.edu/topic/our-services> for more information on student accommodations.

Students who expect to miss classes, examinations, or other assignments as a consequence of their religious observance shall be provided with a reasonable alternative opportunity to complete such academic responsibilities. It is the obligation of students to provide faculty with reasonable notice of the dates of religious holidays on which they will be absent. Please visit <http://www.provost.umich.edu/calendar/> for the complete University policy.

Course Topics/Reading List:

Date	Topic	Readings	Instructor
01/5/17	A. Epigenetics: From Phenomenon to Field (history, epigenetics in genetic context) B. Genetics Review: Nucleic Acids, Genes, and Transcription	A1. <i>Skim</i> : Allis: Chapters 2 and 3, pp. 15-62 A2. Strachen: Chap. 11 pp. 353-357 B. <i>Optional</i> : Strachan and Read: Chap. 1-3 (2 copies available for check out)	Dolinoy

01/12/17	<p>A. DNA Methylation and the Environment (e.g. trans-generational toxicant exposures, maternal behavior; nutrition)</p> <p>B. Human Epigenome Project</p>	<p>A1. Allis: Chap. 18, pp. 341-356 A2. Strachen: Chap. 11 pp. 357-361 A3. Weaver IC et al. Nat Neurosci. 2004, 7(8):847-54 A4. Hoyo C et al. Epigenetics 2011, 6(7), 928-36</p> <p>B1. http://www.epigenome.org/</p>	Dolinoy
01/19/17	<p><i>Ghost in Your Genes</i> – Nova PBS Special</p> <p>B. Open Discussion of DVD – implications for toxicological, nutritional, behavioral, and epidemiological sciences</p>	<p>http://www.pbs.org/wgbh/nova/genes http://www.pbs.org/wgbh/nova/sciencenow/3411/02.html</p>	DVD/ Guest Discussant: Dr. Jaclyn Goodrich (EHS)
01/26/17	<p>A. Histone Code and Histone Variants and the Environment (e.g. dietary influences; metals)</p> <p>B. Pubmed, journal clubs, and article review</p> <p>(JOURNAL CLUB GROUPS/TOPICS ASSIGNED)</p>	<p>A1. Allis: Chap. 10, pp. 191-210 & Chap. 13, pp 249-264 A2. Zheng et al. J. Nut Biochem, 2010 (22)567-573 A3. Zamudio et al. Epigenetics 2011 6(7), 820-7 A4. (Optional) Nian H, et al Environ Mol Mutagen. 2009, 50(3):213-21</p> <p>B1. Journal Club Info: J Eval Clin Pract. 2008 14(5):898-911 Ann Emerg Med. 2004 44(2):169-74 B2. Article Review Examples: http://www.environmentalhealthnews.org/</p>	Dolinoy
02/2/17	<p>A. Epigenetic Transcriptional Regulation (chromatin proteins and microRNA/RNAi)</p> <p>B. Evaluating the Epigenome</p>	<p>A1. <i>Skim</i>: Allis: Chap. 11 &12, pp. 211-248 A2. Strachen: Chap. 9 pp. 283-288</p> <p>B1. Shen, Waterland, Curr Opin Clin Nutr. 2007; 10(5): 576-81 B2. Zilberman D, Henikoff S. Development. 2007;134(22):3959-65</p>	Dolinoy

