

MIT MEDIA LAB

Tue 10:00am - 12:00pm Lecture: E14-633

Wed 7:00pm - 9:00pm Lab: 32-082

<http://stellar.mit.edu/S/course/MAS/sp16/MAS.650>

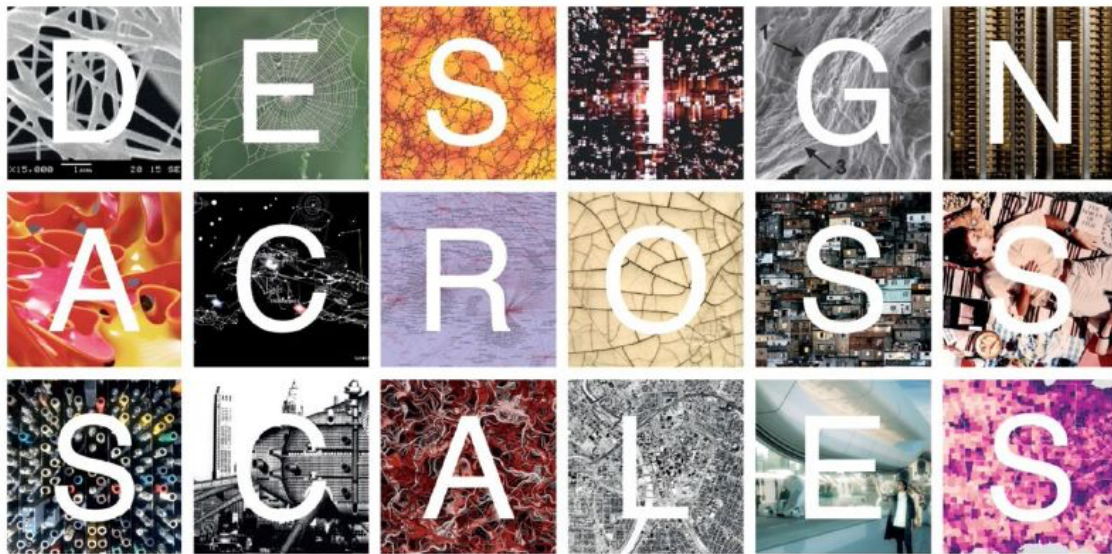
Design Across Scales & Disciplines

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Lecture TAs

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Lab TAs Department of Architecture

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Lab TAs Mediated Matter Group

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DESCRIPTION

Inspired by Charles and Ray Eames' canonical *Powers of Ten*, the course explores the relationship between science and engineering through the lens of Design. It examines how transformations in science and technology have influenced design thinking, and vice versa. It offers interdisciplinary tools and methods to represent, model, design and fabricate objects, machines, and systems. Structured as core lectures and lab sessions, the course is organized by "systems": Designing Data, Designing Materiality, Designing Life and Designing Nature. World-renowned designers, scientists and engineers will contribute with guest lectures. Within a workshop setting, we will design things - material and immaterial; we will learn new computational and fabrication tools along the way; we will develop methodologies for design research of interdisciplinary problems; we will practice what it means to think, live, and breathe Design.

The course creates a new pedagogical paradigm for learning and education, which cuts across various disciplines and scales to demonstrate that design is not a discipline, but a way of looking at the world; one that promotes the synthesis of interdisciplinary knowledge across scales in order to create objects and systems for the greater good. This is partly due to the fact that big, real-world challenges - such as the race to cure cancer, the Mars landing mission and the challenge to design sustainable cities and buildings - require, perhaps more than ever, an interdisciplinary skill set combined with an ability to operate across multiple scales with creativity.

The history of design innovation provides endless examples of cross-disciplinary innovations and individuals. Buckminster Fuller, for instance, was a designer, a futurist, an inventor, an author and a systems theorist. His designs based on the geodesic dome have influenced not only generations of designers, architects, engineers and urban planners but also chemists, material scientists and physicists, who were inspired by his representation of the physical world. Charles and Ray Eames were mid-century American designers working at a range of scales and in a variety of media, from furniture and military aircraft parts to films and exhibitions. Their experiments in design fabrication and cultural media provide significant references for design education today. An example of the value of learning across disciplines today is found in Siddhartha Mukherjee's book, *Emperor of All Maladies: a Biography of Cancer*, which tells the story of how the process of inventing cell dyes to trace the growth of cancerous tissues was actually inspired by textile design.

