

4.021 How to Design

Units: 3-3-6 HASS-A / Mon & Wed 2-5pm

Instructors:

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Schedule: Mon & Wed 2-5pm

Location: W41-3509

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Pre-Requisite: None

Course Description:

Design often begins with what already exists—a need, a material, a site, or a question of how something might work differently.

Drawing from MIT's culture of hacking and hands-on experimentation, this course introduces design as the creative modification of existing objects, spaces, and systems. Working across the scales of the object, the body, and the building, students will transform found objects into drawing tools, urban elements with design prosthetics, and existing spaces into full-scale interventions.

Organized into three cumulative modules, the course develops foundational design skills through observation, drawing, prototyping, digital modeling, and fabrication. Students will learn to work within real constraints—including scale, material availability, budget, and time—while developing an iterative design process grounded in experimentation and collaboration. Rather than designing objects in isolation, students will explore how small interventions can reshape behaviors, activities, and our relationship to the built environment.



Figures 1-3 (left to right): *Drawing Machine* (Handmade Charlotte); *Plus Furniture* (Napp Studio); *Desplome* (Martillo Neumatico).

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Learning Objectives:

- Recognize design opportunities within ordinary objects, behaviors, materials, and existing spatial conditions.
- Foster a culture of making and resourcefulness.
- Develop foundational 2D drawing and 3D modeling skills in Rhino.
- Gain introductory experience with digital and physical fabrication methods, including laser cutting, 3D printing, CNC, woodworking, and textile or membrane construction.
- Move between hand-scale, body-scale, and architectural-scale design problems.
- Introduce product design thinking: a connector is a product with tolerances, ergonomics, and use cases.
- Develop designs through iterative prototyping: making, testing, evaluating, and adjusting.
- Design systems that can be transported, deployed, assembled, disassembled, or reused
- Respond to practical constraints including budget, structural safety, fabrication time, material availability, assembly labor, and deadlines.
- Communicate design intentions through drawings, diagrams, models, prototypes, instructions, performance, video, photography, and narrative.

Course Overview

Module	Title	Mode	Week
1	Drawing Instrument—Hack a Found Object (Hand Scale)	Individual	1–3
2	Urban Prosthetic—Hack an Urban Element (Body Scale)	Team of 2	4–8
—	MID REVIEW—MODULE 1 & 2	Class + Guests	8
3	Inflatable Thresholds—Hack a Space (Architectural Scale)	Teams of 3–4	8–13
—	FINAL REVIEW—MODULE 3	Class + Guests	13

Course Glossary:

Presentation: An in-class lecture introducing concepts, precedents, or methods.

Workshop: An in-class session focused on a specific skill, tool, or technique.

Assignment: Work issued in class with a defined objective and due date.

Deliverable: Required work to be submitted or presented by a specified deadline.

Desk Crit: An individual discussion with the teaching team about work in progress.

Wall Crit: A desk critique with work pinned up for discussion.

Pin-Up: A less formal presentation of work pinned up for group discussion and feedback.

Review: A formal presentation of work to invited critics, faculty, and classmates.

Critique: Constructive discussion that advances a project's ideas, process, and development.

Documentation: A digital submission of your work organized according to the final deliverables.

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Course Schedule:

Week	Day	Date	Class	Presentations	Workshops
1	Wed	9/9	MODULE 1 ISSUED.	Course Introduction	Rule-based Drawing
2	Mon	9/14	Desk Crits		Shop Training
	Wed	9/16	Desk Crits	Color & Materiality	
3	Mon	9/21	Desk Crits		
	Wed	9/23	MODULE 1 PIN-UP		
4	Mon	9/28	MODULE 2 ISSUED + Site Visit	Affordance & Use	
	Wed	9/30	Desk Crits		Rhino 2D
5	Mon	10/5	Desk Crits		Rhino 3D
	Wed	10/7	MODULE 2A Wall Crits		
6	Mon	10/12	Indigenous Peoples' Day — holiday		
	Tue*	10/13	Monday Schedule, MODULE 2B ISSUED	Parts, Joints & Connections	
	Wed	10/14	Desk Crits		Lasercutting
7	Mon	10/19	Desk Crits		
	Wed	10/21	Desk Crits		
8	Mon	10/26	Desk Crits		Documentation
	Wed	10/28	MID REVIEW — MODULE 1 & 2		
9	Mon	11/2	MODULE 3 ISSUED + Site Visit	Thresholds & Lightweight Structures	
	Wed	11/4			Diagramming
10	Mon	11/9	MODULE 3A Wall Crits		
	Wed	11/11	Veterans Day — holiday		
11	Mon	11/16	MODULE 3B ISSUED		Inflatables
	Wed	11/18	Desk Crits		
12	Mon	11/23	Desk Crits		Grasshopper & 3D Printing
	Wed	11/25	MODULE 3 Progress Pin-up		
13	Mon	11/30	Work Session		
	Wed	12/2	Work Session	Storytelling & Visualization	Photoshop
14	Mon	12/7	Work Session		
	Wed	12/9	MODULE 3 REVIEW — last day of classes		

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MODULE 1:

