

BB332: Molecular Medicine Syllabus

Term: Fall 2019
Meeting time: Tu-Th 2:00-3:20pm (3 credits conventional grading)
Meeting location: Linc 268

Required Materials: *Ten Drugs: How plants, powders and pills have shaped the history of medicine.*
(2019 by Thomas Hager, Abrams Press)

Professor: Joseph Beckman
Email: joe.beckman@oregonstate.edu
Office hours: TR 3:20-4:00pm (and by arrangement)
Office: ALS 1031

Course Overview: Molecular Medicine covers a broad range of topics related to modern medicine, biochemistry, and the history and development of these institutions. The interrelationships between economic, regulatory, societal, and ethical perspectives will be highlighted, while also exploring the basic limits imposed by biology and chemistry.

Learning Outcomes: Understand how medicine as evolved from being driven by empirical deduction by understanding the molecular basis for disease. Students will become familiar with the functions of DNA, RNA, and proteins as well as other basic biological processes involved in inflammation and aging. Insights will be gained on how the application of molecular medicine has transformed our society and into the hard decisions ahead as new therapies are developed for orphan diseases.

Students are expected build their skills in judgement about the limitations for developing new therapies for many diseases that have remain untreatable. They should realize what is now impossible, need not be tomorrow. As a class, we will investigate how intractable diseases could be tackled, how to effectively raise funding to support such efforts, and understand the regulatory and societal issues that will determine the chances of success.

Concepts of risk will be explored with emphasis in understanding how to decipher the conflicting health reporting in the popular press. Finally, students will learn about the radical impending transition in medicine because of our new analytical abilities from *-omics* technologies to sequence DNA, RNA and proteins, as well as profile metabolism. We are entering the realm of personalized medicine with so many possibilities that will change our futures.

At the end of participating in this course, students should be able to:

- Appreciate the importance of infections and resulting diseases in the evolution of humans at a biological and societal level.
- Appreciate the role of inflammation in amplifying human diseases.
- Differentiate the mechanisms by which modern medicines aim to treat disease.
- Summarize the pivotal paths of inquiry throughout history that have enabled our understanding of molecular medicine.

- Summarize the ethical and financial dilemmas surrounding the development and use of molecular medicine advances.
- Evaluate the arguments for and against use of controversial medical practices.
- Understand how the process of patenting, drug development and approval evolved over the past century and why?
- Analyze the implications of drug development from the perspectives of researchers, business people, physicians, patients, and politicians.
- Communicate data and arguments professionally in written and oral formats

From the Baccalaureate Core Learning Outcomes for a Science, Technology and Society Synthesis course:

- *Analyze relationships among science, technology, and society using critical perspectives or examples from historical, political and economic disciplines.*
- *Analyze the role of science and technology in shaping the practice of medicine and our approach over time.*
- *Articulate in writing a critical perspective on issues involving science, technology, and society using evidence as support.*

Evaluation of Student Performance:

Grades will be based upon weekly quizzes, two mid-terms aimed at assessing your reading of assigned materials and following lecture materials, and a class project due in November. There will be no final. For many topics we will cover, there may be no right answer and we will be seeking to explore alternatives and working in Groups to understand the multiple complexities involved.

- **Statement Regarding Students with Disabilities:** Accommodations for students with disabilities are determined and approved by Disability Access Services (DAS). If you, as a student, believe you are eligible for accommodations but have not obtained approval please contact DAS immediately at 541-737-4098 or at <http://ds.oregonstate.edu>. DAS notifies students and faculty members of approved academic accommodations and coordinates implementation of those accommodations. While not required, students and faculty members are encouraged to discuss details of the implementation of individual accommodations.
- **Student Conduct Expectations link:** <http://studentlife.oregonstate.edu/code>
- **Reach Out for Success:** University students encounter setbacks from time to time. If you encounter difficulties and need assistance, it's important to reach out. Consider discussing the situation with an instructor or academic advisor. Learn about resources that assist with wellness and academic success at oregonstate.edu/ReachOut. If you are in immediate crisis, please contact the Crisis Text Line by texting OREGON to 741-741 or call the National Suicide Prevention Lifeline at 1-800-273-TALK (8255)

Student Evaluation of Courses: The online Student Evaluation of Teaching system opens to students the Wednesday of week 8 and closes the Sunday before Finals Week. Students will receive notification, instructions and the link through their ONID. They may also log into the system via Online Services. Course evaluation results are extremely important and used to help improve courses and the learning experience of future students. Responses are anonymous (unless a student chooses to “sign” their comments agreeing to relinquish anonymity) and unavailable to instructors until after grades have been posted. The results of scaled questions and signed comments go to both the instructor and their unit head/supervisor. Anonymous (unsigned) comments go to the instructor only.