Design has expanded to include a broad range of scales and disciplines, shifting from the production of objects to the design of experiences, data, networks, territories, and social frameworks. Designers are no longer exclusively committed to design autonomous objects (buildings, cars, furniture and household products), but rather are conceiving and testing whole ecologies of design experiences (robotic construction systems, transportation systems, health care experiences, water distribution, and clean energy). This has prompted Tim Brown, CEO of the design consultancy firm IDEO to state, "Design is too important to be left to designers." The scope of design ecologies is so broad and so integrated with other disciplines that traditionally trained designers are ill equipped to tackle the new breadth of design tasks at hand. Interdisciplinary teams must work together to design the systems, experiences, environments and futures for our increasingly complex world.

Design Across Scales, Disciplines and Problem Contexts responds to this challenge by creating a course that is not a traditional design course for designers, but one about culture, science and technology serving as a foundation course for all students regardless of their major.

REQUIREMENTS AND EXPECTATIONS

In addition to the one lecture per week by the instructor and guest lecturers, one lab session per week will be given. This lab session is mandatory for those who are not familiar with the tools per session, and is optional for those who are familiar with the tools being taught. The readings are highly recommended, particularly for graduate students, but not required. Each student is expected to attend all lectures, be fully prepared for the lab sessions, and spend 2-3 hours per week on assignment tutorials and projects. **Please note that this class has a strict policy of not accepting listeners.**

ASSIGNMENTS

For Undergraduates, the final grade is distributed as follows: (1) Assignments completed in each lab (10 labs total): 5%; (2) class attendance and participation: 25%; (3) Final Assignment: 25%.

For Graduate students, the final grade is distributed as follows: (1) Assignments completed in each lab (10 labs total): 4%, (2) class attendance and participation: 25%; (3) Final Assignment: 25%; (4) Graduate Assignment: 10%. Attendance will be taken at lectures and at labs.

CALENDAR

DESIGNING ACROSS SCALES		
Feb 2	Tues	<p>LECTURE 1: Introduction</p> <p>Neri Oxman Associate Professor of Media Arts and Sciences. Sony Corporation Career Development Professor of Media Arts and Sciences.</p> <p><i>Recommended Readings:</i></p> <p>Beatriz Colomina, <i>Enclosed by Images: The Eameses' Multimedia Architecture</i>. Grey Room, 2001.</p> <p>Paola Antonelli, et. al., <i>Design and the Elastic Mind</i>. New York: Museum of Modern Art. London: Thames & Hudson, 2008.</p> <p>Philip Morrison and Phylis Morrison, <i>Powers of Ten: A Book About the Relative Size of Things in the Universe and the Effect of Adding Another Zero</i>. Redding, Conn: Scientific American Library, 1982.</p>
Feb 3	Wed	NO LAB: Course admissions - TA meeting
Feb 9	Tues	<p>LECTURE 2: Practice</p> <p>Meejin Yoon Department of Architecture, Head. Höweler + Yoon Architecture LLP and MY Studio, Founder.</p> <p><i>Recommended Readings:</i></p> <p>Meejin J. Yoon, <i>Expanded Practice: Höweler + Yoon Architecture / MY Studio</i>. New York: Princeton Architectural Press, 2009. (Introduction only)</p> <p>Jon Dreyfous, Elite Kedan and Craig Mutter, <i>Provisional: Emerging Modes of Architectural Practice</i>. Princeton Architectural Press, 2009.</p> <p>Meejin J. Yoon, <i>Projects at Play: Public Works</i>. In <i>Back to the City: Collaborations Between Artists and Architects, Strategies for Informal Urban Design</i>, Steffen Lehmann ed. Ostfildern: Hatje Cantz Verlag, 2009.</p>
Feb 10	Wed	<p>LAB 1: Documentation by Design</p> <p>Video and Image Capture, Video Editing, Image Processing and Illustration</p> <p><i>Lab TAs:</i> Markus (Guru), Julian, Daniel, Jessica, Nico, Scott</p> <p><i>Location:</i> 32-082</p> <p><i>Tools:</i> Final Cut X - Video Editing; Adobe Photoshop - Image Processing; Adobe Illustrator - Vector Drawing.</p>
MODULE 1 DESIGNING DATA		
Feb 16	Tues	NO LECTURE: MIT Monday schedule due to President's Day

