configuration

MSCI-307P
Fall 2025
Philip Ording
Pratt Institute

MSCI-307P-01 Configuration
Mathematics & the American Avant-Garde

Fall 2025 Wednesdays 9:30am-12:20pm Engineering 111
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Course Description

This course will explore interactions between modern mathematical concepts and 20th century American visual, literary, and performing arts. Our focus will be the experimental Black Mountain College, a small and short-lived college of liberal arts in North Carolina that is distinguished as much by its outsized influence on the development of the post-war avant-garde as its communal approach to education. Retracing the novel exchanges between art and science fostered by this approach will serve as the basis for a broader investigation of the potential mathematics holds for art and design practices today.

Overview

This course is aimed at art and design students as well as those who study the history and education of art and design. No par-ticular background in mathematics is required. It is organized as a collaborative seminar, grounded in discussion of open-ended mathematical problems. These problems will arise primarily from art and design contexts, as described by seminar readings, guest speakers, and art viewings outside class.

We will study the work of celebrated Black Mountain artists and designers including: Anni Albers, Josef Albers, Ruth Asawa, John Cage, Buckminster Fuller, Charles Olson, Dorothea Rockburne, and Kenneth Snelson. The main source of mathematical ideas will derive from the essays and archival teaching materials of Black Mountain College mathematician, Max Dehn. For context, we will sample work of his contemporaries elsewhere, including David Hilbert, Henri Poincaré, and Kurt Gödel.

This is a course in applied mathematics, but students can expect to encounter modern ideas from pure mathematics that range from projective geometry (the abstract principles underlying perspective), mathematical formalism (the modern axiomatic method), combinatorics (combination and permutation) to topology (dimension, surfaces, knots), among others. A common thread will be the idea of a configuration, which is a type of schematic diagram that expresses spatial relationships free of measurement.

Course Goals

The goals of this course are to:

- Explore modern mathematical topics including projection, configuration, chance, projection, surfaces, knots, and geodesics
- Apply mathematical reasoning skills to formal problems that arise in art and design contexts
- Gain a greater appreciation for the historical connections between art and science, especially during the late modern period in America
- Reflect on the potential role of mathematics in educating artists and designers past, present, and future

Student Learning Outcomes

By the end of this course, students will be able to:

- Construct elementary projective configurations and ten-segrity structures, enumerate combinations and permuta-tions, and sketch topological diagrams
- Identify formal problems in art and design that are amen-able to mathematical analysis
- Practice common heuristics (or methods) for discovering solutions to such problems
- Describe the modern (structuralist) axiomatic approach and its limitations and alternatives
- Cultivate their mathematical interests and the interests of others through reading, writing, and discussion

Assignments

Problem sets and revisions

In mathematics, there's an important distinction between exercises, which are more or less routine practice, and problems. Problems ought to be interesting in their own right and usually demand sustained effort. (The mathematician Erica Flapan advises working on homework as soon as possible so her students have enough time to think—and dream—about problems before they're due.) Problem sets are to be worked out in the bound notebook and brought to class, where they will be checked for progress weekly. The expectation is that students respond to every problem. Select problems will be assigned for revision and a formal write up.

Readings and reading presentations

Typically, one or two excerpts from sources listed above will be assigned each week. All readings will be made available for download from the course website. Direct instruction will be provided in the first week of class about how to engage mathematical and other texts assigned. Each student will be responsible for co-leading discussion of two reading assignments over the course of the term. This will entail identifying for each text assigned: three or more key passages, a simple example of one or more mathematical objects defined, and framing one or more discussion questions.

Studio visit

Students will identify an art or design studio affiliated with Pratt that intersects with the mathematical themes of this course in some way. This could be a studio course, a senior thesis studio, a master's thesis studio, or the professional studio / design office of a Pratt instructor. Students will arrange to visit the studio and interview one of its participants about the potential role that configuration, projection, chance, surfaces, knots, geodesics or another mathematical notion plays in their practice. Following the studio visit, students will transcribe their interview and prepare a brief (5-10 minute) in-class slide presentation to illustrate highlights from the interview in words and pictures.

