



HARVARD

John A. Paulson
School of Engineering
and Applied Sciences

ES139/239: Innovation in Science and Technology
Fall Semester 2019

Course Instructors

Dave Weitz

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- *Teaching Fellows:*

Ashlyn Frahm

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Class Details:

- *Lecture:* Tuesday/Thursday, 1:30 p.m. – 2:45 p.m.
- *Location:* Science Center Hall D
- *Web:* Canvas (ES239 will use same site as 139)

Course Format:

The course will consist of in class presentations from world-class Entrepreneurs. In addition, there will be lectures on innovation, entrepreneurship, creativity and how to startup your own company.

Course Description:

Explores factors and conditions contributing to innovation in science and engineering; how important problems are found, defined, and solved; roles of teamwork and creativity; and applications of these methods to other endeavors. Students receive practical and professional training in techniques to define and solve problems, and in brainstorming and other individual and team approaches. Students will investigate an emerging technology and learn how to take it from initial idea to a final pitch for a company startup.

Textbook & Electronic Resources:

Each team member should read one of the following Walter Issacson books: Einstein: His Life and Universe (2007), Benjamin Franklin: An American Life (2003), Steve Jobs (2011) or Leonardo da Vinci (2017)

Online account at thebrain.com

Google account (to upload slides and access google docs).

Course Calendar

Date	Tues	Date	Thurs
September			
3	Introductory Class	5	Innovation Pyramid (Ricketts)
10	Carlos Menendez – President Mastercard	12	Jayatra Das – Director, Franklin Institute
17	John Warner – Green Chemistry	19	From startup-to-exit (Boyce)
24	Tommy Francois - Ubisoft	26	Synectics (Harriman)
October			
Date	Tues		Thurs
1	Business Model Canvas (Seidel)	3	Market Pull/Tech Push (Seidel)
8	Design Thinking (Seidel)	10	Design Thinking Part I (Gong)
15	Mid-Term Meetings	17	Anand Devarajan – Frank Gehry Design
22	Creative Problem Solving (Ricketts)	24	Design Thinking Part II (Gong)
29	Tommy Francois - Ubisoft	31	Lider Sucre Innovation by Nature
November			
Date	Tues		Thurs
5	Mirko Boccalatte - Ferarri	7	Creating the Pitch
12	Paula Apsell – Nova PBS	14	David Graham – San Diego
19	Project time	21	Project time
26	Pitch Practice	28	No Class (Thanksgiving Nov 27-30)
December			
Date	Tues		Thurs
3	Final Pitch (All)		

Grading Algorithm:

Attendance	15%
Speaker Discovery	10%
Speaker Questions	10%
Speaker Challenges	15%
Mid-term	20%
Final Project	30%

Groups

Team Alpha 1:N – Consists of Two Team Bravos (nominal 10 students).

Speaker Discovery will be done by a Team Alpha.

Speaker Questions will be done by a Team Alpha

Team Bravo 1:N

Form a group of 5 students. You may change groups once in the semester, but you are responsible for finding a new group who has an opening (group cannot be more than 6 or less than 4 students). You must participate in a Speaker Discovery and Questions - you cannot switch groups and miss either of these assignments.

Speaker Challenges and Midterm will be done by Team Bravos

Team Final 1:N - You will work in a group for the final project.

Min 4 and max 7 students. This group is independent of the group above, but can include the same people.

**Speakers will be randomly assigned to Alpha teams
Speaker assignments may change – do not do
assignments until 14 days prior to your speaker.**

Assignments (ES139/239):

The class will consist of lectures, which will introduce new material and discuss case studies/examples as well as exercises to help understand the concepts of the lecture:

1) (15%) Attend lecture

Attendance is taken every lecture. Attendance will be taken by posting a time limited key on the blackboard in class. You must enter it online within 10 min of class ending.