02/9/17	<p>A. X-inactivation /Genomic Imprinting and the Environment (e.g. famine; metals exposure)</p> <p>B. Special Considerations: Epigenetic Epidemiology of Environmental Exposures (e.g. Hg and Pb)</p>	<p>A1. Strachen: Chap. 11 pp. 365-371 A2. <i>Skim</i>: Allis Chap. 17, pp. 321-340; Chap. 19 pp. 357-376 and Chap. 23 pp. 439-443 A3. Heijmans BT, et al. Proc Natl Acad Sci. 2008;105(44):17046-9</p> <p>B1. Waterland RA, Michels KB. Annu Rev Nutr. 2007;27:363-88 B2. Goodrich et al EMM 2013</p>	<p>Dolinoy</p> <p>Guest Lecturer: Dr. Jaclyn Goodrich (EHS)</p>
02/16/17 GROUP PAPE R for JOUR NAL CLUB SELEC TION DUE	<p>A. Windows of Vulnerability: Developmental Origins of Health and Disease (DOHaD);</p> <p>B. Media Perspective</p>	<p>A1. Bateson P, Barker D, et al. Nature. 2004;430(6998):419-21 A2. Aagaard-Tillery KM, et al. Maternal diet modifies the primate fetal epigenome. J Mol Endocrinol. 2008;41(2):91-102 A3. Suter M, et al. In utero tobacco epigenetically modifies...Metabolism. 2010 Oct;59(10):1481-90.</p> <p>B1. <i>Time Magazine</i> January 2010 Why Genes Aren't Destiny B2. Smithsonian Magazine Nov 2013</p>	Dolinoy
02/23/17	<p>A. Genome Organization</p> <p>B. Metastable Epialleles (e.g. bisphenol A (BPA), methyl donors, and radiation exposure)</p>	<p>A1. Strachen and Read, Chap. 9 pp. 289-293</p> <p>B1. Rakyan VK, et al. Trends Genet. 2002, 18(7):348-51 B2. Dolinoy et al. Proc Natl Acad Sci. 2007, 104(32):13056-61 B3. Bernal et al. Low-dose radiation and the fetal epigenome. FASEB 2012 (SKIM)</p>	Dolinoy
03/2/17	Spring Break – No Class		
3/9/17	<p>A. Ethics & Policy</p> <p>B. Risk Assessment Implications</p>	<p>A1. Rothstein MA, et al. Ghost in Our Genes. Health Matrix Clevel. 2009;19(1):1-62 (SKIM) A2 Ethics Watch, Nature Genetics April 2009</p> <p>B. Goodman et al. Toxicol Sci. 2010 Aug;116(2):375-81</p>	Dolinoy

03/16/17	A. EXAM (1.5 hour)		Guest Exam Proctor: Dr. Olivia Anderson (NUTR)
03/23/17	A. Background Readings for Journal Clubs B. Twins and the Epigenome Journal Club C. Diet/Nutrition and the Epigenome Journal Club	A1. Fraga MF, et al. Proc Natl Acad Sci 2005;102(30):10604-9 A2. "Nutrition in Epigenetics" M. Niculescu, <i>ILAR Journal</i> B. Student Group 1 (Reading on <i>Canvas</i>) C. Student Group 2 (Readings on <i>Canvas</i>)	Dolinoy Student Groups 1 & 2
03/30/17	A. Background Reading for Journal Club B. Toxicology and the Epigenome Journal Club C. Environmental Exposures and the Epigenome Journal Club	A. Jirtle RL, Skinner MK. Nat Rev Genet. 2007 Apr;8(4):253-62 B/C. Student Group 3 & 4 (Readings on <i>Canvas</i>)	Dolinoy Student Groups 3 & 4
04/06/17	A. Research Presentation: Stem Cells and the Epigenome B. Fill our Course Evaluations (on your own time)	A. Colacino J.A. Epigenomics 2016 8(11): 1453-1457	Guest Lecture: Dr. Justin Colacino, (EHS)
04/13/17 SEMINAR REVIEW DUE 4/13/17	A. Background Reading for Journal Club B. Behavior and the Epigenome Journal Club C. Epigenome Editing D. Course Wrap Up	A1. Smart et al. Psych Medicine 2015 A2. Liu et al Cell. 2016 B/C. Student Group 5 & 6 (Readings on <i>Canvas</i>)	Student Groups 5 and 6 Dolinoy
4/20/17	ARTICLE REVIEW DUE		