BIO 110: Evolution in Health and Medicine

Location: Arts & Letters 205
Hours: Mon & Wed 9:40-11:10am

Instructor: Dr. Windsor Aguirre
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Office Hours: By appointment

Introduction: Humans are part of the evolutionary tree of life and have a historical legacy that reflects their past evolution. This legacy can have serious implications for our health because evolution by natural selection has no foresight; the best available solution at a given time in a given environment is what is adopted. As a consequence, humans are not perfect. Our modern environment is also very different from that in which we evolved. How do the demands of modern life impact our health? Where do diseases come from and why are new infectious diseases still emerging? Why do our bodies breakdown as we get older?

In this course, we will study how scientists are increasingly incorporating evolutionary thinking and research methods into better understanding the diseases that affect us. In the process, we will reflect on how the scientific method works and how professional scientists go about answering pressing questions. Some of the questions asked will be very basic. Why do we get sick? Why do we age? Answering these questions properly will require a deep exploration of how our bodies work and where we came from. You will use a combination of resources to learn about evolution, health, and the cutting edge technologies that are allowing scientists to treat diseases in new ways. Hopefully, by the end of the course you will have expanded your perspective on the value of science, what it means to be human, and how our place in the natural world relates to the health challenges that we face.

Readings: This course will rely heavily on reading and discussion so be prepared to invest time outside of the classroom. For many of the topics covered, we will read chapters from the book *Body by Darwin, How Evolution Shapes Our Health and Transforms Medicine* by Jeremy Taylor (2015). This book discusses the emerging science behind our efforts to understand the health consequences of evolution. For additional reading, I recommend *Evolutionary Medicine* by Stephen Stearns and Ruslan Medzhitov (2016), which is a more traditional textbook on the subject, and *Why We Get Sick, The New Science of Darwinian Medicine* by Randolph M. Nesse and George C. Williams (1994), which is a popular science book that launched the field. Besides books, we will have weekly reading assignments that will be posted as pdfs on D2L.

Attendance Policy: Plan on attending class. Being absent means that you cannot participate and participation is worth 30% of your final grade. If you know you will miss class (e.g., you are a student athlete), talk to me ahead of time so that we can make arrangements. If you are sick, you should obviously not come to class. <u>You will be allowed to drop your two lowest participation grades</u> to account for possible health issues that may arise or other unforeseen circumstances. **Late Assignments:** Late assignments will be penalized with -10% for up to one day late and -25% for one week late. Assignments will not be accepted after one week.

Scientific Inquiry: Science as a Way of Knowing Learning Outcomes

At the end of this course, students will be able to:

- Identify the types of questions that can and cannot be answered by science, and recognize the strengths and limitations of science in answering questions about the natural world.
- Critically evaluate the assumptions that underlie scientific investigations.
- Substantiate the claim that scientific knowledge is durable but can evolve with new evidence and perspectives.
- Connect evidence to the predictions made by theories and hypotheses, and then assess the extent to which the presented evidence supports or refutes a scientific claim.
- Evaluate the role of creativity, curiosity, skepticism, open-mindedness and diligence of individuals in scientific discovery and innovation.
- Recognize the uncertainty inherent in the scientific approach and evaluate scientists' efforts to minimize and understand its effect through experimental design, data collection, data analysis and interpretation.
- Evaluate the role of communication, collaboration, diversity and peer review in promoting scientific progress and the quality of scientific evidence and ideas, and ensuring compliance with ethical standards.
- Determine the extent to which science both influences and is influenced by the societies
- Apply scientific approaches to problem solving and decision-making in their own lives, and evaluate how scientific knowledge informs policies, regulations, and personal decisions.

Writing Expectations:

Formal writing is essential for communicating ideas and progress in science, mathematics, and computation to experts within the field and to the broader society. Courses within the Scientific Inquiry Domain should include both formal writing (for example lab reports, essays, and written responses to questions) and supplemental elements that are appropriate for the subject of the course such as mathematical equations, computer code, figures and graphs, lab notebooks, or field journals.

