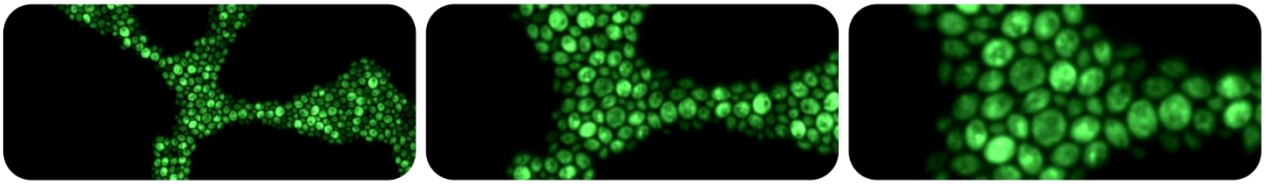
HOS6932 - Advances in Plant Synthetic Biology, Fall 2024



3 Graduate Credits

Meets: 10:40-11:30 am on Mon, Wed, Fri;
Synchronous Classes via Zoom, with materials on Canvas
Join Zoom Meeting Meeting ID: 970 3507 9957 Passcode: 865477

95% Online; 5% of Assignments Require Physical Presence at UF

Instructors (Horticultural Science Department):
Cătălin Voiniciuc (Coordinator) Bldg. 885, 0003B; (352) 273-4782, cvoiniciuc@ufl.edu
Andrew Hanson Fifield Hall, 2143; (352) 273-4856, adha@ufl.edu
Edmar R. Oliveira-Filho Fifield Hall, 2302; (352) 273-4859, ramosdeoli.edmar@ufl.edu

Course Description
This course is designed to introduce graduate students to the basic principles of synthetic biology (SynBio) as well as the latest advances in this emerging field. Topics will include the implementation of Design-Build-Test-Learn cycles for metabolic pathways and regulatory circuits, directed evolution, and biofoundry-driven automation. Emphasis will be on plant systems, with bacterial and yeast systems included when appropriate to accelerate the study of plant enzymes and products. This online class will enable state-wide participation and combine lectures with interactive discussions and activities, but space is limited so register early. Part of the final assignment (5% of course-grade) will involve an in-person outreach activity. This class will empower students to identify, evaluate, and effectively present SynBio innovations that address agricultural challenges.

Knowledge Prerequisites: There are no strict prerequisites, but basic knowledge of molecular biology such as the flow of information (DNA → RNA → protein) in living organisms is needed.

Learning Objectives:
After successful completion of this course, students will be able to:
- Recognize the origins of SynBio, the state of the art, and emerging opportunities
- Analyze and evaluate the feasibility of proposed solutions to real-world problems
- Compare SynBio successes in microbial systems with recent advances in plants
- Demonstrate how biological cells can be programmed to make designer molecules
- Propose SynBio approaches to address relevant biological challenges
- Predict the bottlenecks to reaching the desired targets and design alternatives

Office hours: The course coordinator will have office hours at 3:00 to 3:30 pm Fridays. Meetings can be arranged by personal appointment via email to the instructors using the contact details above. General questions and discussions can be posted on the Canvas discussion forum. Please follow these guidelines for effective online interactions:
- Guide from UF's Quality Assurance Committee: Netiquette Guide for Online Courses

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Weekly Schedule and Assignments

- Subtopics that include assignments are marked in **bold**
- UF approved holidays are shaded in blue

Date	Class	Instructor	Module	Subtopic
Fri, Aug 23	01	Voiniciuc	SynBio and its origins	Scope of SynBio
Mon, Aug 26	02	Hanson		History of SynBio & Plant SynBio
Wed, Aug 28	03	Voiniciuc		DBTL cycle & examples
Fri, Aug 30	04	Voiniciuc		Biofoundries & industrialization of biology
Mon, Sept 2	Holiday		Labor Day	-
Wed, Sept 4	05	Hanson	Applying Fermi calculations	Worked examples in class
Fri, Sept 6	06	Hanson		**Presentation/discussion of Fermi homework**
Mon, Sept 9	07	Voiniciuc & Hanson		Introduction to Class Projects and Choices
Wed, Sept 11	08	Voiniciuc	Cells as circuit boards	Logic gates & building them in cells
Fri, Sept 13	09	Voiniciuc		Bacterial logic gates & metabolic valves
Mon, Sept 16	10	Voiniciuc		Plant logic gates – development
Wed, Sept 18	11	Voiniciuc		Plant logic gates – physiology/metabolism
Fri, Sept 20	12	Voiniciuc	Biosensors & optogenetics	Design principles
Mon, Sept 23	13	Voiniciuc		Bacterial biosensors
Wed, Sept 25	14	Voiniciuc		Plant and eukaryotic biosensors
Fri, Sept 27	15	Voiniciuc		Non-plant optogenetics
Mon, Sept 30	16	Voiniciuc		**Plant optogenetics**
Wed, Oct 2	17	Hanson	Directed evolution	Classical vs. continuous directed evolution
Fri, Oct 4	18	Hanson		Classical enzyme evolution examples
Mon, Oct 7	19	Hanson		Continuous directed evolution examples
Wed, Oct 9	20	Hanson		**Plant directed evolution activity**
Fri, Oct 11	21	Oliveira-Filho	Plant-related Industries	Case 1 - Artemisinin
Mon, Oct 14	22	Oliveira-Filho		Case 2 - Amyris products
Wed, Oct 16	23	Oliveira-Filho		Scale-up & its problems
Fri, Oct 18	Holiday		Homecoming	-