2) (10%) Speaker Discovery (Two Alpha teams together)

You and your team will be responsible for briefing your class on guest speakers. Your team will prepare a 2 page background on the speaker, including material on their contribution to innovation and entrepreneurship. The brief will be due 7 days before the speaker and posted for the entire class to read.

In addition, you will prepare a ½ page (200 word maximum) introduction and one team member will introduce the speaker. Please rehearse the introduction.

3) (8+2%) Speaker Questions (Two Alpha teams together)

You and your team will generate a list of 10 seed questions and post them to the class 7 days before your assigned speaker. The class will contribute additional questions during the week. Your team will compile a list of 15 questions and be prepared to facilitate a Q&A at the end of the speaker. Each member of your team can ask a question or assign a smaller sub-set of the group to ask questions. Typically Q&A will go for 15 min or until all questions are answered.

Each student in class will be responsible for posting at a question for each speaker. The 2% of your grade (individual) is for your posting questions.

4) (15%) Speaker Challenges (One slide per Alpha team)

A Challenge or short assignment will be posted for each speaker. Your team will respond with a single slide (uploaded into a join google slide deck – you may not submit a file online, it must be added to the deck for each challenge). You should convey your solution visually with images and a story. Your team member names should be put on the lower right in small, but readable, text.

One Slide.

5) **(20%) Midterm - Due Tuesday, Oct. 16th at 11:55pm.**

Your team will create a *Connections* mind-map of a topic or innovation assigned by the course instructors.

6) **(30%) Final project. (5% individual, 25% group)**

- a) ES139: You will identify an interesting emerging technology. You will determine what you find interesting about it, and identify a good solution space, and develop it from initial idea all the way through to a final pitch for a company startup.
 - i Due Oct 9th, submit project brief on Canvas before 11:59pm. Due
 - ii October 30th, submit 1 pager (1" margins, single spaced, standard font) based on interview with an external expert .
- b) Your team will choose a pitch method: "Shark Tank", SBIR, other approved by instructors.
- c) You will prepare an assessment of your team, what worked, what didn't. This will be used for your individual portion of the grade.
- d) ES239: Participate in the pitch as with the ES139 (15% pitch 5% individual). In addition, using your research, prepare a critical assessment and innovation strategy based upon the framework of the course. 10-page written report. (10%) select on that you find interesting and relevant to your coursework.

A suggested calendar is below for a successful final project is below. You will not have official assignments (except for the Midterm assignment) this may be helpful for keeping you and your team on track for a truly successful pitch. If you already have an interesting start up idea that you would like to pursue, please come talk to us.

Week 3: Team (Team Final) Formation

Week 4: Select emergent technology

Week 5: Creating background brief on emergent technology (what it is, how it works, any background) Submit to Canvas by 10/9

Week 6: Find an external expert to interview. Identifying potential business applications of tech

Week 7: Finding one advisor/industry expert, reach out for interview, create one-pager on how your start up idea could work.

Due October 30th, submit 1 pager (1" margins, single spaced, standard font) based on interview with technology expert

Week 9: Finding potential client for pilot case

Week 10: Developing business plan with potential client in mind

Week 11: Creating initial prototype/mock up of start up offering

Week 12: Draft of slide deck

Week 13: Pitch critique

Week 14: Pitch Day

Instructor Bios

Dave Weitz is a Professor of Physics and Applied Physics at Harvard, and is currently the Director of the NSF-funded Harvard Materials Research Science and Engineering Center. Dave graduated with a PhD from Harvard and worked for nearly 18 years as a research physicist at Exxon Research and Engineering Co. He then spent three and a half years as a Professor of Physics at the University of Pennsylvania and came to Harvard in the last century. His research is in the field of materials physics, and his group studies soft materials, specifically easily deformable materials such as foams, emulsions, and gels. His lab also investigates the mechanical properties of many biological materials, such as those that make up a cell. More information about his research can be found at <http://www.seas.harvard.edu/projects/weitzlab/>.