Feb 17	Wed	LAB 2: Parametric Design and Material Computation
		<p><i>Lab TAs:</i> Chikara (Guru), Julian, Daniel, Jessica, Nico, Scott</p> <p><i>Location:</i> 32-082</p> <p><i>Tools:</i> Rhinoceros 5.0 + Grasshopper, Solidworks</p>
Feb 23	Tues	LECTURE 3: Design of Representation
		<p>Neri Oxman Associate Professor of Media Arts and Sciences, Sony Corporation Career Development Professor of Media Arts and Sciences.</p> <p>Ben Fry Principal at Fathom, Processing co-founder.</p> <p><i>Recommended Readings:</i></p> <p>Lorraine Daston and Peter Galison, <i>Objectivity</i>. New York: Zone Books, 2007.</p> <p>John Maeda, <i>The Laws of Simplicity</i>. MIT Press, 2013.</p> <p>Marshall McLuhan, <i>The Medium is the Message. Understanding Media: The Extensions of Man</i>. New York: Signet, 1964.</p> <p>Edward Tufte, <i>Envisioning Information</i>. Cheshire, CN: Graphics Press, 1990.</p> <p>Casey Raes, and Ben Fry, <i>Processing: A Programming Handbook for Visual Designers and Artists</i>. MIT Press, 2007.</p> <p><i>Recommended Talks:</i></p> <p>Strata 2014: Keynote with Ben Fry</p> <p>Ben Fry: Keynote on Visualizing Data</p> <p>Ben Fry: Eye02012</p> <p>Ben Fry at TED Active 2014-03-18</p>
Feb 24	Wed	LAB 3: Data Processing and Visualization
		<p>Data Stream, Sound Input/Outputs, and Visualization</p> <p><i>Lab TAs:</i> Jorge (Guru), Christoph, Dominik, Jessica, Nico, Scott</p> <p><i>Location:</i> 32-082</p> <p><i>Tools:</i> Processing</p>
Mar 1	Tues	LECTURE 4: Design of Data
		<p>Neri Oxman Associate Professor of Media Arts and Sciences, Sony Corporation Career Development Professor of Media Arts and Sciences.</p> <p>Jer Thorp adjunct Professor in NYU, ITP program, co-founder of The Office for Creative Research.</p> <p>Danny Hillis visiting Professor in MIT, Media Lab, co-founder of Applied Invention.</p> <p><i>Recommended Readings:</i></p> <p>John Maeda, <i>Creative Code</i>. London: Thames & Hudson, 2004.</p> <p>Casey Reas, and Ben Fry, <i>Processing: A Programming Handbook for Visual Designers and Artists</i>. Cambridge, MA: MIT Press, 2007.</p> <p>Ben Fry, <i>Visualizing Data</i>. O'Reilly Media, Inc, 2008.</p> <p>Jack Burnham, <i>Systems Esthetics</i>. Artform, 1968.</p> <p>Kate Crawford and Dana Boyd, <i>Critical Questions for Big Data</i>. 2012.</p> <p>Jer Thorp, <i>Art and the API</i>. 2013.</p>

