

Sutardja Center for Entrepreneurship & Technology
UC Berkeley
scet.berkeley.edu

Course Number: INDENG 185-001- Class # 30700

Course Title: **Challenge Lab- Product Design of Plant-Based Foods**

Semester: SPRING- 2022

Instructors: Ricardo San Martin, rsanmartin@berkeley.edu; Celia Homyak, chomyak@berkeley.edu

GSI or Course Coordinator: Erin Rieckmann, erinrieckmann@berkeley.edu

Meeting Day/Time: MW 4:00P-5:59P

Meeting Location: | In person 241 CORY- Zoom as instructed by Campus Policies.

Grading Basis: Letter grade, P/NP, S/U

Course Format: 2 h lectures or instructor-led workshops / team projects (4-person max)

Office Hours: M-W 3-4 pm via zoom, please request meetings (15 min). A link will be provided to sign in.

Final Presentation and/or Final Exam: Final presentation during recitation week- May 2-6, 2022

Course Website: <https://bcourses.berkeley.edu/courses/1512014>

Course Prerequisites- Background in biological sciences, chemical engineering, plant biology, business and related subjects is recommended. Other majors are also welcomed on a case-to-case basis.

Course Objectives

In this class you will learn the entrepreneurial skills required to design novel plant-based foods (PBF) capable of triggering massive consumer change and positively impacting our world. By looking in depth into how existing PBF are produced: plant-based milk, meat, cheese, etc., you will develop research skills to navigate this until now secretive research and production landscape. This will allow you to develop an independent point-of-view to critically assess the present narrative developed by the wPBF and if these products will truly generate the positive impact that they promise.

Working in teams you will design an original and meaningful PBF, based on a thorough understanding of the scientific and technological foundations needed for its production: food microstructure-macrostructure relationships, texture and flavor chemistry, manufacturing processes (scaling-up), quality assurance, regulatory issues, etc. The project will involve product design (iterative prototyping), production process, inputs (raw materials, utilities, etc.) and outputs of the process (unwanted by-products, secondary products, effluents, etc.), sizing of equipment, production costs and estimated income, distribution and marketing issues, identifying potential partners, among others. The projects will draw upon our network of scientists, entrepreneurs, collaborating companies (Nestle, Thimus, Merck, Louis Dreyfus, Mantiqueira), venture capitalists, etc.

At the end of this course, you will have gained knowledge and/or experience in the following areas:

- Independent and team-based research skills to understand how novel PBF are manufactured and critical skills to assess if the products are healthy, sustainable and affordable.
- Scientific and technological principles involved in the production of present and future PBF.
- Effective teamwork skills to explore this new landscape and identify opportunities for novel ventures.
- Skills to develop from concept to market innovative and meaningful PBF.

Textbook/Resources

- Research papers/videos/ book chapters/industry studies will be provided in the web site by the instructor

Assignments

Independent reflections: You will be asked to develop your own independent research skills to understand the scientific, technological and cultural hurdles needed to effectively design meaningful and impactful PBF. To accomplish this, you will be required to submit 6-8 independent reflections around specific questions provided by the instructor.

Readings: the class relies heavily on your passion to learn about plant-based foods, by reading numerous research papers, book chapters, etc. provided by the instructor and by your own research. These readings are meant to be read before each class. In some classes, you will be examined on the readings.

Project: The team-based, semester-long project has three team-based presentations and one final presentation in front of a jury composed by entrepreneurs, scientists, venture capitalists and collaborating companies. Project details are given in a separate handout (project brief).

Attendance/Participation- regular attendance to classes is required to pass. Because the course is largely based on group participation, mandatory attendance is to your benefit. If you have an unexpected problem, you need to communicate this in advance to the instructors. If you do not do this, you will be marked as absent.

Camara on policy: During zoom sessions, you will be asked to have your zoom camara on during the class. Short interruptions are allowed, but you need to warn the teaching team using the chat.

Grading

Semester-Long Team Project: (60%): Your team project will make up the bulk of your grade. Three interim presentations are worth 12% each, plus one final presentation at 24%. Please see the project brief for details.

Reading assignments (10%): Based on the assigned readings, you will be asked to submit your thoughts in either in writing or verbally during class around specific portions of the readings. No late assignments will be accepted.

Blogs/reflections (10%): You will be asked to complete reflections based on questions/activities defined by the instructor. No late assignments will be accepted.

Class participation (10%): You will be asked to make comments on the class/reading contents during lectures.

Team dynamics (10%): at the end of the course each team member will be asked to anonymously evaluate the contribution to the project of other members (see below).

Weekly Schedule (tentative)

The following schedule is meant to provide a broad outline of the course material and structure. However, it is not set-in stone and may be modified as the semester unfolds. Any updates will be communicated via bcourses.