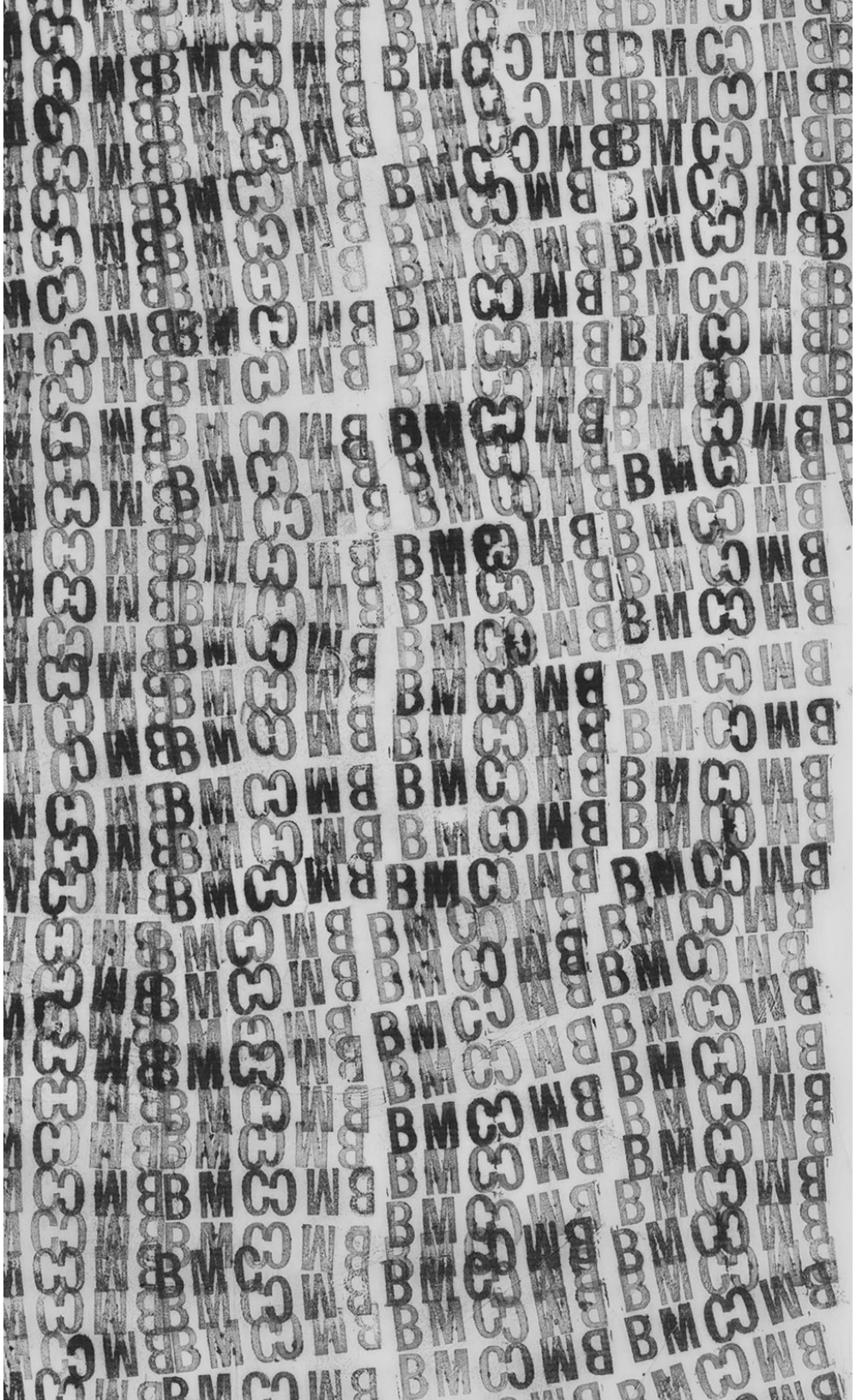
Pratt math reader

Michael Polyani argued that "mathematics cannot be defined without acknowledging its most obvious feature: namely, that it is interesting." Following the studio visit assignments, students will identify and research a mathematical question of interest not only to themselves but also others at Pratt. Through an iterative process, students will: identify formal elements manifest in the studio work, describe relations among these elements, articulate mathematical questions about these relationships, test possible solutions, and gather relevant literature. All students will file their research findings (existing scholarship, studio interviews, mathematical definitions, examples, diagrams, puzzles, problem statements, solutions, etc.) in a shared course reader. This document, halfway between a magazine and an academic journal, will be collectively edited, annotated, and illustrated by the class as a whole.

Materials

Students should bring the following drawing/writing materials to each class. Please feel free to use whatever you have already, provided it is of reasonable quality. If you need to purchase materials, examples available from Blick are provided.

