

**Level:** U.G.

**Instructors:** Jeff Landman (jeff.landman@gmail.com) & Paul Pettigrew (paulpett@mit.edu)

**Teaching Assistants:** Susan Williams (susanwil@mit.edu) & Tatiana Estrina (testrina@mit.edu)

**Schedule:** MW 2:00 p.m. - 5:00 p.m. Room 7-434

**Units:** 3-3-6 HASS-A

**Prerequisites:** None

## Class Overview:

4.021 How to Design introduces fundamental design principles as a way of demystifying design and providing a basic introduction to all aspects of the design process. Through lectures and exercises, students will develop skills of creativity, abstract thinking, representation, iteration, and design development. 4.021 is an introductory class intended for students without a design background, geared towards enabling more effective collaboration with designers, and the ability to apply foundational principles of design to any discipline. Limited to 26; preference to Course 4 and 4B majors/minors, first- and second-year students.

## The Design Process:

Each week the class will explore aspects of the design process from context to concepts, drawing, making, iterating, building a narrative and finally presenting. This path exemplifies a traditional design process where a designer starts with an idea and works through testing, expanding, refining, and eventually realizing their idea for review and evaluation. Through weekly topics and assignments, students will develop a variety of design skills relating to each stage of the design path.

## Learning Objectives:

The course consists of three projects exploring various topics through concepts, drawings and physical fabrication. Students should be able to engage with an increasing level of design research through iterative studies and move fluidly between different modes and scales of operation. Conventions of design representation and communication through drawing and modeling will be explored. Students will need to demonstrate basic application of design skills, understanding of conventions, and an ability to sustain an increasing level of research in the projects over the semester.

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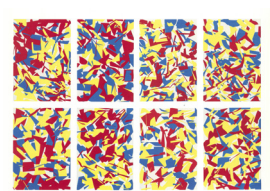
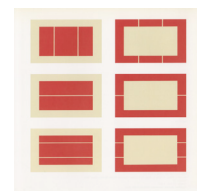
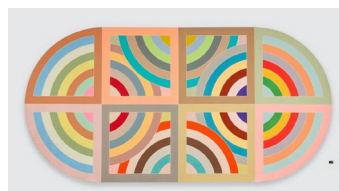
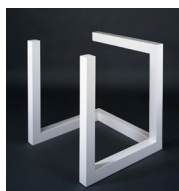
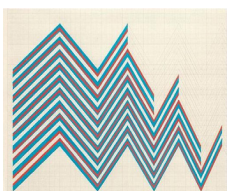
## Exercise 1: *Designing Drift*

“In conceptual art the idea or the concept is the most important aspect of the work. When an artist uses a conceptual form of art, it means that all of the planning and decisions are made beforehand and the execution is a perfunctory affair. The idea becomes a machine that makes the art...It is usually free from the dependence on the skill of the artist as a craftsman.” Sol LeWitt, “Paragraphs on Conceptual Art”, Artforum, V/10, Summer 1967,

The first exercise is to develop a drawing that features the process of iteration, a concept essential to design that we will explore in various ways throughout the semester. You will select or invent a drawing tool, and method for using your tool, by developing a series of rules governing your tool’s use. Rules will become a set of written instructions used to produce rule-based drawings authored by you, and additionally by your classmates.

The intent of this exercise is to allow a “way in” for each of you, regardless of your prior experiences in design. This exercise will also begin to establish a common set of graphic and verbal vocabularies that we will use throughout the semester, in a variety of contexts.

Drift Drawings should consider how your drawing acts to divide the space of the drawing paper; how various lines, marks, imprints and/or incisions interact with one another; how various parts affect a larger whole; and, how successive drawers interact with the actions of prior drawers.



## Drawing Requirements:

- A clear concept/intention/thesis about dividing the space of the drawing paper.
- A clear concept/intention/strategy for color in your rules and composition.
- Your drawing should feature anomalies, deformations or randomness coded into your instructions with the intent of producing “drift.”
- Temporal components of the mechanics (human or other) must be evident.

## Drawing Strategy:

- Start with a geometric primitive (point, line, plane, curve, etc.), placed at a location of your choice, within the bounds of a 18” x 18” sheet of drawing paper & develop rules for transforming your initial primitive (e.g. move, rotation, reflection, scale, deformation, etc.).
- Expand from the starting point to the rest of the drawing area/paper.

## Additional Drawing Strategies:

- A secondary tool or template
- A surface to place under the drawing paper
- A method of physical manipulation: crease, fold, erase, score, etc.
- A system of measurement

## Rules:

- Rules should be divided into 3 primary stages: one for each of 3 classmate to draw
- Rules should be written, printed and sited within the studio space by 02.15.23 @ 2:00 p.m.
- Rules cannot feature diagrams or images.
- The amount of time a single student/drawer should spend on your drawing is 30 minutes - 45 minutes.