Class	Date	Topic	Homework		Readings
			Assigned	Due	
1	1/19/22	Welcome, outline class details (project-grading-rules-teams), animal welfare talk. GUEST SPEAKER	HW1		1,2
2	1/24/22	Description of challenges/projects. Intro to animal & plant-based foods. Microstructure, chemistry, hierarchy	HW2		
3	1/26/22	GUEST SPEAKER Plant Proteins and how the market for plant-based foods and ingredients is evolving; what are the needs. Teams assigned		HW1	3–6
4	1/31/22	Supply chain for various plant sources (from seed/grain to protein processing to food processing, from distillers grain to protein processing to food processing)	HW3	HW2	7–10
5	2/2/22	Intro to plant protein processing (variation in material/ protein types and how to process them (dry vs wet processing); need to cover variation in processing of different proteins (e.g. prolamins, globulins, albumins)			11–15
6	2/7/22	Intro to different types of plant-based foods (beverages/emulsions, yogurts/cultured, cheeses/gels, meats/texturized), their main components (protein, fat, ash, carbohydrates, moisture) and their function	HW4	HW3	1,16–18
7	2/9/22	Plant-based beverages; components, processing, and microstructure. GUEST SPEAKER			19,20
8	2/14/22	Plant-based meats; components, processing, and microstructure		HW4	21–24
9	2/16/22	PRESENTATION 1: outline project scope (e.g. problem, purpose, goal, preliminary ideas,etc)			
	2/21/22	NO CLASS			
10	2/23/22	Upcycling from spent brewers grains. GUEST SPEAKER	HW5		25
11	2/28/22	Plant protein functionality and its effect on processing and food production			7,15,26–28
12	3/2/22	Characterization of proteins, and plant-based foods (typical instruments and techniques)	HW6	HW5	29,30
13	3/7/22	Extrusion of plant proteins. GUEST SPEAKER			31–33

14	3/9/22	Entrepreneurial class (specific topic TBD)	HW7	HW6	
15	3/14/22	Taste and flavor. GUEST SPEAKER		HW7	34
16	3/16/22	PRESENTATION 2: Scientific basis of solutions proposed; initial cost analysis, first prototypes			
	3/21/22	NO CLASS			
	3/23/22	NO CLASS			
17	3/28/22	VC Vision of plant based foods. GUEST SPEAKER	HW 8		35
18	3/30/22	Fermentation of plant proteins (process, benefits, applications etc.)			36–39
19	4/4/22	Economic evaluation (flow sheet design, mass energy-balances, capital, COGS, ROI)	HW9	HW8	40
20	4/6/22	Scale-up challenges in protein processing			
21	4/11/22	Scale-up challenges in food processing		HW9	
22	4/13/22	Entrepreneurial class (specific topic TBD) GUEST SPEAKER			
23	4/18/22	Technical class (specific topic TBD)			
24	4/20/22	PRESENTATION 3. Process diagram with mass balance and equipment to be used in the production of your food, Address supply chain issues + costing of the ingredients to be used, Address scalability issues, Improved prototype, Timeline with activities and funds required			
25	4/25/22	Techno-economical challenges of cell-based meat OR ANOTHER VC TALK			
26	4/27/22	TBD			
27	5/2/22				
28	5/4/22	FINAL PRESENTATION			

Course Evaluations

At the end of the term, students will be asked to fill out an evaluation to give feedback about the course. SCET values and appreciates student responses, which are used to better understand and improve our courses. Students are strongly encouraged to submit the evaluation.

Scheduling Conflicts

Please notify Michelle Lee (lee.2293@berkeley.edu) in writing as soon as possible about any known or potential extracurricular conflicts. We will try our best to help you with making accommodations but cannot guarantee them in all cases.

Student Code of Conduct & Academic Integrity

UC Berkeley's honor code states "As a member of the UC Berkeley community, I act with honesty, integrity, and respect for others." As a Cal student, you are held to the University's [Student Code of Conduct](#). You are expected to demonstrate integrity in all of your academic endeavors and will be evaluated on your own merits.

Any assignment submitted by you and that bears your name is presumed to be your own original work that has not previously been submitted for credit in another course unless you obtain prior written approval to do so from your instructor. In all of your assignments, you may use words or ideas written by other individuals, but only with proper attribution. To copy text or ideas from another source without appropriate reference is plagiarism and will result in a failing grade for your assignment and usually further disciplinary action. For additional information on plagiarism, self-plagiarism, and how to avoid it, see [Berkeley Library website](#).

If you are not clear about the expectations for completing an assignment or taking a test or examination, be sure to seek clarification from your instructor beforehand. Anyone caught committing academic misconduct will be reported to the University Office of Student Conduct. Potential consequences of cheating and academic dishonesty may include a formal discipline file, probation, dismissal from the University, or other disciplinary actions.

Student Accommodations

The University is dedicated to supporting student success and removing barriers to educational access. If you need disability-related accommodations in this class, have emergency medical information you wish to share with me, or need special arrangements in case the building must be evacuated, please inform me immediately so that we can plan for appropriate accommodations. The Disabled Students' Program (DSP) is the campus office responsible for authorizing disability-related academic accommodations, in cooperation with the students and their instructors. Students who need academic accommodations, or have questions about their eligibility, should contact DSP. See the [DSP website](#) for additional information.