Course Specific Learning Outcomes:

Upon completing BIO 110, students will be able to:

- Explain some of the most important ways in which scientists incorporate evolutionary principles to study the origin and evolution of diseases
- Explain how new diseases originate and why they are an increasingly serious threat
- Discuss examples of how our evolutionary legacy impacts our health
- Identify technological advances that are allowing scientists to gain new insight into the nature of human diseases and how to treat them

Grading Scale: The following grading scale will be used:

A	93-100
A-	90-92
B+	87-89
B	83-86
B-	80-82
C+	77-79
C	73-76
C-	70-72
D	60-69
F	≤ 59

Grading Scheme:

Participation	30%
Zoonotic Disease Presentation	10%
Review Paper Section Drafts	20%
Peer Review	10%
Final Review Paper	30%

Participation: The exchange of ideas is critical for fostering an active learning environment so I am counting on you to share your thoughts and participate often. Peer reviews and helping your classmates will also be counted towards the Participation grade. Beginning in week 2, you will be assigned a participation grade, and your lowest two participation grades will be dropped. The remaining grades will be used to compute your final Participation grade. Participation will account for 30% of your final grade.

Zoonotic Disease Presentation: Students will work in groups of three and prepare a 15 minute presentation (12 minutes presenting plus 3 minutes for questions) on a zoonotic disease, a disease that originated in an animal and evolved to infect humans. Each group will work on a different disease. I will post your group topic selections on D2L so that diseases are not duplicated. The presentation should have at least five sections:

- **Background and Evolutionary Context**: Put the disease in historical context indicating when and how it was discovered, the type of pathogen involved, where it came from, and how it evolved to be able to infect humans.
- **Mode of Action:** Describe how the pathogen works, what it does to humans (symptoms and damage), and why it is a threat.
- **Methods used to understand the disease**: Highlight a scientific method or tool that was particularly important for understanding the disease and explain how the method works and what it taught investigators.
- **Future challenges and threats**: Highlight the future directions for research and any concerns about the future impacts of this disease on humans.

- **Policy implications**: What policies or regulations if any were established to help combat the spread of the disease or mitigate its consequences.
- **Sources:** Include the sources of information used to create the presentation so other students can review them.

The presentation should be divided into three sections, each covered by one student and each lasting approximately 4 minutes:

- **Student 1** should present on 1) Background and Evolutionary Context and 2) Mode of Action
- **Student 2** should present on 3) Methods Used to Understand the Disease.
- **Student 3** should present on 4) Future Challenges and Threats and 5) Policy Implications.

Although each will present a different section of the presentation, groups should work together on the presentation to standardize the formatting, avoid duplicating topics or having gaps, and ensure a smooth flow. I expect a high quality presentation that has been well researched and practiced. You should make sure that your individual section is approximately 4 minutes long. Practice your section by speaking out loud at a presentation pace and timing yourself. The presentations will be posted on D2L.

Evolution, Health, and Medicine Review Paper: How does evolution impact our health and the medical treatments that we receive? You will work on an individual Evolution, Health and Medicine Review Paper based on what you learn in this class and your own research on the topic. The paper will be divided into eight sections plus a literature cited section. You will write the paper in sections over time, such that one section of the paper will be due most weeks beginning week 3. I will provide feedback on the draft of the first section that is due on The Scientific Method & Pseudo-Science. Thereafter, these sections will be peer-reviewed weekly by your fellow students. At the end of the quarter, you will review the section drafts based on the feedback you receive, add an introduction, and submit the final paper via D2L. The paper should be single-spaced and you should cite your sources as you go. A rubric for the paper will be posted on D2L. The paper will have the following sections:

1. Introduction to Evolution in Health and Medicine: Although this section goes at the beginning of the paper, it will not be due until the end of the quarter so you have time to reflect on the topic and can use the knowledge gained throughout the quarter to write it. You will provide a broad introduction and background on the topic of evolution in health and medicine and set up the rest of the paper in this section. (2 pages)
2. The Scientific Method and Pseudo-Science: In this section, you will provide a review of what science is, the scientific method, and pseudo-science. You should address questions like: What is science and how do scientists go about conducting science? What are the assumptions of science? Does science have limits and if so, what are they? How do we distinguish scientific endeavors from non-scientific endeavors or pseudoscience? (2 pages)

3. Human Evolution: In this section you will address questions like: What is evolution? What do we mean by genetic variation, natural selection, and genetic drift? When did humans evolve and what was the environmental context in which we evolved? How can our evolutionary legacy impact our health? (2 pages)
4. Zoonosis: What is meant by a zoonotic disease? Where do zoonotic diseases come from and what are factors that lead to their emergence? (1 page)
5. The Old Friends Hypothesis: Auto-immune diseases are increasing in wealthy nations. What are the possible reasons for this and what can be done? (1 page)
6. The Evolutionary Biology of Cancer: How does cancer relate to evolution? What is mutation and what role does it play in cancer? How is natural selection involved? (1 page)
7. Heart Disease: How does the legacy of our evolution impact the high frequency of heart disease that occurs in modern societies? (1 page)
8. Ageing: Why do we age? It is so difficult and complex to transform a single fertilized cell into a human being, why does our body begin to fall apart after a few decades of life? Shouldn't it be easier to simply maintain an existing individual than create a whole new individual? What hypothesis exist to explain why humans age? (1 page)
9. Literature Cited: Make sure to cite your sources as you go. You should use a bibliography management program like Zotero, Mendeley, or Endnote.

The section drafts will be graded for effort and the lowest section draft grade will be dropped.

Peer Review: Beginning in week 3, you will provide peer review on the Paper section drafts that your classmates present. This peer review is intended to help your classmates and provide you with some insight into how your classmates are preparing their section drafts. Your peer review will not affect your classmate's grade and you will receive a grade for your peer reviews so make sure to do a good job. Your thoughtful input can only help your classmates. Your lowest Peer Review grade will be dropped.

Academic Integrity: Academic integrity entails absolute honesty in one's intellectual efforts. The DePaul Student Handbook details the facets and ramifications of academic integrity violations, but you should be especially aware of the policies on cheating and plagiarism. **Cheating** is any action that violates University norms or an instructor's guidelines for the preparation and submission of assignments. Such actions may include using or providing unauthorized assistance or materials on course assignments, or possessing unauthorized materials during an examination. **Plagiarism** involves the representation of another's work as your own, for example: (a) submitting as one's own any material that is copied from published or unpublished sources such as the internet, print, computer files, audio disks, video programs or musical scores without proper acknowledgement that it is someone else's; (b) paraphrasing another's views, opinions or insights without proper acknowledgement or copying of any source in whole or in part with only minor changes in wording or syntax even with acknowledgement; (c) submitting as one's own work a report, examination, paper, computer file, lab report or other assignment which has been prepared by someone else. If you are unsure about what constitutes unauthorized help on an exam or assignment, or what

information requires citation and/or attribution, please ask your instructor. Violations may result in the failure of the assignment, failure of the course, and/or additional disciplinary actions. For more information, visit DePaul's Academic Integrity Website: https://offices.depaul.edu/academic-affairs/faculty-resources/academic-integrity/Pages/default.aspx

Respect for Diversity and Inclusion: At DePaul, our mission calls us to explore "what must be done" in order to respect the inherent dignity and identity of each human person. We value diversity because it is part of our history, our traditions, and our future. We see diversity as an asset and a strength that adds to the richness of classroom learning. In my course, I strive to include diverse authors, perspectives and teaching pedagogies. I also encourage open dialogue and spaces for students to express their unique identities and perspectives. I am open to having difficult conversations and I will strive to create an inclusive classroom that values all perspectives. If at any time the classroom experience does not live up to this expectation, please feel free to contact me via email or during office hours.