## Schedule: Process & Iteration

02.06.23 (m)

**Presentation:** Class Introduction + Exercise 1: *Precedents & References*

**Assignment:** Study precedents/references and select one that you prefer, tell us why and about the author & their work(s). Analyze which rules/procedures are behind the “drawing” you’ve selected and start to develop a series of rules/procedures for your drawing on sketch/trace paper. Think about a drawing tool or drawing technique that might introduce “drift” into your drawing process.

02.08.23 (w)

**Presentation:** *Color Theory*

**Assignment:** Make a first draft-drawing based on your rules on a (18”x18”) sheet of practice paper. Make a second draft-drawing on a second (18”x18”) sheet of practice paper modifying your rules, or keeping the same rules and modifying your implementation of the rules, or using your drawing tool in a different manner.

02.13.23 (m)

**Presentation:** *Google Slides Use & Preparation*

**Assignment:** Type out rules for your selected iteration on an 8 1/2” x 11” piece of paper so that your classmates can successfully draw your rule based drift drawing. Add your rules to your google slides presentation. Make a final iteration of your drift drawing following your rules and take a time-lapse video with your phone – of you creating your drawing. Add your time lapse video to your google slides presentation.

02.15.23 (w)

**Assignment:** Follow the rules written by 3 of your classmates, work to contribute towards the creation of 3 of your classmate’s drawings. Assemble your project presentation on Google Slides.

02.21.23 (t)

**Assignment:** Display & present to your classmates, TA’s & faculty.



## Exercise 2: *Light As Paper*

“Light is a powerful substance. We have a primal connection to it. But, for something so powerful, situations for its felt presence are fragile . . . I like to work with it so that you feel it physically, so you feel the presence of light inhabiting a space.” James Turrell

This exercise explores the steps of (a) building a design concept (b) framing a context within a design process (c) exploring the properties and the possibilities of a single material. Through this assignment, you will develop the conceptual foundation upon which you can design and fabricate a “Light As Paper” experience.

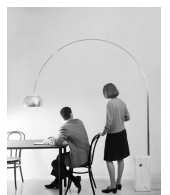
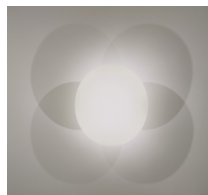
You are tasked with developing a concept for your *Light As Paper* and framing a context around it. Your concept should be focused on:

- The **performance** of your *Light As Paper* with regards to functionality and user experience – i.e. with regards to transparency, translucency, views, optics, movement, or something additional.
- The **material exploration**, material manipulation, and fabrication techniques with which you’ll achieve the design and performance of your *Light As Paper*.
- The **context** which can be built upon inspiration from existing art, product design, industrial design, architecture, functional objects, objects without a function, fabrication processes, material manipulations, or natural phenomena across various scales. You will be asked to translate your concept & its associated performance into volumetric explorations that focus on implementation & iteration of your initial concept. Having a strong concept, performance, & material exploration supported by a relevant context, is very important.

### Schedule: Process & Iteration

Progress in studio is a process. Work in the classroom and between classes is cumulative. Instructors and Teaching Assistants will review your work during studio providing you with feedback which you will incorporate into a revised or final version of your project for the next class. Iteration is a key condition of effective design. Make, critique, repeat, as many times as possible for best results.

- 02.22.23** (w) **Presentation:** *Unnatural Light*  
**Assignment:** 3 concept sketches or models that describe your light's performance, context, material exploration, and fabrication process.
- 02.27.23** (m) **Assignment:** Refine your concepts – narrow down to 1 concept and draw it clearly (by hand/sketch) Concepts should be about: (a) The performance of your *Light As Paper* in relation to people/views/light etc. and (b) Fabrication process – i.e., how is it made from paper, and how does it work.
- 03.01.23** (w) **Presentation:** *Introduction to Rhino*  
**Assignment:** Refine your concept & draw your concept diagram in Rhino/Vector 2D.. Start working with paper – fold/shred/weave/etc. Experiment with the paper & start to understand how you can manipulate it to produce certain effects, textures, & performances, & how paper manipulations can inform your concept & fabrication process.
- 03.06.23** (m) **Presentation:** *Introduction to Adobe*  
**Assignment:** Use your new fabrication process and experiments with the paper(s)- understand the paper's formal possibilities. Update your concept and fabrication technique(s) based on what you learn about your paper.
- 03.08.23** (w) **Presentation:** *Student Presentations/Mid-Project Review*  
**Assignment:** Prepare a presentation using the provided Google template including: Concept diagram, vector drawing of the enclosure, precedents/context and small-scale physical models.