Drawing Instrument—Hack a Found Object

Duration: Weeks 1–3 (4 class days) | Mode: Individual | Scale: Hand Scale

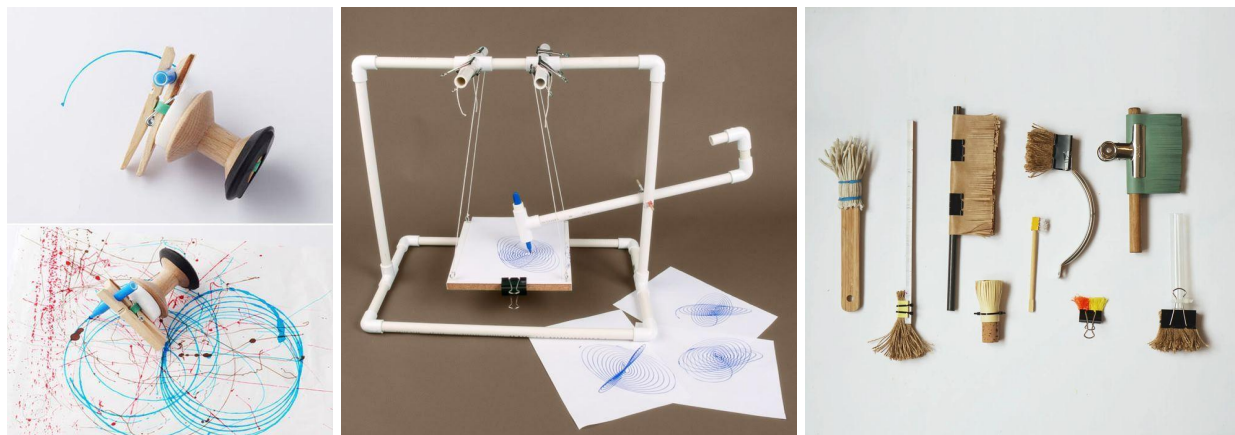
Overview

Design often begins at home – out of necessity, curiosity, and creative opportunities found in ordinary objects.

Module 1 asks you to hack a found object into a drawing instrument. You will modify the object that will then produce a drawing using rule-based operations. You may design specific add-on parts that rely on geometric movements, joints, and connections that produce a certain mechanism using readily available materials. However, all tools must be operated manually and may not rely on motors or automation. We encourage you to draw from your own interests and expertise, whether in mathematics, physics, mechanics, craftsmanship, or simply the pleasure of making by hand.

You will think about intention and precision, as well as process and iteration, as design tools for creating three replicable drawings (19"x24")—two made by you and one by another student—all produced by following the same written operational rules.

What is the original function of your found object? How might it be transformed into a drawing instrument? Does it rely on a particular geometry, movement, or sequence of actions? Is it operated by one person or through collaboration? How do process, precision, and control shape the resulting drawing?



Figures 4-6 (left to right): *Drawing Machine* (Handmade Charlotte); *Pendulum Drawing Board (Harmonograph)* (Exploratorium); *The Misused Brushes* (Liang-Jung Chen).

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MODULE 2:

Urban Prosthetics—Hack an Urban Element

Duration: Weeks 3–8 (9 class days) | Mode: Team of 2 | Scale: Body Scale

Overview

Design is everywhere—our paved pathways, stairs that rise and run, and rest stops that guide us on the way.

Module 2 asks you to hack an existing urban element to design an urban prosthetic that introduces a new activity and use. Working from a given map of sites on campus, you will choose an urban element and carefully observe the existing conditions through surveys, drawing, and 3D modeling.

Each group will be provided a \$100 material budget along with introductions to on- and off-campus resources that include found objects, furniture reuse, and reclaimed materials. This exercise will also introduce a range of fabrication methods and tools. The design must consider how it will be transported, deployed, and performed, and removed after use.

- Urban elements (your site)—Stairs, ramps, sidewalks, bike racks, telephone poles, window sills, benches, trash can, road blocks, railings, exterior columns, etc.
- Activities (your intervention)—sleeping, sitting, lounging, eating, writing, reading, studying, birdwatching, climbing, shading, playing, gardening, etc.

How might your intervention invite new ways of occupying, using, or sharing the space? What materials and fabrication methods best suit your proposal? How does your prosthetic deploy, assemble, and append to the existing? Is it on wheels, does it have a handle, or can you wear it? Is it designed for individual or shared use?



Figures 7-9 (left to right): *Stair Squares* (Mark Reigelman); *Pfandring* (Paul Ketz); *Plus Furniture* (Napp Studio & Architects).

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MODULE 3:

Inflatable Thresholds—Hack a Space

Duration: Weeks 8–13 (10 class days) | Mode: Team of 3-4 | Scale: Architectural Scale

Overview

Buildings are filled with thresholds—entries, exits, windows, corridors, stairways, vertical shafts—of liminal and in-between spaces.

In Module 3, you will scale up to design an architectural intervention. Working in teams of three or four, you will design and fabricate an inflatable (pneumatic) structure that transforms the experience of a chosen threshold within the MET building.

You will choose a threshold site and carefully observe and diagram the key characteristics of its existing context.