Course Organization

Week 1. (This Thursday)

Sept 26. *Introductions, Expectations, Course Outline & Introduction to Sickle Cell Anemia*

We will start with an initial assessment test (not scored) that will also help gauge your backgrounds and interests.

Assignments: Read the *Introduction - 50,000 pills* in *Ten Drugs* by Thomas Hager. (Mr. Hager is based in Eugene and also wrote a great biography on Pauling.) The book is available on line and should be at the bookstore. This book will help you to understand the founding of the modern pharmaceutical industry and medicine and its deep-reaching impact on everyday life.

Read Distributed Chapters from “*The Gene*”

View “*The Inner Life of a Cell*” <http://www.xvivo.net/animation/the-inner-life-of-the-cell/>

Look at the different structures and processes being illustrated. To understand the type of the cell being shown, look at the animation at: <http://multimedia.mcb.harvard.edu> on Extravasation of Neutrophils. It is important for understanding the first video and this inflammatory cell is a key player discussed later.

Week 2. Origins of Molecular Medicine

Assignments: *The Joy Plant* (Chapter 1)

Oct 1. *Sickle Cell Anemia, Protein Structure and Coevolution*

Additional Assignment: Readings handed out in class. Also, go search the Pauling Collection at OSU and read about Pauling and “Sickle Cell Anemia”. Pauling arguably started Molecular Medicine and the best collection in the world on this is here on campus. We will look at sickle cell anemia, which is a well-worn story that you most likely will have read about. But we will look at the edges where the story is not so clean. To understand sickling, you will need to know about actin, which is well illustrated in “The Interlife of...” We will discuss why is the disease still a terrible burden and the evolutionary pressures that have made it so prevalent.

Oct 3. *DNA, The Book of Man and Therapeutic Platforms from Molecular Biology*

Week 3.

Assignment: *Lady Mary’s Monster* (Chapter 2).

Oct 8. Tour of OSU Campus Facilities (bring rain gear and comfortable shoes)

Oct 10. Mitochondria, Oxidation, Infections, and Inflammation

Week 4. Neurodegeneration

Assignment: *The Mickey Finn, ...Heroin and The Enchanted Ring* (Chapters 3, 4 and 8).

Oct 15. ALS as a case study in Molecular Disease

Oct 17. Midterm 1 (1/2 of class period): Connections between pain, ALS and neurodegeneration.

Week 5. Drug Development and The Evolution of the FDA

Assignment: *Magic Bullets and The Golden Age* (Chapter 5 and Interlude).

Oct 22. Sulfa Antibiotics (Patent Medicines, the color mauve, Aspirin & Heroin, and the Elixir Disaster)

Oct 24. Orphan Diseases, Drug Development and How to raise a few Million \$\$\$.

Week 6. Monoclonal Antibodies and Biotherapeutics

Assignment: *A Perfection of Blood* (Chapter 10 and Epilogue).

Oct 29. The War on Cancer

Oct 31. Monoclonal Antibodies, CAR T-Cells and *The War on Cancer*

Week 7.

Nov 5. Midterm 2. Project review

Nov 7. The World of -omics. Top-Down Proteomics and e-MSion (mass spectrometry)

Week 8. Statistics, Relative Risk and Clinical Testing

Assignment: Statins (Chapter 9).

Nov 12. Heart Disease, Atherosclerosis and Statins

Nov 14. Project review

Week 9.

Nov 19. Biotherapeutic development

Nov 21. Open topics

Week 10. Class Presentations on Disease Treatment

Nov 26. *Final Project Read Outs*

Nov 28. Thanksgiving

Week 11. In Class Presentations (Read Outs) on Final Project -- Continued

Dec 1. *Final Project Read Outs*

Dec 3. *Graded Final Internal Review of Class Projects*