## Exercise 2: *Light As Paper* (cont.)

- 03.13.23** (m) **Assignment:** Update your concept and fabrication technique/use of paper based on the feedback you received during our mid-project reviews. Update your concept diagram & revise in Adobe.
- 03.15.23** (w) **Assignment:** Fabricate your first full-scale experiment with paper.
- 03.20.23** (m) **Presentation:** *Final Documentation Tutorial/Design Project Photography*  
**Assignment:** Sketch/diagram describing the fabrication process for your second/final pass at a full-scale paper prototype. Start fabrication. Work on the diagrams/presentation and begin the process of preparing final presentation documentation, concept diagram, vector drawing of your light modulator, precedent studies, context, full-scale physical prototype, photographs, and time-lapse video(s).
- 03.22.23** (w) **Presentation:** *Final Project Presentation.*  
**Assignment:** Prepare a Google slide presentation including: Concept diagram, vector drawing of your *Light as Paper* precedent studies, context, full-scale physical prototype, photographs, and time-lapse video(s).
- 03.27.22** (m) Spring Break
- 03.29.22** (w) Spring Break

## Exercise 3: *Folding Function*

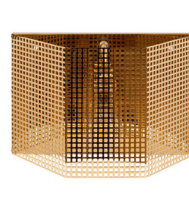
"The visionary starts with a clean sheet of paper, and re-imagines the world. The tweaker inherits things as they are, and has to push and pull them toward some more nearly perfect solution. That is not a lesser task." Malcolm Gladwell, *The Tweaker*, *The New Yorker*, November 11, 2011

"The danger is that Gladwell's article will likely be misread in executive suites and boardrooms as confirming the wrong-headed idea that innovation should be cheap, easy and incremental and, no matter what, should not involve any serious invention. That is a recipe for near-term gain and long-term doom and, unfortunately, buttresses the misguided course being taken by more and more companies." Chunka Mui, *Innovators Beware: The Danger of Viewing Steve Jobs as a 'Tweaker'*, *Forbes*, November 15, 2011

## ***Folding Function: Does the World Really Need Another Functional Object?***

Does the world really need another functional object? How is our process different if we set out to design with a noun in mind vs. a verb, i.e., "I would like to design and fabricate a desk organizer" is very different than "I would like to re-imagine how I interact with the objects in my everyday student dormitory life."

Vessels for holding and storing were invented thousands of years ago but that hasn't stopped nearly every generation since from evolving storage from one design to another via an ever changing assortment of materials, tools, and technologies. The history of functional object design is filled with inventors and tweekers. This semester *4.021 How to Design* asks you to choose a path. Would you like to be an inventor or a tweaker? Initially we will study the histories of functional object inventors and tweekers to better understand the various processes used in the past to arrive at an invented or tweaked solution in the present. We will then use our investigations and acquired knowledge to forge our own path and evolve or invent the next generation of functional objects capable of reordering the activities of our everyday lives, improving our everyday lives or perhaps even changing the way we live.





## Exercise 3: *Folding Function (cont.)*

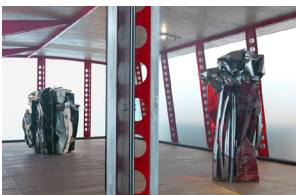
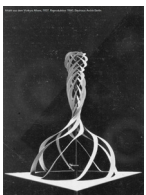
Building upon the skills, techniques, and experiences you acquired working through and completing exercises 1 & 2, exercise 3 asks you to design and fabricate function using a single sheet of metal of a given dimension, geometrically guided fabrication instructions, and kinetic folding as a technique to transform a plane into a volume with a particular function of your choosing.

Working at full scale with function offers students the opportunity to experience in a single exercise through sketches, physical models, digital models, full-scale mock-ups and completed prototypes, the traditional design sequence of schematic design, design development, presentation drawings, fabrication drawings, fabrication, use, and analysis.

## Schedule: Process & Iteration

Progress in studio is a process. Work in the classroom and between classes is cumulative. Instructors and Teaching Assistants will review your work during studio providing you with feedback which you will incorporate into a revised or final version of your project for the next class. Iteration is a key condition of effective design. Make, critique, repeat, as many times as possible for best results.