- Architectural Thresholds—porches, atria, corridors, entryways, elevators, balconies, bridges, stairways, landings, etc.

Throughout the project, you will work across multiple scales, developing ideas through prototyping, fabrication, and testing. You will investigate how individual inflatable modules assemble to create larger architectural elements—such as walls, roofs, screens, enclosures, or partitions—transforming how the space is occupied and perceived visually, acoustically, tactilely, or atmospherically.

How does your intervention relate to its site? Does it stand freely, suspend from above, or attach to an existing element? How do people enter, move through, and occupy the space? How does it shape light, sound, privacy, visibility, enclosure, or collectivity? How might a temporary intervention transform our perception of an everyday architectural threshold?



Figures 10-12 (left to right): *Pillow Tent* (Lambert Kamps); *Leverage* (BARSK Projects); *Pionier* (Carsten Nicolai).

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Absence Policy

Attendance for the full duration of each class is mandatory. The studio is an exceptional learning environment that requires your physical presence as well as your intellectual presence. You are allowed 3 excused absences for the semester. An excused absence is defined as one that was discussed with & approved by the instructor at least 24 hours prior to the absence, or a family or medical emergency that is confirmed by your physician or a dean in Student Support Services. Absences beyond the three allotted will result in a decrease in your final grade. If you miss six or more studio classes, you will be asked to drop the subject or receive a failing grade.

Evaluation Criteria, Completion Requirements & Grading

Evaluation Criteria

- **Observation & Research** Ability to identify opportunities through careful observation, documentation, and analysis of existing conditions.
- **Design Development** Strength of the design concept and the evolution of ideas through iteration, testing, and refinement.
- **Making & Craft** Resourceful and effective use of materials, available tools, fabrication methods, assembly, and construction techniques.
- **Technical Resolution** Quality of drawings, models, prototypes, digital files, and attention to detail.
- **Communication** Ability to communicate ideas through drawings, diagrams, models, presentations, and written instructions.
- **Studio Engagement** Attendance, preparedness, participation in critiques and workshops, collaboration, and consistent contribution to the studio environment.

Completion Requirements

Successful completion of the course requires timely completion of all exercises, rigor in process, and clarity in representation, as well as the overall progress of the semester (including attendance). Students are also required to document and upload their work to the Dropbox folders provided by the teaching team. This documentation serves both as a record for your own professional portfolios and as part of the department's student work archive. Failure to submit documentation may delay grading and must be resolved before the specified deadline.

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Grading

Component	Weight
Module 1 — Drawing Instrument	20%
Module 2 — Urban Prosthetic	35%
Module 3 — Inflatable Thresholds	35%
Studio Engagement	10%

A: Excellent - Project surpasses expectations in terms of inventiveness, appropriateness, verbal and visual ability, conceptual rigor, craft, and personal development. Student pursues concepts and techniques above and beyond what is discussed in class.

B: Above Average - Project is thorough, well researched, diligently pursued, and successfully completed. Student pursues ideas and suggestions presented in class and puts in effort to resolve required projects and demonstrates potential for excellence.

C: Average - Project meets the minimum requirements. Suggestions made in class are not pursued with dedication or rigor. Project is incomplete in one or more areas.

D: Poor - Project is incomplete. Basic skills including graphic skills, model-making skills, verbal clarity or logic of presentation are not level-appropriate. Student does not demonstrate the required design skill and knowledge base.

F: Failure - Project is unresolved. Minimum objectives are not met. Performance is not acceptable. This grade will be assigned when you have excessive unexcused absences.

Iteration and Progress Matters

Design is an iterative process. Students are expected to experiment, test ideas, revise their work, and respond to feedback throughout the semester. Grades reflect sustained development and engagement with the design process rather than the success of a single final outcome.

Studio Culture

F.I.R.E (Fun, Iterative, Resourceful, Engaged)

Studio is a shared environment for making, experimentation, and learning. We encourage you to bring joy and fun to the process: stay curious, take risks, and find pleasure in making. Design is iterative, so test ideas early, learn through both successes and failures, and continually develop your work throughout the semester. Be resourceful by working creatively with the tools, materials, knowledge, and people around you. And stay engaged: participate in critiques, reviews, and discussions, and learn not only from your own work but also from the work of your peers. Respect for one another, shared tools, materials, and the studio environment is fundamental to our collective studio culture.

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Academic Integrity/Honesty

Massachusetts Institute of Technology students are here because of their demonstrated intellectual ability and because of their potential to make a significant contribution to human thought and knowledge. At MIT, students will be given unusual opportunities to do research and undertake scholarship that will advance knowledge in different fields of study. Students will also face many challenges. It is important for MIT students to become familiar with the Institute's policies regarding academic integrity, which are available at [Academic Integrity at MIT: A Handbook for Students](#).

Medical

If you are on a Medical Hold due to attesting to potential Covid symptoms, or have tested positive and must isolate, then please contact your instructors so we can make sure you have access to course materials and we can discuss how we address the missed work. In anticipation of students being ill this semester we have already decided that we will provide the following types of academic assistance. You can also contact Student Support Services for additional Assistance <https://studentlife.mit.edu/s3>.