

SynBio in the Environment

Course Description:

“SynBio in the Environment” is a discussion-guided class in which students are introduced to different problems in the environment, how synthetic biologists have tried to solve them, and how those solutions were implemented (or not) in the real world. In addition to introducing the emerging field of synthetic biology, this course equips students with analytical frameworks to investigate synthetic biology solutions through the lens of economics, ethics, policy and sustainability.

Prerequisites:

None.

Textbooks/Readings:

Readings will be assigned on a weekly basis and will be the focus of each lecture. Readings will consist of scientific journals, reviews and news articles. In addition, relevant news articles will be shared and briefly addressed in class if students have questions but are not required.

Grading Policy:

(50%) Participation: Attendance and contribution to class discussions

(20%) Homework: Five brief assignments consisting of literature reviews and opinion-based responses

(30%) Final project: Identify a world issue and create or improve upon a GMO to solve it. Students will also address potential societal benefits and concerns and its socioeconomic impact.

Lecture Objectives:

The goal of each lecture is to address...

1. Problem: Is a scientific advancement necessary? Why?
2. Solution: What was the solution? How does it address the issue at hand?
3. Science: How was the solution identified and synthesized?
4. Societal response: Was the device/organism put to use? Why or why not?

Weekly Schedule:

Week 1: What is Synthetic Biology? How do synthetic biologists think?

- Understand the essence of synthetic biology, as well as basic practices/techniques and motifs
- Learn the importance of maintaining practical bioethical standards
- **Homework:**
 - Browse [this timeline of SynBio milestones](#)
 - Read about the use of GMOs to clean oil spills in article [1](#) or [2](#)

Week 2-4: How do GMOs Impact the Oil Industry?

Week 2

- Learn about a patented synthetic organism that eats crude oil
- **Homework:**
 - Watch Pump! (documentary), paying close attention to viability of alternatives
 - Learn about [the basics of biofuel production](#)

Week 3

- Discuss the first release of a synthetic organism into the ecosystem
- Importance of biocontainment, and common strategies in practice
- **Homework:**
 - Read more about [the synthesis of biofuels](#)

Week 4

- Discuss the economy and readiness of biofuel production
- **Homework:**
 - Read "[The Superpowers of Genetically Modified Pigs](#)"

Week 5-7: SynBio in Agriculture and American Homes

Week 5

- Discuss the creation and enhancement of the corn crop
- Learn how pigs that fart less cause cancer (or don't!)
- **Homework:**
 - Watch Food Revolution (documentary) and provide a written response
 - By week 8, collect 5 interviews about why people do/don't buy GMO food products
 - [Read about AgroSpheres](#)

• Week 6

- Learn about antibiotic, disease and pest resistance and its effect on the food industry
- **Homework:** response to critics' review on GMO chicken
 - Read "[The Genetically Modified Chicken: How We Have Altered 'Broiler' Chickens for Profit](#)"

• Week 7

- How larger populations are achieved in agriculture and aquaculture
- **Homework:**
 - Finish and submit a transcript of GMO interviews
 - Read about [the use of GMOs for water treatment](#)

Week 9-10: Cleaning Waterways

- Week 8
 - Use of nitrogen fixation to clean waterways
 - **Homework:**
Read about [bioinspired methods of cleaning waterways](#)
- Week 9
 - Learn what other drugs/chemicals are being detected in and removed from waterways
 - **Homework:**
Read about "[Self-Healing Concrete](#)"

Week 10-11: SynBio in Infrastructure

- Week 10
 - The creation, improvement and impact of self-healing concrete
 - **Homework:**
Read about [MITs creation of glowing plants](#)
- Week 11
 - The long-time promise of glowing plants
 - **Homework:**
Check out [our site](#) and describe one project component and its significance

Weeks 12-13 Micro-Organisms and Microplastics:

- Week 12
 - Discuss Transfoam in light of global plastic use
 - Introduce elementary biosafety regulations
 - Learn about various careers in the field and their relation to the environment
 - **Homework:**
Research Sci-Fi uses of GMOs and come up with your own
- Week 13
 - Potential long-term promise of synthetic organisms in the environment
 - Terraforming Mars with synthetic organisms and its implications
 - **Homework:**
Complete class reflection and start wrapping up your final project

Week 14: Sci-fi future

- Wrap up future applications and begin final presentations/discussions
- **Homework:** Finish your final and be ready to present/discuss next week

Week 15: Finals and open discussion

- Final project presentations
- Open discuss opinions of cases/examples covered in class
- **Homework:** try out for iGEM in the Fall!