Mar 2	Wed	LAB 4: Generative Design and Computational Modeling
		Shape Representation, Shape Generation and Shape Analysis <i>Lab TAs:</i> Christoph and Dominik (Gurus), Jorge, Jessica, Nico, Scott <i>Location:</i> 32-082
Mar 6	Sun	Optional Desk Critiques for Final Assignment
		<i>Lab TAs:</i> Jessica, Nico, Scott <i>Location:</i> 32-082
MODULE 2 DESIGNING MATTER		
Mar 8	Tues	LECTURE 5: Design of Natural Matter
		Neri Oxman Associate Professor of Media Arts and Sciences, Sony Corporation Career Development Professor of Media Arts and Sciences. Admir Masic Assistant Professor, Department of Civil and Environmental Engineering. James Weaver Senior Research Scientist, Wyss Institute for Biologically Inspired Engineering, Harvard University. <i>Recommended Readings:</i> James Weaver et al, <i>Hierarchical assembly of the siliceous skeletal lattice of the hexactinellid sponge Euplectella aspergillum</i> . Journal of Structural Biology, 2007. Ali Miserez et al., <i>Effects of Laminate Architecture on Fracture Resistance of Sponge Biosilica: Lessons from Nature</i> . Advanced Functional Materials. 2008. Li Wen et al., <i>Biomimetic shark skin: design, fabrication and hydrodynamic function</i> . The Journal of Experimental Biology, 2014. Nicholas W. Bartlett et al., <i>A 3D-printed, functionally graded soft robot powered by combustion</i> . Science, 2015.
Mar 9	Wed	LAB 5: Fabrication Workshop 1 (Overview & Subtractive Processes)
		Introduction to Fabrication Processes; Subtractive Fabrication <i>Lab TAs:</i> Julian (Guru), Markus, Chikara, Jessica, Nico, Scott <i>Location:</i> 32-082 <i>Tools:</i> Laser Cutting: Design, Process & Possibilities.
Mar 15	Tues	LECTURE 6: Design of Synthetic Matter
		Skylar Tibbits Director Self-Assembly Lab. Ryan Truby PhD Candidate at the Lewis Lab, Wyss Institute for Biologically Inspired Engineering, Harvard University. <i>Recommended Readings:</i> Tim Brown and Barry Katz, <i>Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation</i> . New York: Harper Business, 2009. Bruce Mau and Jennifer Leonard, <i>Massive Change</i> . London: Phaidon, 2004. William McDonough and Michael Braungart, <i>Cradle to Cradle: Remaking the Way We Make Things</i> . New York: North Point Press, 2002.
Mar 16	Wed	LAB 6: Fabrication Workshop 2 (Additive Processes & Manufacturing)
		3D Printing: Design, Process & Possibilities; Manufacturing at Scale <i>Lab TAs:</i> Julian (Guru), Markus, Chikara, Jessica, Nico, Scott

Location: 32-082

Tools: Additive Fabrication Tools

Mar 22	Tues	NO LECTURE: Spring Break
Mar 23	Wed	NO LAB: Spring Break
MODULE 3 DESIGNING LIFE		
Mar 29	Tues	LECTURE 7: Designing (with) DNA - S1
<p>David Sun Kong Technical Staff, MIT Lincoln Laboratory. Neri Oxman Associate Professor of Media Arts and Sciences, Sony Corporation Career Development Professor of Media Arts and Sciences.</p>		
Mar 30	Wed	LAB 7: Programmable Bacteria - S1 SYNBIOTA*
<p>DNA Design: Concepts, Methods, Tools and Example Applications <i>Lab TAs:</i> Sunanda (Guru), BIO-TEAM, Jessica, Nico, Scott <i>Location: 68-074</i> <i>Tools:</i> Synbiota DNA Tinker Studio This lab session will be 7-10 pm</p>		
Apr 5	Tues	LECTURE 8: Designing (with) DNA - S2
<p>David Sun Kong Technical Staff, MIT Lincoln Laboratory.</p>		
Apr 6	Wed	LAB 8: Programmable Bacteria - S2 SYNBIOTA*
<p>DNA Design: Concepts, Methods, Tools and Example Applications <i>Lab TAs:</i> Sunanda (Guru), BIO-TEAM, Jessica, Nico, Scott <i>Location: 68-074</i> <i>Tools:</i> Synbiota DNA Tinker Studio</p>		
MODULE 4 DESIGNING NATURE (SPECIAL WORKSHOP)		
Apr 12	Tues	LECTURE 9: (Re) Designing Nature
<p>Markus Holzbach Architect, Materials & Processing Engineer, Professor of Visualization and Materialization, School of Design University of Art & Design in Offenbach, Germany. Werner Lorke Physicist and Material Scientist, Professor of Technology & Ecology, School of Design University of Art & Design in Offenbach, Germany. <i>Recommended Readings:</i> Markus Holzbach et al, <i>Material Design</i>. 2014. M. Singh and J.A. Salem, <i>Mechanical Properties and Microstructure of Biomimetic Silicon Carbide Ceramics Fabricated from Wood Precursors</i>. 2002.</p>		
Apr 13	Wed	LAB 9: Ceramic Wood Workshop
<p>Non-obligatory for ML students during Members Week <i>Lab TAs:</i> Architecture TAs <i>Location: 32-082</i></p>		
Apr 19	Tues	NO LECTURE: Patriots Day Holiday

