

Synthetic Biology

BSC 4467 / MCB 6937, Fall 2023

Instructor

Dr. Xin Wang

Microbiology and Cell and Science, Office – MCS 1152

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Please resolve technical issues by contacting the UF helpdesk (<http://helpdesk.ufl.edu>; (352) 392-HELP (4357); helpdesk@ufl.edu · HUB 132).

Delivery Method

Online - asynchronous

Credits

3 Credit hours

Course Description

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 engineering 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. This course will introduce design principles and applications of biological cells. Topics include synthetic pathway design, artificial photosynthesis, repurposing genetic codons, genome synthesis and editing, and genetic circuit design among others.

Course Objectives/Goals/Learning Outcomes

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

- Have an in-depth understanding of microbial genetics
- Have an in-depth understanding of microbial physiology
- Have a basic understanding of metabolic engineering principles
- Understand design principles for biology
- Be able to design synthetic biology research
- Explore the possibility to develop synthetic biology tools for applications in biotechnology and human health.

Prerequisites

MCB 3020 or 3023 (or equivalent)

Course Material and Assignments

All required course materials will be available through the Canvas e-Learning site (<http://elearning.ufl.edu/>). Instructions for and submission of assignments will also be through Canvas.

Required Textbooks

There is no required textbook.
Required reading materials will be posted to Canvas.

Weekly Course Schedule

Dates (week)	Topics	Readings
Week 1	Introduction to synthetic biology	Weekly reading materials will be posted on Canvas.
	Principle of biosynthesis	
Week 2	Central metabolism: glycolysis	
	keto acids metabolism	
Week 3	Biofuel production-higher alcohols	
	Central metabolism: PPP	
Week 4	Glycolysis redesign	
Week 5-6	Secondary metabolism: terpene biosynthesis	
	The Tale of artemisinin biosynthesis	
Week 7	Energy generation in cells	
Week 8	Synthetic electron transport chain	
Week 9-10	Photosynthesis and its redesign	
Week 11	Central Dogma and the molecular machinery	
Week 12-13	Expanding the genetic code	
	Genome synthesis	
	Multiplex genome engineering	
Week 14-15	Gene regulation	
	Genetic circuit design and Applications	

Exam Dates/Calendar/Critical dates and deadlines

Week 6 – Exam 1
 Week 10 – Review paper first submission due
 Week 11 – Manuscript Presentation Due
 Week 14 – Review paper final submission due
 Week 15 – Final exam

Exam Administration - Honorlock

All exams will be administered through Honorlock using Canvas in E-learning with

students using personal computers. The exam may be taken at any location approved by Honorlock during the scheduled exam window on Canvas. Appointments are not needed with Honorlock.

Evaluation of Learning/Grades

- Bonus Quizzes (Up to 10%)
- Review paper writing (20%)
- Mid-term exam (30%)
- Research paper presentation (10%)
- Discussion and participation (10%)
- Final exam (30%)

Exams

There will be two exams in the form of short answers. It requires critical thinking skills and knowledge from the content learned in lectures.

Discussion, Quizzes, Homework

Bonus Quizzes – There will be non-proctored quizzes for certain lecture modules, worth up to 10% of your total grade. You will be notified through Canvas about the quizzes on certain concepts. The purpose of the quizzes is for you to refresh your knowledge on certain concepts you have learned in this class or previous classes.

Discussion groups and Homework – The purpose of the discussion group is to encourage student-student interaction and peer learning. The discussion is on current literature that follows lectures of each module. There will also be homework assignments that ask you to answer questions related to the literature. This will count toward your participation points and serve as a starting point for discussion. Students are encouraged to ask and answer other related questions in the discussion group. I will monitor the discussion on Canvas.

Presentation

Each student will present a manuscript from the primary literature that was published within the last 5 years. The presentation will be 10-15 minutes in length and must adequately describe the methods and results conveyed in at least three figures from the manuscript or its supplemental data. You will need to make a video and upload it to Canvas. Each presentation will be reviewed by two of your peers. Grades will be assigned based on the input of your classmates and the view of the instructor.

Opinion-type review papers:

There are two opinion-type review paper submissions during the semester regarding microbial metabolism. You will be notified of topics to write about ahead of time through Canvas. This is to gauge your understanding of the class topics and your critical thinking abilities. Instructions for the paper will be posted on Canvas.

Grading Policy

Final letter grades will be assigned based on the number of points earned, as follows:

A = 92-100%, A- = 90-91%
B+ = 88-89%, B = 83-87%, B- = 80-82%
C+ = 78-79%, C = 73-77%, C- = 70-72%
D+ = 68-69%, D = 63-67%, D- = 60-62%
F = <60%

More information on grades and grading policies is here:

<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

Class Attendance and Make-Up Policy

Requirements for class attendance and make-up exams, assignments and other work are consistent with university policies that can be found at:

<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>.