- Bound blank notebook (Fabriano 11.7"x8.3" $7)
- Two-color pencil (Caran d'Ache Red/Blue $3)
- Graphite writing pencil
- Eraser
- Ruler



Assessment, Grading & Policy

Problem sets		40%
Math reader		30%
Studio visit		20%
Reading presentations & participation		10%
	total	100%

* See Attendance Policy below for grade impact.

Pratt Institute Grade System

Grade	Evaluation	Quality Points/Credit
A	Excellent	4.0
A-	Excellent	3.7
B+	Very Good	3.3
B	Good	3.0
B-	Good	2.7
C+	Above Average	2.3
C	Average	2.0
C-	Below Average (UG only)	1.7
D+	Less than Acceptable (UG only)	1.3
D	Less than Acceptable (UG only)	1.0
F	Failure	0.0
WF	Failure Due to Lack of Attendance.	0.0

Attendance Policy*

Consistent attendance is essential for the completion of any course or program. Attending class does not earn students any specific portion of their grade, but is the pre-condition for passing the course, while missing class may seriously harm a student's grade. Pratt Institute respects students' requirements to observe days of cultural significance, including religious holy days, and recognizes that some students might need to miss class to do so. In this, or other similar, circumstance, students are responsible for consulting with faculty ahead of time about how and when they can make up

work they will miss. Reasonable accommodations for students with documented disabilities will continue to be provided, as appropriate. For full details, see Pratt's Attendance Policy.

The expectations for this class are as follows:

- Absences (partial and full) can be excused if written proof is given, showing that the time and date of the appointment overlapped with class time, and the completion of a make-up assignment on the work covered during the absence.
- One unexcused absence is allowed, two will reduce grade by half a grade; three will normally constitute failure.
- Three unexcused partial attendances, i.e. lateness or early departure, will count as one unexcused absence.

Community Standards

All Pratt students, faculty, and staff members are expected to value and uphold the community standards essential to the pursuit of academic excellence and social responsibility. These include expectations for social conduct, academic integrity, non-discrimination, and other policies described in the link above, and apply to all Pratt-sponsored activities, on or off campus.

Standards specific to the community of this class will be discussed in class, decided collectively, and added to the syllabus.

Academic Integrity

Academic integrity at Pratt means using your own and original ideas in creating academic work. It also means that if you use the ideas or influence of others in your work, you must acknowledge them.

At Pratt,

- We do our own work,
- We are creative, and
- We give credit where it is due.