Writing Center: I strongly recommend you make use of the Writing Center throughout your time at DePaul. The Writing Center provides free peer tutoring for DePaul students, faculty, staff, and alumni. Writing Center tutors work with writers at all stages of the writing process, from invention to revision, and they are trained to identify recurring issues in your writing as well as address any specific questions or areas that you want to talk about. Visit www.depaul.edu/writing for more information.

Students with Disabilities: Students seeking disability-related accommodations are required to register with DePaul's Center for Students with Disabilities (CSD) enabling you to access accommodations and support services to assist your success. There are two office locations: Loop Campus - Lewis Center #1420 - (312) 362-8002; Lincoln Park Campus - Student Center #370 - (773) 325-1677. Students can also email the office at csd@depaul.edu . Students registered with the Center for Students with Disabilities can contact me privately to discuss how I may assist in facilitating the accommodations you will use in this course.

University Counseling Services: DePaul University Counseling Services (UCS) is committed to providing a range of culturally aware and sensitive clinical services to help currently enrolled DePaul students remove barriers to academic and personal success by addressing emotional, psychological, and interpersonal concerns through multiple treatment modalities. Services offered include: group counseling, individual counseling, couples counseling, crisis management, consultation, referrals, and telereach/outreach workshops. To connect with the counseling center, contact their main number at (773) 325-7779 during regular business hours (Monday-Friday, 9am-5pm) to schedule an initial consultation, which is typically scheduled within 1-2 business days of your call.

Class Schedule

DATE	TOPIC	READING ASSIGNMENT	ASSIGNMENT DUE
Jan 3	Course Introduction		
Jan 5	Why Do We Get Sick? Introduction to Evolutionary Medicine	Stearns (2012); Taylor (2015) 1-12*	
Jan 10	Science and The Scientific Method	Understanding Science: Cold fusion	
Jan 12	Pseudo-Science and How to Identify It	Stemwedel (2011), Willingham (2012)	
Jan 17	***Martin Luther King Day – No Class***		
Jan 19	**Skills Workshop**: Bibliography Tools, Preparing Presentations and Papers		Review Paper: The Scientific Method & Pseudo-Science section
Jan 24	Evolution Basics: Genetic Variation, Natural Selection, and Genetic Drift	Watch The Making of a Theory Documentary	
Jan 26	Human Evolution and The Mismatch to Modernity	Maslin et al. (2015); Opt: Fan et al. (2016)	
Jan 31	Introduction to Zoonosis	Greene (2007) Opt:Sharp and Hahn (11)	Review Paper: Human Evolution section
Feb 2	Zoonosis: Class Presentations		
Feb 7	Zoonosis: Class Presentations		Review Paper: Zoonosis section
Feb 9	The Old Friends (Hygiene) Hypothesis	Taylor pp. 13-48 Opt: Scudellari (2017)	
Feb 14	Class Discussion: The Old Friends (Hygiene) Hypothesis		Review Paper: Old Friends Hypothesis section
Feb 16	The Evolutionary Biology of Cancer	Taylor pp. 141-174 Opt: Greaves (2007)	
Feb 21	Class Discussion: The Evolutionary Biology of Cancer		Review Paper: Cancer section
Feb 23	Heart Disease	Taylor pp. 175-206 Opt: Thompson et al. (13)	
Feb 28	Class Discussion: Heart Disease		Review Paper: Heart disease section
Mar 2	Why do we age?	Taylor pp. 207-243 Opt: Kirkwood (2005)	
Mar 7	Class Discussion: Why do we age?		Review Paper: Ageing section
Mar 9	Final Class Discussion: Evolution in Health and Medicine		

***Taylor in the Readings refers to our course book Body by Darwin by Jeremy Taylor (2015).**
Opt indicates Optional reading assignment.
***** Final Review Paper due Wednesday March 16 by 11:59pm*****