Counseling and Psychological Services (CAPS)

As a student, you may experience mental health concerns or stressful events that can cause barriers to learning, participation and performance. The University offers a broad range of mental health services available on campus via the Counseling and Psychological Services (CAPS). There is no charge to get started, and all registered students can access services regardless of insurance. For details on the CAPS resources, see the [CAPS website](#).

Prevention of Harassment and Discrimination

The University is committed to creating and maintaining a community dedicated to the advancement, application and transmission of knowledge and creative endeavors through academic excellence, where all individuals who participate in University programs and activities can work and learn together in an atmosphere free of discrimination, harassment, exploitation, or intimidation. For more information on

related policies, resources and how to report an incident, see the [Office for the Prevention of Harassment and Discrimination \(OPHD\) website](#).

Safety and Emergency Preparedness/Evacuation Procedures

As class activities may keep you on campus at night, check out the Cal's [Night Safety Services website](#) for details on the University's comprehensive free night safety services. See the [Office of Emergency Management website](#) for details on Emergency Preparedness/Evacuation Procedures. The UC Berkeley [Police Department website](#) also has information regarding safety on campus. Dial 510-642-3333 or use a Blue Light emergency phone if you need help.

Grievances

If you have a problem with this class, you should seek to resolve the grievance concerning a grade or academic practice by speaking first with the instructor. Then, if necessary, take your case to the SCET Chief Learning Officer, SCET Faculty Director, IEOR Department Chair, and to the College of Engineering Dean, in that order. Additional resources can be found on the [Student Advocate's Office website](#) and the [Ombuds Office for Students website](#).

Additional Resources

See the [Student Affairs website](#) for more information on campus and community resources.

SCET Certificate in Entrepreneurship & Technology

This class can be used towards requirements to earn the SCET Certificate in Entrepreneurship & Technology. For details on the certificate requirements and other opportunities to engage with the Center, see the [SCET website](#).

Disclaimer: Syllabus/Schedule are subject to change.

Reading References

- (1) Grossmann, L.; McClements, D. J. The Science of Plant-Based Foods: Approaches to Create Nutritious and Sustainable Plant-Based Cheese Analogs. *Trends Food Sci. Technol.* **2021**, *118* (PA), 207–229. <https://doi.org/10.1016/j.tifs.2021.10.004>.
- (2) Fardet, A. *New Concepts and Paradigms for the Protective Effects of Plant-Based Food Components in Relation to Food Complexity*; Elsevier, 2017. <https://doi.org/10.1016/B978-0-12-803968-7.00016-2>.
- (3) Troya, M.; Byrne, B.; Dowdy, R. Anticipating 2030 Production Requirements.
- (4) Grossmann, L.; Weiss, J. Alternative Protein Sources as Technofunctional Food Ingredients. *Annu. Rev. Food Sci. Technol.* **2021**, *12*, 93–117. <https://doi.org/10.1146/annurev-food-062520-093642>.
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- (9) Absalome, M. A.; Massara, C. C.; Alexandre, A. A.; Gervais, K.; Chantal, G. G. A.; Ferdinand, D.; Rhedoor, A. J.; Coulibaly, I.; George, T. G.; Brigitte, T.; Marion, M.; Jean-Paul, C. Biochemical Properties, Nutritional Values, Health Benefits and Sustainability of Palm Oil. *Biochimie* **2020**, *178*, 81–95. <https://doi.org/10.1016/j.biochi.2020.09.019>.
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- (11) Gagnaire, V.; Lechevalier, V.; Famelart, M. H.; Croguennec, T.; Bouhallab, S. Chapter 2: The Role of Proteins in the Development of Food Structure. *Food Chem. Funct. Anal.* **2020**, *2020-Janua* (18), 29–58. <https://doi.org/10.1039/9781788016155-00029>.
- (12) Mäkinen, O. E.; Sozer, N.; Ercili-Cura, D.; Poutanen, K. Protein From Oat: Structure, Processes, Functionality, and Nutrition. *Sustain. Protein Sources* **2016**, 105–119. <https://doi.org/10.1016/B978-0-12-802778-3.00006-8>.
- (13) Waglay, A.; Achouri, A.; Karboune, S.; Zareifard, M. R.; L'Hocine, L. Pilot Plant Extraction of Potato Proteins and Their Structural and Functional Properties. *Lwt* **2019**, *113* (June), 108275. <https://doi.org/10.1016/j.lwt.2019.108275>.
- (14) Schweiggert-Weisz, U.; Eisner, P.; Bader-Mittermaier, S.; Osen, R. Food Proteins from Plants and Fungi. *Curr. Opin. Food Sci.* **2020**, *32*, 156–162. <https://doi.org/10.1016/j.cofs.2020.08.003>.
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- (23) Kyriakopoulou, K.; Dekkers, B.; van der Goot, A. J. *Plant-Based Meat Analogues*; Elsevier Inc., 2018. <https://doi.org/10.1016/B978-0-12-814874-7.00006-7>.
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