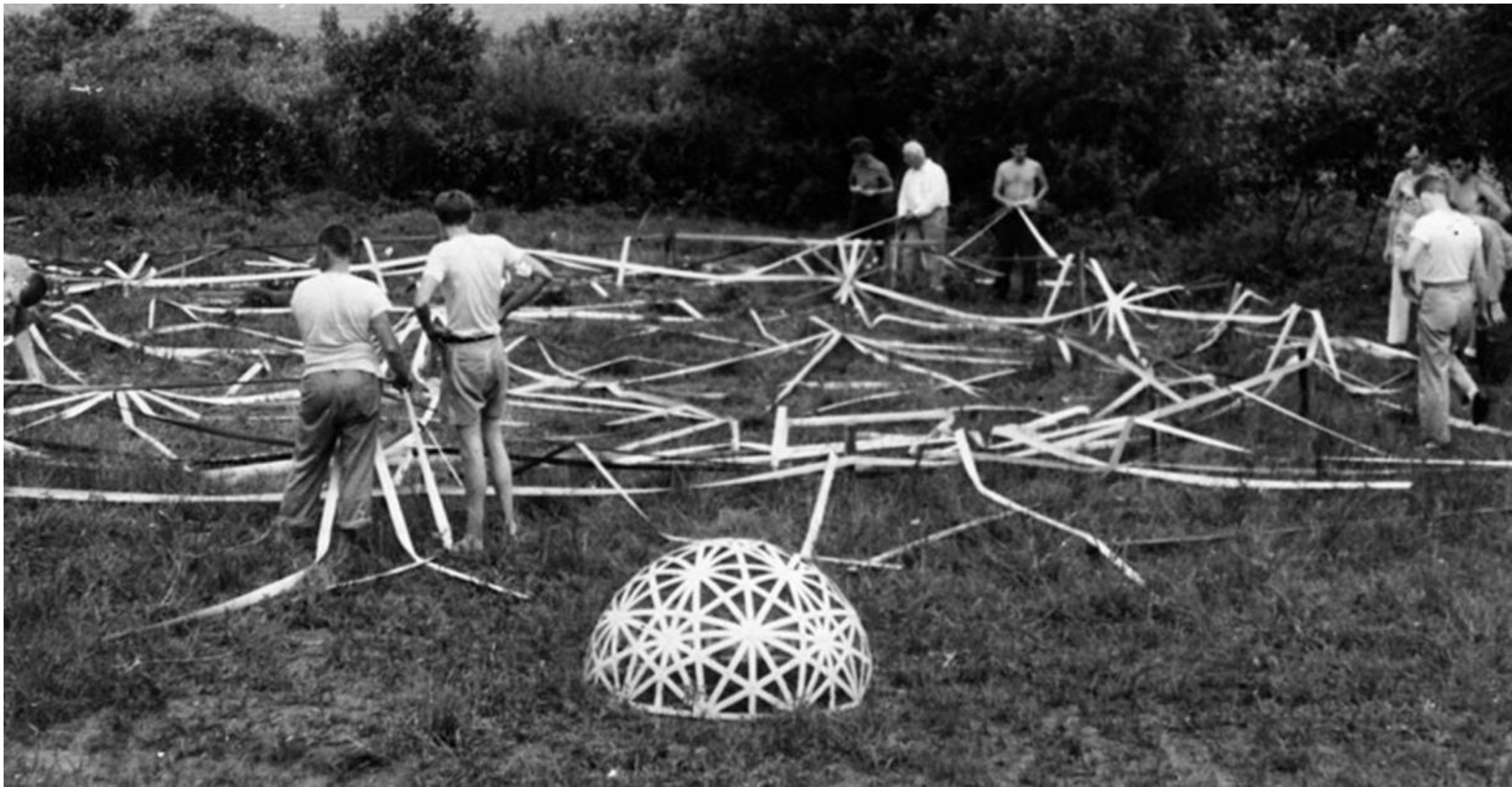
When students submit any work for academic credit, they make an implicit claim that the work is wholly their own, completed without the assistance of any unauthorized person. These works include, but are not limited to exams, quizzes, presentations, papers, projects, studio work, and other assignments and assessments. In addition, no student shall prevent another student from making their work. Students may study, collaborate, and work together on assignments at the discretion of the instructor.

Examples of infractions include but are not limited to:
The following examples are drawn from the Academic Integrity Code and should be curated or supplemented based on assignments for your course.

1. Plagiarism, defined as using the exact language or a close paraphrase of someone else's ideas without citation.
2. Violations of fair use, including the unauthorized and uncited use of another's artworks, images, designs, etc.
3. The supplying or receiving of completed work including papers, projects, outlines, artworks, designs, prototypes, models, or research for submission by any person other than the author.
4. The unauthorized submission of the same or essentially the same piece of work for credit in two different classes.
5. The unauthorized supplying or receiving of information about the form or content of an examination.
6. The supplying or receiving of partial or complete answers, or suggestions for answers; or the supplying or receiving of assistance in interpretation of questions on any examination from any source not explicitly authorized. (This includes copying or reading of another student's work or consultation of notes or other sources during an examination.)

7. The use of generative artificial intelligence (AI) to produce or to improve work, whether visual or textual, except when called for by an assignment or instructor and acknowledged transparently as one tool among others in the creative process.

The Academic Integrity Standing Committee (AISC) is charged with educating faculty, staff, and students about academic integrity practices. Whenever possible, we strive to resolve alleged infractions at the most local level possible, such as between student and professor, or within a department or school. When necessary, members of this committee will form an Academic Integrity Hearing Board to hear cases regarding cheating, plagiarism, and other infractions described below; these infractions can be grounds for citation, sanction, or dismissal. Detailed procedures are explained in the full version of the Academic Integrity Policy.



