

Course Name: Introduction to Molecular Biology

Course Number: BB 331Section 001, CRN 56529

Location: LINC 307

Course Credits: 3 credits.

Instructor: Phil McFadden, Office 2151 ALS. Email: Phil.McFadden@oregonstate.edu Office hours: Right after class or by other arrangement.

Lecture schedule and dates: TR 1400-1520, Full spring term 4/1/2019 - 6/7/2019

OSU Catalog Description of the Course: "Course dealing with the molecular basis of cellular function, with emphasis upon modern developments, and the foundation for practical applications of this knowledge. The course will involve the conceptual background necessary to appreciate the applications of molecular biology. Throughout the course opportunities will be given to discuss public policy issues and questions: What are the moral and practical problems that flow from identification of an individual as being at risk for a late-appearing genetic disorder, such as Huntington's disease or certain cancers? Does the scientific or public value of knowing the entire DNA sequence of the human genome justify a situation in which individual or small-scale research cannot be supported? What issues arise when the fruits of biological research, mostly publicly funded, are commercialized? Should a novel organism be patented? How can biotechnology be applied to environmental problems?"

Prerequisites: CH 122 [D-] or CH 202 [D-] or CH 222 [D-] or CH 225H [D-] or ((CH 232 [D-] or CH 232H [D-]) or (CH 262 [D-] or CH 262H [D-] or CH 272 [D-]))

Course Learning Objectives

This course fulfills the Baccalaureate Core requirement for the Core, Synth, Sci/Tech/Soc category. It does this by:

1. Analyzing relationships among molecular biology, technology, and society using critical perspectives or examples from historical, political, or economic disciplines. Students will learn to recognize and explain how the science and tools of molecular biology have emerged from past endeavors to solve scientific, technical and social problems. Students will learn to situate present day and near future explorations in historical context. In particular, students will critically examine current trends that are culminating in practical tools and procedures for precisely manipulating and editing the inherited genomes of organisms;
2. Analyzing the role of molecular biology and technology in shaping diverse fields of study over time. Students will learn to recognize and explain advances in the science

of molecular biology and will learn to correlate those advances to resulting changes in social practices and attitudes at large;

3. Synthesizing and articulating in writing a critical perspective on issues involving molecular biology, technology, and society using evidence as support. As a class project, students will put together a "molecular biology impact statement" (MBIS) to study the scientific, technical and social impacts of a recently proposed project in molecular biology.

Course Content (approximate schedule of learning objectives and activities):

Unit 1. Weeks 1-3

- Our first class meeting on Tuesday, April 2 will include a Molecular Biology pre-test. This will allow you and me to assess your current knowledge level.
- *Textbook topics:* You will be able to explain how the Golden Era of Molecular Biology has provided scientific answers to long-standing questions of biological inheritance. For a given type of cell, you will predict its type of genome and information content. You will connect codes -- from DNA to RNA to protein -- in various exercises. You will be able to portray the typical structure of a gene structure and how it is expressed.
- *In-the-news topics:* You will gain an eagerness to argue (politely) about the social questions in relationship to molecular biology. Gene editing technologies will become one of your specialties, enabling you to make intelligent commentary on topics such as the recent announcement of the birth of CRISPR edited humans: How to regulate the Genie?
- *Class project:* You will participate in putting together a hotlist of designer biology projects. Questions such as Can we? and Should we? will become part of your intellectual drive.
- *Exam 1 focus (Thursday, April 18) - The flow of genetic information: DNA makes RNA makes protein.*