David Ricketts is a faculty Associate in the Technology and Entrepreneurship Center at Harvard. Prof. Ricketts received his PhD from Harvard University and has held appointments at Carnegie Mellon University, Harvard University, MIT and North Carolina State University. For the past decade Prof. Ricketts has helped co-teach the Innovation in Science and Technology courses in the School of Engineering and Applied Sciences. He teaches and speaks regularly on innovation and business strategy. He focuses on the role of the individual innovator and helps senior leaders develop new innovators and systemic innovation in their companies. In addition to Prof. Ricketts' innovation research, he is an award winning scientist and engineer whose innovations have been featured by Popular Science, Smithsonian, NBC News, CBS News, Fox News, ESPN, and many other science news outlets. More information can be found at <http://scholar.harvard.edu/davidricketts-innovation/>

Victor Seidel is faculty Associate in the Technology and Entrepreneurship Center at Harvard, a Visiting Scholar at the University of Oxford, and is also a faculty member at Babson College. He teaches in the areas of design and innovation management, and he researches how highly novel concepts are generated and adopted in organizations and through online communities. Prior to his Ph.D. at Stanford, he was with IBM in technical and managerial roles in the US and Europe, and he holds several patents covering the design and testing of semiconductor devices.

John Boyce was awarded the honor as one of the top 15 Technology Luminaries in the state of Massachusetts by the Boston Business Journal and Mass High Technology in 2013. John is an energetic leader and serial entrepreneur who has successfully raised over \$150MM in funding from venture capital, as well as from private investors. He has extensive connections and inroads to the top leaders in pharma, biotech, and diagnostic companies, as well as venture capital and investment banking. John specializes in building and positioning companies for exit with the highest ROI possible. Most recently, John was the President and CEO of GnuBIO, Inc, a desktop DNA sequencing company that John co-founded in December 2009. John raised an initial Series A round of \$8 MM

in November 2010 (after receiving \$60MM in term sheets). John closed an additional round of \$10 MM (after receiving over \$90MM in term sheets) in September 2012, and grew the company to 54 employees. Based on the clinical strategy and product roll out initiative that John put in place GnuBIO was acquired by Bio-Rad in April 2014, providing investors with a significant return with a deal valued at 6X ROI (\$110 MM). Prior to GnuBIO, John built and sold A omix (a digital proteomics company) to Illumina for \$25MM resulting in a 5X ROI, in under 3 years, for investors and shareholders. Through numerous additional companies in the life science space, John built and served in key positions to either drive these companies towards a sale or drive towards an IPO, generating over a total of \$300MM in returns for investors. John is also a visionary who conceived, founded, and ran the Consumer Genetics Conference, which he sold to Cambridge Health Institute in 2012. He can also be reached at cideriv28@gmail.com.

Rick Harriman is currently a Senior Fellow, and formerly for several decades he was the CEO and innovation consultant at Synecticsworld, Inc®, a fifty-eight year old international consulting firm that specializes in fostering innovation in business (www.synecticsworld.com). Synectics conducted much of the earliest research on operationalizing creativity, including work in the 1940's at Harvard's Underwater Sound Laboratories. Over the years Synectics partners have published books as the body of knowledge developed – Synectics in 1960, Practice of Creativity in 1970, The Innovator's Handbook in 1987 and Creativity, Inc. – Building an Inventive Organization published by The Harvard Business School Press in 2003. The latter was co-written by Rick. He is also the author of a number of articles and book chapters on creativity in business. He is a Social Innovation Fellow at Babson College's Lewis Institute focusing on bringing the concepts and tools of entrepreneurial thought and action to rural Tanzania. Rick is a co-patent holder on software designed to support collaborative innovation. Prior to joining Synectics, he held positions in new product development and marketing management after completing his M.B.A. at Columbia University. He is an Innovation Fellow at the Technology and Entrepreneurship Center at Harvard.