Schedule

Week	In class	Homework	Reading/viewing
I. Overview August 27	Introductions Syllabus Meander drawing How to read (about) math Schedule office hour	1. Solve meander problems 2. Read Phillips article 3. Draft reading presentation	Tony Phillips, “The Topology of Roman Mosaic Mazes” *Optional*: Robert Wiesenberger, “A Key”
II. Black Mountain September 3	Discuss Phillips reading Share meander solutions Intro Black Mountain College How to talk (about) math Office hour sign-up	1. Prepare meander talk 2. Attend office hour 3. Read Blume	Eugen Blume, “Science and Its Double” *Optional*: Helen Molesworth, “Imaginary Landscape” Natasha Goldowski Renner, “Physics for Liberal Arts Students”
III. Discovery September 10	Meander chalk talks Discuss Blume reading Plan reading presentations How to write (about) math	1. Meander write-up 2. Read Davis & Hersh 3. Math literature date	Philip Davis & Reuben Hersh, “Pólya’s Craft of Discovery” *Optional*: George Pólya, *How to Solve It* Max Dehn, “The Mentality of the Mathematician”
IV. Rhythm September 17	Share meander write-ups Discuss Reuben & Hersh View Pólya demonstration Binary sequences	1. Solve rhythm problems 2. Read Anni Albers 3. Prepare rhythm problem talk or reading co-lead	Max Dehn, “On Ornamentation” and Anni Albers, “Work with Material” *Optional*: Anni Albers “One Aspect of Art Work”
V. Weaving September 24	Discuss Dehn & Albers reading Paper weaving Discuss rhythm problems Studio visit assignment	1. Solve weaving problems 2. Attend office hour 3. Studio visit proposal 4. Prepare talk/co-lead	Anni Albers, “The Fundamental Constructions” *Optional*: Anni Albers, “Draft Notation”

Week	In class	Homework	Reading/viewing
VI. Invention October 1	Discuss Albers Present studio proposals Discuss weaving problems	1. Rhythm or weaving write-up 2. Studio visit 3. Read Davis & Hersh 4. Prepare talk/co-lead	Davis & Hersh, "The Creation of New Mathematics" *Optional*: Imre Lakatos, *Proofs and Refutations*
VII. Configuration October 8	Discuss Davis & Hersh Share write-ups Projective diagrams View *College Geometry Project* films	1. Construct configurations 2. Prepare studio visit presentation 3. Read Kline	Morris Kline, "Projective Geometry" *Optional*: Brenda Danilowitz & PO, "Toward A Happy Life: Max Dehn at Black Mountain College" College Geometry Project, "Central Perspectivities" Ad Reinhardt, "How to Look at Space"
VIII. Research October 15	Studio visit presentations start Pratt Library visit Discuss Kline	1. Library research 2. Peruse journal articles 3. Prepare talk/co-lead	Scientific American Journal of Mathematics & the Arts Leonardo
IX. Fieldtrip October 22	Ruth Asawa Retrospective Museum of Modern Art	1. Configurations or folding write-up 2. Read Schwartz 3. Prepare talk/co-lead	Richard Schwartz, "Cell Divisions" and Charlotte Healy, "Triangles to Topology: Ruth Asawa, Max Dehn, and Buckminster Fuller" *Optional*: Jordan Troeller, "Milk-Carton Sculpture: Ruth Asawa, Geodesic Geometry, and the Maternal Counterculture of the Alvarado School Arts Workshop
X. Intuition October 29	Studio visit presentations Share configurations Discuss Schwartz	1. Library research 2. Read Davis & Hersh 3. Prepare talk/co-lead	Davis & Hersh, "Nonanalytic Aspects of Mathematics" *Optional:* David Silver, "Barn Raising"

Week	In class	Homework	Reading/viewing
XI. Fold November 5	Discuss Davis & Hersh Paper folding Share library research	1. Solve folding problems 2. Attend office hour 3. Read O'Rourke 4. Prepare talk/co-lead	Joseph O'Rourke, "Flat Vertex Folds" *Optional*: Eva Díaz, "Topologies of the Fold" Vanessa Gould, *Between the Folds*
XII. Dimension November 12	Discuss O'Rourke Folding problems	1. Attend office hour 2. Read Davis & Hersh 3. Prepare talk/co-lead	Davis & Hersh, "Four Dimensional Intuition" *Optional*: Edwin Abbott, *Flatland* Michele Emmer, "Cagli, Olson, Coxeter" Banchoff & Strauss, *The Hypercube*
XIII. Geodesic November 19	Discuss Davis & Hersh Topology experiments Dome construction	Draft reader contribution	*Optional*: Jeff Weeks, "The Sphere" Buckminster Fuller, US Patent 2,682,235
November 26-29	THANKSGIVING BREAK		
XIV. Draft reader December 3	Peer editing Layout Front and back matter	Revise and submit final reader contribution	
XV. Final reader December 10	Assemble reader Final reflections		

Course webpage

http://c-o-n-f-i-g-u-r-a-t-i-o-n.org/