Mon, Oct 21	24	Hanson	Synthetic metabolism	Going beyond nature
Wed, Oct 23	25	Hanson		In vitro synthetic metabolism
Fri, Oct 25	26	Hanson		Bacterial syn. metabolism
Mon, Oct 28	24	Hanson		Plant synth metabolism
Wed, Oct 30	25	Voiniciuc	Making and breaking polymers	Biopolymer engineering
Fri, Nov 1	26	Voiniciuc		Protein glycosylation
Wed, Nov 4	27	Voiniciuc		Designer polysaccharides
Wed, Nov 6	28	Voiniciuc		Lignin valorization
Fri, Nov 8	29	Voiniciuc		**Biomass challenges and the new bioeconomy**
Mon, Nov 11	Holiday		Veterans Day	-
Wed, Nov 13	33	Voiniciuc		Plants for biofortification
Fri, Nov 15	34	Voiniciuc & Hanson	SynBio solutions to planetary problems	**Class project presentations & critiques**
Mon, Nov 18	35	Voiniciuc & Hanson		**Class project presentations & critiques**
Wed, Nov 20	36	Voiniciuc & Hanson		**Class project presentations & critiques**
Fri, Nov 22	37	Voiniciuc	Future of Plant SynBio	Emerging plant systems
Mon, Nov 25	Holiday		Thanksgiving Break	-
Wed, Nov 27	Holiday		Thanksgiving Break	-
Fri, Nov 29	Holiday		Thanksgiving Break	-
Mon, Dec 2	38	Voiniciuc		Transformation barriers
Wed, Dec 4	39	Voiniciuc		**Plant SynBio Outreach**

- **Student Evaluation and Grading**

The class will combine lectures with interactive assignments that will be done primarily in small groups, as well as some individual tasks. Students will have take-home assignments to assess the scale and feasibility of SynBio solutions to global problems using Fermi calculations. The primary semester project (activity 5) will involve research on start-up companies and in-class presentations. For all assignments, a portion of the grade will be based on professional attitude and active participation in the discussions. As part of activity 6, in addition to regular class participation throughout the semester, students will disseminate key lessons from the course to the UF/IFAS community and beyond. Graduate student expectations and standards for all the activities will be detailed in class and will follow the UF Grades and Grading Policies.

Activity	**Points**	**% of Grade**
1) Fermi Calculations and Discussion	60	15%
2) Biosensors and Optogenetics Activity	20	5%
3) Plant Directed Evolution activity	20	5%
4) Lignocellulosic Biomass / Bioeconomy Activity	20	5%
5) SynBio Solutions to Planetary Problems	200	50%
6) Plant SynBio Class Participation and Outreach	80	20%
Total	400	100%

Class Attendance

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This course will be delivered synchronously online via Zoom, so students will need internet access and are expected to log in prior to scheduled class times to ensure a timely start. Physical presence at UF/IFAS research facilities (https://research.ifas.ufl.edu/research-areas/facilities/) will be required to complete the outreach assignment. The course coordinator will record the bulk of class activities and post them on Canvas. Sharing of course materials is prohibited without the written consent of the instructors. Since attendance of all classes is expected, contact the coordinator **prior to** the scheduled meeting if you are ill or an emergency occurs. The attendance requirements are consistent with university policies that can be found at: https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx

Course Materials
No textbooks are required for this class, since there is no book that fully covers this rapidly developing field. Review and research articles will be provided to students electronically on Canvas. The required and optional reading will be available at least a week before each lecture.

- There are no materials and supplies fees for this course.

Online 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/.

University's Honesty Policy
UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students 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."

- Student Honor Code: http://www.dso.ufl.edu/sccr/process/student-conduct-honor-code
- Guidelines for acceptable use of AI Tools: https://go.ufl.edu/edis-ai-v1

Health and Wellness Resources

- University Counseling & Wellness Center, 352-392-1575, www.counseling.ufl.edu/cwc/
- Matter We Care, www.umatter.ufl.edu/
- Career Resource Center, First Floor JWRU, 392-1601, www.crc.ufl.edu/
- Student Success Initiative, http://studentsuccess.ufl.edu

Students with Disabilities
To request classroom accommodations, please consult the *Disability Resource Center*, 0020 Reid Hall, 392-8565, www.disability.ufl.edu

Student Complaints

- You can file and resolve any complaints about your experience in this course in the following site: www.distance.ufl.edu/student-complaint-process