

Synthetic Biology: design principles and applications in medicine and industry

Course number: MBI450/750C

Spring 2020

Credit hours: 2 (MBI450) / 3 (MBI750)

Time: 10:05-11:00 am MW(F)

Classroom: 004 Hughes Laboratories

Instructor

Dr. Xin Wang

50 Pearson Hall | Office Hours: 11:00am-12:00pm MW

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Prerequisite

Students from biology, microbiology, chemistry, and engineering majors are welcome to elect the course. Basic understanding on molecular biology, biochemistry, and microbiology are required. MBI201 serves as the prerequisite for MBI students.

Course rationale

Synthetic biology applies basic genetic/metabolic principles to engineer biological cells to attain new functions. Synthetic biology research is a cutting-edge area that marries knowledge from biology, chemistry, physics, and engineer principles. It is still in the infancy of development, yet synthetic biology has already brought breakthroughs in human medicine, industrial and pharmaceutical development, environmental protection, and crop improvement. Leading institutes in the country are promoting cutting-edge research in synthetic biology initiatives. Internationally well-known synthetic biology contest such as the International Genetically Engineered Machine (iGEM) brings talent from all over the world every year to advance synthetic biology design, inspiring young minds to bring novel solutions to combat problems in our societies. As one of the leading public research institutes for undergraduates in the nation, synthetic biology is noticeably absent from our programs and initiatives. The establishment of such a course will serve as a starting point to bring this cutting-edge field into Miami University.

Course goals

Students are expected to gain the following knowledge and principles regarding synthetic biology.

- Have in-depth understanding on microbial genetics
- Have in-depth understanding on microbial physiology
- Have basic understanding on engineering principles
- Understand design principles for synthetic biology
- Be able to design synthetic biology research by applying engineering principles to biological cells

- Explore the possibility to develop synthetic biology tools for applications in biotechnology and human health.

Academic Integrity:

Miami University has extremely strict policies on academic misconduct and plagiarism. I expect all students to behave honestly in their learning and I will not tolerate cheating, plagiarism or any other forms of academic dishonesty. You should familiarize yourself with Miami's policies and punishments for Academic Dishonesty:

<http://miamioh.edu/policy-library/students/undergraduate/academic-regulations/academic-integrity.html>

Students who are found responsible for committing academic dishonesty will receive a sanction that ranges from a zero on the assignment to an F in the course. Students who are found responsible for committing two acts of dishonesty (academic or Code of Student Conduct section 102 (Dishonesty)) automatically will be suspended from Miami University.

Miami University's Withdrawal Policy:

Miami's policy regarding withdrawal from class can be found in section 01-204 of chapter one of the student handbook. Students are personally responsible for obtaining and submitting the correct paperwork, and following up on BannerWeb on their status. Please be informed on the withdrawal dates.

Unless otherwise noted, all materials presented in this course are the instructors' intellectual property and may not be distributed to any other individuals besides those in the course without the instructor's permission.

Other Course-Specific Information:

Disabilities: Miami University will make reasonable accommodations for students with properly documented disabilities. If you are a student with a disability and feel that you may need a reasonable accommodation to fulfill the essential functions of the course that are listed in this syllabus, students with physical, medical and/or psychiatric disabilities or students with AD(H)D and/or specific learning disabilities are encouraged to contact Student Disability Services at 513-529-1541.

Exams: There will be two take-home exams in the form of short answers. It requires your critical thinking and literature search skills. There will be a one-week period for you to turn in the work.

Quizzes: You will be notified through canvas about the quizzes on certain concepts. The purpose of the quizzes is for you to refresh your memory on certain concepts you have learned in previous classes. Therefore, quizzes must be taken PRIOR to a particular lecture. All quizzes will be turned in through Canvas.

Literature Presentation: You will be working in teams to present a selected research article by the instructor. Your grade will depend on peer review and instructor evaluation.

Grading

- Online quizzes (10%)
- Take-home mid-term exam (30%)
- Research presentation on a selected paper by the instructor (20%)
- Take-home final exam (30%)
- In class participation (10%)

Course structure and schedule

The course contents include lectures, in-class discussion, and literature presentation.

Week 1				
Jan 27	M	Introduction to synthetic biology		
Jan 29	W	Principle of biosynthesis		
Jan 31	F	MBI750 Literature discussion		
Week 2	II.			
Feb 3	M	Central metabolism: glycolysis		
Feb 5	W	Central metabolism: keto acids metabolism		
Feb 7	F	MBI750 Literature discussion		
Week 3				
Feb 10	M	Biofuel production-higher alcohols		
Feb 12	W	Central metabolism: PPP	no grade drop date (2/13/20)	
Feb 14	F	MBI750 Literature discussion		
Week 4	III.			
Feb 17	M	Glycolysis redesign-I		
Feb 19	W	Glycolysis redesign-II		
Feb 21	F	MBI750 Literature discussion		
Week 5				
Feb 24	M	Secondary metabolism: terpene biosynthesis		
Feb 26	W	The tale of artemisinin biosynthesis		
Feb 28	F	MBI750 Literature discussion		
Week 6				
Mar 2	M	Exam I		
Mar 4	W	Energy generation in cells-I		
Mar 6	F	MBI750 Literature discussion		
Week 7				
Mar 9	M	Energy generation in cells-II		
Mar 11	W	Synthetic electron transport applications		
Mar 13	F	MBI750 Literature discussion		
Week 8				
Mar 16	M	Synthetic electron transport applications		
Mar 18	W	Photosynthesis		
Mar 20	F	MBI750 Literature discussion		

Week 9				
Mar 23-27		No Classes - Spring Break		
Week 10				
Mar 30	M	Photosynthesis redesign		
Apr 1	W	Photosynthesis redesign		
Apr 3	F	MBI750 Literature discussion		
Week 11				
Apr 6	M	Central dogma and the molecular machinery	<i>Last day to drop with 'W'</i>	
Apr 8	W	Expanding the genetic code		
Apr 10	F	MBI750 Literature discussion		
Week 12				
Apr 13	M	Genome synthesis		
Apr 15	W	Multiplex genome engineering		
Apr 17	F	MBI750 Literature discussion		
Week 13				
Apr 20	M	Psilocybin biosynthesis		
Apr 22	W	Systems biology techniques: mass spec		
Apr 24	F	MBI750 Literature discussion		
Week 14				
Apr 27	M	Gene regulation		
Apr 29	W	Genetic circuit		
May 1	F	MBI750 Literature discussion		
Week 15				
May 4	M	Genetic circuit applications		
May 6	W	Group literature presentation		
May 8	F	Group literature presentation		
Week 16				
	Finals Week			