*This lab session will be 7-10 pm

Apr 20	Wed	NO LAB: Desk Critiques for Final Assignment
		<i>Lab TAs:</i> All TAs <i>Location:</i> 32-082
DESIGNING ACROSS DISCIPLINES		
Apr 26	Tues	LECTURE 10: Design of Health
		Steven Keating PhD Candidate at the MIT Media Lab Mediated Matter Group and the MIT Department of Mechanical Engineering. Laurence Reid Chief Executive Officer at Warp Drive Bio, LLC. David Sengeh Doctor from MIT Media Lab Biomechatronics Group. <i>Recommended Readings:</i> Madeleine Ball et al., <i>Harvard Personal Genome Project: Lessons from participatory public research</i> . Genome Medicine, 2014. Leonard Kish and Eric Topol, <i>Unpatients - Why Patients Should Own Their Medical Data</i> . Nature Biotechnology, 2015. The National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, <i>The Belmont Report: Ethical Principles and Guidelines for the Protection of Human Subjects of Research</i> . The Belmont Report, 1978. Robert Wachter. <i>The Digital Doctor</i> . McGraw-Gill Education, 2015. Janice Walker, et al., <i>Inviting Patients to Read Their Doctors' Notes: Patients and Doctors Look Ahead: Patient and Physician Surveys</i> . Ann Intern Med, 2011.
Apr 27	Wed	LAB 10: Design Development Crit for Final Assignment
		<i>Lab TAs:</i> All TAs <i>Location:</i> 32-082
May 3	Tues	LECTURE 11: Design of Play
		Kevin Slavin Assistant Professor of Media Arts and Sciences, Benesse Career Development Professor of Media Arts and Sciences. Allan Chochinov Chair and co-founder of the SVA MFA in Products of Design Program. <i>Recommended Talks:</i> Kevin Slavin: How Algorithms Shape Our World (TED Global 2011). Kevin Slavin: Eyeo2013 Ignite #12. Kevin Slavin: Debunking Luck. Kevin Slavin: Reality is Plenty, Thanks.
May 4	Wed	LAB 11: Review of Final Assignment
		<i>Lab TAs:</i> All TAs <i>Location:</i> 32-082
May 10	Tues	LECTURE 12: Design of Food
		David Edwards Gordon McKay Professor of the Practice of Idea Translation, Harvard John A. Paulson School of Engineering & Applied Sciences, Founder and Director of Le Laboratoire in Paris, France, Faculty Associate in Center for Nanoscale Systems. Lee Moreau Principal at Continuum.

Recommended Readings:

John Dewey, *Art as Experience (Chapters 1 & 3)*. 1934.
 David Edwards, *ArtScience: Creativity in the Post-Google Generation*. 2009.
 David Edwards, *American Schools Are Training Kids For a World That Doesn't Exist*. 2014.
 Emily Wallace, *Pure Imagination*. 2012.
 Julia Lasky, *Matters of Taste*. 2014.
 Dusica Sue Malesevic, *The Dapper Doctor's Vaporized Sushi and Clouds of Cognac*. 2014.
 Richard Buchanan, *Wicked Problems in Design Thinking*. 1992. (Why do we do what wevdo?) http://web.mit.edu/jrankin/www/engin_art/Design_thinking.pdf.
 Susan Weinschenk, *100 Things Every Designer Needs to Know About People*. 2011. (Why is empathy so important to our design process?) http://www.amazon.com/dp/0321767535/ref=cm_s_w_u_dp.
 Hugh Dubberly, *Dubberly Design Process*. 2008. (What are all different ways to approach or reframe a problem?) <http://www.dubberly.com/articles/how-do-you-design.html>.
 Marc Stickdorn and Jakob Schneider, *This is Service Design Thinking*. 2010. (What are some good examples of service and experience design projects?) <http://thisisservicedesignthinking.com>.
 Michael Rock, *F#k Content*. 2013. (Why do you need to just make things?) <http://2x4.org/ideas/2/fuck-content/>.

May 11	Wed	LAB 12: Conversations about Design
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Lab TAs: All TAs

Location: 32-082

May 17	Tues	NO LECTURE: Final Exam Week
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May 18	Wed	NO LAB: Final Exam Week
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Changes to the schedule, if necessary, will be announced via email.

Supplemental graduate student Assignment due dates will be determined in advance.