- 04.03.23 (m)** **Presentation:** *Functional Object Design a History of Invention and Tweaking*  
**Assignment:** Read Malcolm Gladwell's article "The Tweaker." Identify a design problem or opportunity in your dormitory room, apartment, or everyday life that you feel might be an opportunity for tweaking or invention. Prepare (min. of) 3 sketches and/or diagrams, describing your proposed tweaks and/or inventions.
- 04.05.23 (w)** **Presentation:** *Laser Cutting Tutorial + Folding Logic*  
**Assignment:** Refine your concepts – narrow down to 1 concept and draw it clearly (by hand/sketch) Concepts should be about: (a) The function of the proposed object in relation to its context/the design problem its trying to solve/improve (b) Fabrication process – i.e., how it might be made from a single sheet of metal folded in such a way as to have structural integrity, perform its given function, and be graceful.
- 04.10.23 (m)** **Assignment:** Draw your concept in Rhino and prepare your drawing for cutting on the laser. Using a piece of the supplied cardboard, make a test cut of your concept.
- 04.12.23 (w)** **Assignment:** Modify your concept and/or laser cut prototype based on the success (or failure) of your initial full-scale mock-up.
- 04.17.23 (m)** **Assignment:** Begin preparations for a mid-project presentation using the provided Google template including: Concept diagram, vector drawing of your 2d sheet & 3d folded functional volume, precedents/concept/context, and full scale physical models in cardboard
- 04.19.23 (w)** **Presentation:** *Student Presentations/Mid-Project Review.*  
**Assignment:** Prepare a Google slide presentation including: Concept diagram, vector drawing of your 2d sheet & 3d folded functional volume, precedents/concept/context, and full scale physical models in cardboard
- 04.24.23 (m)** No Class Patriots Day
- 04.26.23 (w)** **Assignment:** Modify your concept, diagrams, sketches, Rhino drawing, and/or laser cut prototype based on the feedback you received during our mid-project review
- 05.01.23 (m)** **Presentation:** *Metal Laser Cutter Tutorial @ N52*  
**Assignment:** Desk Critiques
- 05.03.23 (w)** **Presentation:** *Powder Coating Tutorial @ N52*  
**Assignment:** Desk Critiques & final testing of Rhino file for metal laser cutter using cardboard for mock-up/test



## Exercise 3: *Folding Function* (cont.)

- 05.08.23** (m)      **Assignment:** Desk Critiques & prepare final preparations of Rhino file for metal laser cutter
- 05.10.23** (w)      **Assignment:** Metal Laser Cutting @ N52
- 05.15.23** (m)      **Assignment:** Begin/continue preparations for a final-project presentation using the provided Google template including: Concept diagram, vector drawing of your 2d sheet & 3d folded functional volume, precedents/context, and full scale physical models in metal
- TBD** (?)            **Presentation:** *Final project presentation.* Prepare a presentation using the provided Google template including: Concept diagram, vector drawing of your light modulator, precedent studies, context, full-scale physical prototype, photographs, and time-lapse video(s).

## 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 and Grading:** The following criteria will be used for the evaluation of student's work, both in terms of helping their progress and in final grading. (01) Concept: How clearly is the student articulating their conceptual intentions? (02) Translation of Concept: How well is the student using their concept to develop a design response to given problems? (03) Representation Appropriateness: How well matched is the student's choice of representational means to their intentions? (04) Representation Quality: How accomplished are students with drawing, modeling, and/or digital representation? To what degree do student's representations convey what they ought to? (05) Oral Presentation Skills: How clearly are students presenting their ideas orally, whether at their desk, in class discussions, or to a more formal jury? (06) Participation in Discussions: How actively and how constructively are students involved in class discussions, both formally and informally? (07) Response to Criticism: How do students effectively take advantage of criticism from instructors, classmates and outside jurors? (08) Auto-Critical Skills: To what extent are students able to critique their own work regularly and effectively? (09) Attendance – see below.

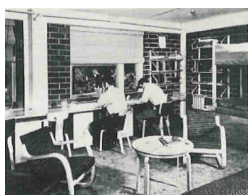
**A: Excellent** - Project surpasses expectations in terms of inventiveness, appropriateness, verbal and visual ability, conceptual rigor, craft, and personal development. Student pursues concepts and techniques above and beyond what is discussed in class.

**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. Project is complete on all levels 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.



## Completion requirements

Completion of each of the exercises, rigor in process and clarity in representation, as well as the overall progress of the semester (including attendance) will be fundamental to completing the course.

## Studio Culture

Work in the studio will build sequentially. Therefore, your commitment to continual development on a daily basis is of paramount importance. It is important that you take advantage of the studio environment. Magnification of your development as a designer is made possible by the collective nature of the class. Group reviews are collective for a reason. Each of you has something to gain from your peers. Since studio is a place for all, it necessitates the careful attention to the needs of everyone in it. Please see your instructors if there are any problems that you are unable to resolve on your own. All spraying of fixative, spray paint or any other substance should be done inside the shop spray booth.

## 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 is 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>

