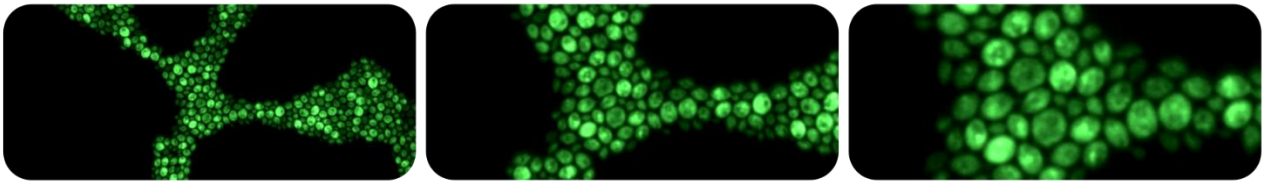
Advances in Plant Synthetic Biology, Fall 2023



HOS6932, Section 3355, Class 013290
3 Graduate Credits

Meets: 10:40-11:30 am on Mon, Wed, Fri;
Synchronous Classes via Zoom, with materials on Canvas
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. Due to team-based activities, **class registration is limited to only 16 students**. Part of the final assignment (5% of course-grade) will require an in-person interview with a scientist at one of the UF/IFAS research facilities. 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 be available from 3 to 4 pm on Fridays. Meetings can be arranged by personal appointment via email to the instructors using the contact details above. Questions and discussions about course content are encouraged to be posted on the Canvas discussion forum. Please follow these guidelines for effective online interactions

Advances in Plant Synthetic Biology, Fall 2023

- Guide from UF's Quality Assurance Committee: Netiquette Guide for Online Courses
- Email etiquette rules: https://www.inc.com/business-insider/email-etiquette-rules.html

Weekly Schedule and Assignments

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

Date	Class	Instructor	Module	Subtopic
Wed, Aug 23	01	Voiniciuc	SynBio & its origins	Scope of SynBio
Fri, Aug 25	02	Hanson		History of SynBio and Plant SynBio
Mon, Aug 28	03	Voiniciuc		DBTL cycle and examples
Wed, Aug 30	04	Voiniciuc		Biofoundries and industrialization of biology
Fri, Sept 1	05	Hanson	Applying Fermi calculations	Worked examples in class
Mon, Sept 4		Holiday – Labor Day		-
Wed, Sept 6	06	Hanson		**Presentation/discussion of Fermi calculations 1**
Fri, Sept 8	07	Hanson		**Presentation/discussion of Fermi calculations 2**
Mon, Sept 11	08	Voiniciuc	Cells as circuit boards	Building genetic circuits
Wed, Sept 13	09	Voiniciuc		Bacterial logic gates
Fri, Sept 15	10	Voiniciuc		Plant logic gates – Part I
Mon, Sept 18	11	Voiniciuc		Plant logic gates – Part II
Wed, Sept 20	12	Voiniciuc	Biosensors & optogenetics	Design principles
Fri, Sept 22	13	Voiniciuc		Bacterial biosensors
Mon, Sept 25	14	Voiniciuc		Plant and eukaryotic biosensors
Wed, Sept 27	15	Voiniciuc		Non-plant optogenetics
Fri, Sept 29	16	Voiniciuc		**Plant optogenetics activity**
Mon, Oct 2	17	Hanson	Directed evolution (DE)	Introduction to DE DE and genome editing (GE)
Wed, Oct 4	18	Hanson		Classical DE – enzyme examples
Fri, Oct 6		Holiday – Homecoming		-
Mon, Oct 9	19	Hanson		Continuous DE – enzyme examples
Wed, Oct 11	20	Hanson		**Plant DE-GE activity**
Fri, Oct 13	21	Hanson	Synthetic metabolism	Concept of going beyond nature
Mon, Oct 16	22	Hanson		In vitro synthetic metabolism
Wed, Oct 18	23	Hanson		Microbial synthetic metabolism
Fri, Oct 20	24	Hanson		Plant synthetic metabolism
Mon, Oct 23	25	Voiniciuc	Making & breaking polymers	Polymers and biotechnology
Wed, Oct 25	26	Voiniciuc		**Engineered living materials activity**
Fri, Oct 27	27	Voiniciuc		Designer polysaccharides

Mon, Oct 30	28	Voiniciuc		Lignin valorization
Wed, Nov 1	29	Voiniciuc		Lignocellulosic challenges

Date	Class	Instructor	Module	Subtopic
Fri, Nov 3	30	Oliveira-Filho	Plant-related Industrial SynBio	Example 1 - Artemisinin
Mon, Nov 6	31	Oliveira-Filho		Example 2 - Amyris products
Wed, Nov 8	32	Oliveira-Filho		Scale-up and its problems
Fri, Nov 10		Holiday – Veterans Day Observed		-
Mon, Nov 13	33	Voiniciuc		Plants for biofortification
Wed, Nov 15	34	Voiniciuc & Hanson	**Class project presentations and critiques**	**Project I: Replacing vegetable oils**
Fri, Nov 17	35	Voiniciuc & Hanson		**Project II: Carbon sequestration**
Mon, Nov 20	36	Voiniciuc & Hanson		**Project III: Better indoor air quality**
Wed, Nov 22		Holiday – Thanksgiving		-
Fri, Nov 24		Holiday – Thanksgiving		-
Mon, Nov 27	37	Voiniciuc	New Tools & Future SynBio	*In silico* tools for SynBio
Wed, Nov 29	38	Voiniciuc		Plant transformation barriers
Fri, Dec 1	39	Voiniciuc		Emerging plants for SynBio
Mon, Dec 4	40	Voiniciuc		**Your SynBio Adventure – Part I**
Wed, Dec 6	41	Voiniciuc		**Your SynBio Adventure – Part II**

Student Evaluation and Grading

The class will combine lectures with interactive assignments that will be done primarily in small groups (activities 1 and 5), as well as some individual tasks. For instance, 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 poster preparation and in-class presentation. 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, students will have to interview a scientist at a physical UF/IFAS location. 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 DE-GE activity	20	5%
4) Engineered Living Materials Activity	20	5%
5) SynBio Solutions to Planetary Problems	200	50%
6) Your SynBio Adventure and Discussion		
a. In-person Interview with UF/IFAS Scientist	20	5%
b. Class presentation with infographic	40	10%
c. Written reflection on Plant SynBio	20	5%
Total	400	100%

Advances in Plant Synthetic Biology, Fall 2023

Class Attendance
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 final assignment. Recording and sharing of 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