Services for Students with Disabilities

The Disability Resource Center coordinates the needed accommodations of students with disabilities. This includes registering disabilities, recommending academic accommodations within the classroom, accessing special adaptive computer equipment, providing interpretation services and mediating faculty-student disability related issues. Students requesting classroom accommodation must first register with the Dean of Students Office. The Dean of Students Office will provide documentation to the student who must then provide this documentation to the Instructor when requesting accommodation - 0001 Reid Hall, 352-392-8565, www.dso.ufl.edu/drc/

Campus Helping Resources

Students experiencing crises or personal problems that interfere with their general well-being are encouraged to utilize the university's counseling resources. The Counseling & Wellness Center provides confidential counseling services at no cost for currently enrolled students. Resources are available on campus for students having personal problems or lacking clear career or academic goals, which interfere with their academic performance.

- *University Counseling & Wellness Center, 3190 Radio Road, 352-392-1575, www.counseling.ufl.edu*
 - Counseling Services
 - Groups and Workshops
 - Outreach and Consultation
 - Self-Help Library
 - Wellness Coaching
- U Matter We Care, www.umatter.ufl.edu/
- *Career Connections Center, First Floor JWRU, 392-1601, <https://career.ufl.edu/>.*

Academic Resources

- E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. <https://lss.at.ufl.edu/help.shtml>.
- Career Resource Center, Reitz Union, 392-1601. Career assistance and

- counseling. <http://www.crc.ufl.edu/>
- Library Support, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.
 - Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. <http://teachingcenter.ufl.edu/>
 - Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers. <http://writing.ufl.edu/writing-studio/>

Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>

Netiquette guide for online courses

It is important to recognize that the online classroom is in fact a classroom, and certain behaviors are expected when you communicate with both your peers and your instructors. These guidelines for online behavior and interaction are known as netiquette.

<http://teach.ufl.edu/wp-content/uploads/2012/08/NetiquetteGuideforOnlineCourses.pdf>

University Honesty Policy

As a student at the University of Florida, you have committed yourself to uphold the Honor Code, which includes the following pledge: *"We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity."* You are expected to exhibit behavior consistent with this commitment to the UF academic community, and on all work submitted for credit at the University of Florida, the following pledge is either required or implied: *"On my honor, I have neither given nor received unauthorized aid in doing this assignment."*

It is assumed that you will complete all work independently in each course unless the instructor provides explicit permission for you to collaborate on course tasks (e.g. assignments, papers, quizzes, exams). Furthermore, as part of your obligation to uphold the Honor Code, you should report any condition that facilitates academic misconduct to appropriate personnel. It is your individual responsibility to know and comply with all university policies and procedures regarding academic integrity and the Student Honor Code. Violations of the Honor Code at the University of Florida will not be tolerated. Violations will be reported to the Dean of Students Office for consideration of disciplinary action. For more information regarding the Student Honor Code, please see: <http://www.dso.ufl.edu/sccr/process/student-conduct-honor-code>.

Additional comments regarding academic integrity:

Students are encouraged to discuss material with each other from the course, help each other understand concepts, study together, and even discuss assessment questions with each other once the quiz window is closed. However, the following is considered academic dishonesty, and I expect that no student will ever do any of the following:

- Have another person complete a quiz in this course
- Copy another student's quiz in this course
- Collaborate with anyone during a quiz in this course
- Discuss the questions and answers of a quiz with other students while the quiz window is still open
- Manipulate and/or distribute any materials provided in this course for any purpose (including course lecture slides).
- Use any materials provided by a previous student in the course

Software Use

All faculty, staff and students of the university are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against university policies and rules, disciplinary action will be taken as appropriate.

Microsoft Office 365 Software is free for UF students

<http://www.it.ufl.edu/gatorcloud/free-office-365-downloads/>

Other free software is available at:

<http://www.software.ufl.edu/>

To check for availability of the media and technical requirements, contact the UF Computing Help Desk at (352)392-HELP(4357).

University of Florida Complaints Policy and Student Complaint Process

The University of Florida and most instructors believe strongly in the ability of students to express concerns regarding their experiences at the University. Most problems, questions and concerns about courses can be resolved by professionally communicating with the instructor. Please try to meet your instructor in person, make an appointment to call, or try to set up a remote meeting through Zoom or other media.

If this does not help the University encourages the students who wish to file a written complaint to submit that complaint directly to the department that manages that course. If a problem really persists and cannot be resolved by communicating with the instructor and the department, contact:

- For Residential Course:
https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf.
- For Online Course:
<http://www.distance.ufl.edu/student-complaint-process>

This said, professionalism is a two-way-street. Unprofessional behavior of students includes, among other things: lack of communication, blaming other people or external factors, lying, affecting others negatively in a group or in the class, not accepting

criticism and not being proactive in solving problems or seeking help. Furthermore, faculty often have family and other obligations to tend to. Over the weekend, replies to your inquiries or questions may be delayed. If a student is lacking professionalism repeatedly, the instructor has the rights to file formal complaint against the student through the Dean of Student office.