Unit 2. Weeks 4 - 6

- *Textbook topics:* You will learn the procedures involved in cloning molecular sequences, amplifying nucleic acids by PCR, and sequencing DNA, including whole genomes. Explanatory hierarchies – you will be able to explain the distinctions and overlaps between genomes, transcriptomes, proteomes, and metabolomes. You will be capable and feel increasingly confident in making predictions of new areas of discovery and invention in molecular biology.
- *In-the-news topics:* Your opinion will become better informed as you learn about the social and legal implications of bioinformatics. Privacy issues will start to bother you either more or less, backed by your own logic. You will recognize health care claims and promises that are realistic versus those that are not. Depending on your personal interests, you will start to specialize in certain areas, such as tackling

cancer and other molecular diseases using advanced techniques and designer medicines; or gaining new insights into environmental and molecular toxicology; or testing theories of aging and the limits of DNA repair and cell maintenance. A question that will come back to you often is, who profits and who benefits from these and other advances in molecular biology?

- *Class project:* You will participate in putting together an opinion cloud on "biohacking" and other forms of "rapid progress" in the present era of cheap and easy tools for reaping information from biological samples and for manipulating genomes.
- *Exam 2 focus (Thursday, May 9) - The two-way street of progress: New techniques improve our understanding of how biology works; that improved understanding then spurs the invention of the next round of new techniques.*

Unit 3. Weeks 7-10

- *Textbook topics include:* Which organisms can be genetically manipulated? Cloning and using ancient DNA. CRISPR technology for precision engineering of genomes. Gene drives for spreading new genomes across populations.
- *In-the-news topics may include:* Molecular machines built to order. Expanded genetic code. Synthetic cells. Molecular technologies and patent law. Limits of biological design and engineering costs. Shaping evolution. GMO mosquitoes for fighting the Zika epidemic.
- *Class project: Put together a Molecular Biology Impact Statement (MBIS) on a specific topic chosen by the class. Possibilities include "Making pests extinct: Menace or opportunity?" or "Restoring extinct species: Menace or opportunity?" or "Designer children: Menace or opportunity?" You get the idea. We'll choose something interesting.*
- *Exam 3 focus (Wednesday June 12 9:30 am). Cumulative synthesis of all topics we have touched upon. Gene editing.*

Evaluation of Student Performance

Performance categories and approximate weightings: Participation in discussions and completion and timely submission of assignments related to class projects in Units 1 and 2 (~30%); graded exams in Units 1, 2 and 3 (~45%); participation in discussions and timely submission of assignments related to the final class project, our molecular biology impact statement (~25%). Scoring in these categories will be based on announced rubrics.

Final letter grade: The grading scale will be modified University standard, i.e. 100-85% A; 85-75% B; 75-65% C. The plus/minus system will be used near the interfaces. Scores below 65% but that involved a steady effort and participation will generally receive a grade of C-. You will not fail if you participate! Letter grades of D (65%-50%) or F (below 50%) will be issued if low scores are accompanied by lack of participation, failure to regularly attend class, failure to turn in assignments, or failure to take exams. Excused absences and

makeup exams are not given lightly and require documented explanations that meet university guidelines.

Learning Resources

- *Free textbook.* [An Introduction to Molecular Biology](#). I have used online source materials to edit and tailor a book that aligns well with the topics we will cover.
- *Canvas.* Lecture notes, slides and links to outside information will be posted on Canvas. Lecture notes will often include graphics and text from wikimedia, including the freely available [Chapter 7 of Biochemistry Free for All](#) by Kevin Ahern and Indira Rajagopal.
- *Canvas discussions.* I'm fairly new to this method, so let's work out the bugs together.
- *Many other free online sources.* These will be announced as we proceed.
- *Articles from the scientific literature* will be frequently assigned. Some titles will require access through the OSU library.
- *Google Docs:* Group projects may involve collaborations using documents and spreadsheets.

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> ([Links to an external site.](#))[Links to an external site.](#). 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.

Expectations for Student conduct

Choosing to join the Oregon State University community obligates each member to a code of responsible behavior. Here is a link to the OSU [Statement of Expectations for Student Conduct](#) ([Links to an external site.](#))[Links to an external site.](#): Please review these expectations and practice this code of behavior in all of your campus activities.