HONR 105AE
Fundamental Concepts of Inquiry in Science and Math
The Art of Mathematical Proof

Instructor Information

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Office hours	MWF 9:30 am – 11:00 am
Appointment hours	MT 1:00 pm – 2:30 pm
Click here to book an appointment	

Course Information

HONR 105AE
Fall 2022 CRN24879
Thursdays 2-3 pm HT401

Catalog Description:

Selected themes and topics in the natural sciences and mathematics will be used to help students develop a better understanding of the concepts, terminology, and methodology of the study of natural sciences and mathematics. Students may take this course twice to fulfill the requirements of the Honors Scholar Program, provided each time it is taken, a different topic is covered. Specific information about each section of this course will be published prior to the start of each registration and may be obtained from the campus honors coordinator.

1 semester hour

Course Outcomes:

Upon course completion, a student will be able to:

- Demonstrate an understanding of the concepts, terminology, and methodologies associated with proof-writing in mathematics.
- Explain the importance and limitations of proofs in the field of mathematics.
- Explain the differences and similarities in approach to art and mathematics.
- Explain the differences and similarities in approach to science and mathematics.
- Communicate effectively concepts in both oral and written presentations.

Course Topic:

We will explore the idea of mathematical proof. What is a mathematical proof and why are they necessary? Can a mathematical proof be beautiful? Beginning with Aristotle's ideas of logical

deduction, we will study proofs by Euclid, Euler, Cantor, and others. We will also discuss what cannot be proven mathematically as proved by Gödel.

Prerequisites:

Students must have completed 12 MC credits, including an A or B in EN101/EN101A, with a minimum GPA of 3.4. Students must also be eligible for college-level math; this means eligibility for any MATH course at the 100 level or above without support (e.g. MATH 117 without MATH 017, MATH 120 without MATH 020, or MATH 165).

Text:

Dunham, W. (1990). *Journey through genius: The great theorems of mathematics.* New York: Wiley. (You will receive a copy of this book to use for the semester, curtesy of the math department 😉)

Attendance:

Class meets every Thursday, 2-3 pm in HT 401, Germantown campus.

You are expected to be at every class meeting. Attendance is critical to doing well in this course. Missing class will have a devastating effect on your ability to comprehend the course material and enjoyment of the class, so please let me know as soon as possible if you are going to miss class.

Communication:

I will use your MC email and Microsoft Teams to communicate with you. Our class discussion board will also be on Microsoft Teams. Your journals will be on Microsoft OneNote.

Assignments:

- Assigned readings for each week.
- Weekly guided journal entries and online discussion posts.
- Proof presentation (~2 minutes) – students are to work in pairs or groups of 3 to create a video presentation aimed at educating the general public on the art of mathematical proof, featuring a proof one we studied in class or another proof with the approval of the instructor.
- Comparison paper (5-8 pages) – each student is to write a paper comparing the creation of mathematical proofs with another creative art form (panting, film, music, literature, etc.)

Grading:

Class Participation	15%
Journal	15%
Discussion Board	15%
Proof Presentation	25%
Comparison Paper	30%
Total	**100%**

90% – 100%	A
80% – 89%	B
70% – 79%	C
60% – 69%	D
Below 60%	F

Grading rubric for class participation: 0 – 2 points per week.

2 points	Came to class prepared and actively participated in class discussion
1 point	Came to class but not fully prepared or did not participate in class discussion
0 points	Missed class

There are 14 class meetings. You will be graded out of 25 total participation points. This means you can earn 3 "bonus" points if you came to all 14 class meetings prepared and actively participated.

Grading rubric for journal: 0 – 2 points per week.

2	Thoughtful and thorough response, submitted on-time.
1	Thoughtful and thorough response, but submitted one week late. Or Incomplete response submitted on-time.
0	Response not submitted within two weeks.

There are 14 journal entries. You will be graded out of 25 total journal points. This means you can earn 3 "bonus" points if you submit 14 well-thought entries on time.

Grading rubric for discussion board: 0-2 points per week.

2	Made at least 3 quality posts to the discussion board.
1	Made only 1 or 2 quality posts to the discussion board.
0	Made no quality posts.

There are 14 weeks. You will be graded out of 25 total discussion board points. This means you can earn 3 "bonus" points if you earn 2 points for all 14 weeks.

Grading rubrics for the Presentation and Comparison paper will be given out later.

Academic Dishonesty:

All students are expected to achieve their goals with academic honor. Cheating, plagiarism, and/or other forms of academic dishonesty or misconduct, examples of which can be found in The Student Code of Conduct, are not tolerated. Students who engage in any act of academic dishonesty or misconduct are subject to sanctions ranging from an F on the assignment to failing the course. Each student should read and comply with the policies and procedures in The Student Code of Conduct.

Late/Make-up Work:

Since I expect to see you every class period, there should be little need for late or make-up work. Journal entries may be submitted the week after its original due date. Weekly discussion board posts cannot be made-up.

Classroom Conduct:

To do well in this course you should do each reading assignment and be on time for every class. Be prepared to ask questions, take notes and participate in classroom activities. In other words, be actively involved in the learning process. Of course, I will expect all students to comply with the behaviors outlined in The Student Code of Conduct.

Disability:

Any student who may need an accommodation due to a disability, please make an appointment to see me during my office hour. A letter from Disability Support Services authorizing your accommodations will be needed.

Tentative Course Outline/Schedule:

Week	**Topic and Reading Assignment**

1 9/1	Math and Art • A Mathematician's Lament https://www.maa.org/sites/default/files/pdf/devlin/LockhartsLament.pdf • The element of surprise in mathematics https://plus.maths.org/content/1089-and-all
2 9/8	Mathematical Proof • Why we want proof https://plus.maths.org/content/brief-introduction-proofs • Introduction to mathematical arguments https://math.berkeley.edu/~hutching/teach/proofs.pdf
3 9/15	Euclid (1 of 2) • The origins of proof https://plus.maths.org/content/origins-proof • Dunham Chapter 2. Euclid's Proof of the Pythagorean Theorem (ca. 300 B.C.) • Seeing Pythagoras https://plus.maths.org/content/seeing-pythagoras • Painting - Proof of the Pythagorean Theorem (Euclid) https://americanhistory.si.edu/collections/search/object/nmah_694620
4 9/22	Euclid (2 of 2) • Dunham Chapter 3. Euclid and the Infinitude of Primes (ca. 300 B.C.) • Maths in a minute: How many primes? https://plus.maths.org/content/maths-minute-how-many-primes
5 9/29	Archimedes • Dunham Chapter 4. Archimedes' Determination of Circular Area (ca. 225 B.C.) • What is the area of a circle? https://plus.maths.org/content/os/issue43/features/korner/index • The Pi Day Recipe Book https://mathwithbaddrawings.com/2016/03/14/the-pi-day-recipe-book/
6 10/6	Calculus (1 of 2) • Dunham Chapter 7. A Gem from Isaac Newton (Late 1660s) • Painting - Fluxions (Newton) https://americanhistory.si.edu/collections/search/object/nmah_694638
7 10/13	Calculus (2 of 2) • Dunham Chapter 8. The Bernoullis and the Harmonic Series (1689) • Outer space: The rule of two https://plus.maths.org/content/outer-space-series • Painting - Harmonic Series from a Quadrilateral (Pappus) https://americanhistory.si.edu/collections/search/object/nmah_694642
8 10/20	Euler (1 of 3) • Euler's polyhedron formula https://plus.maths.org/content/eulers-polyhedron-formula • Painting - Polyhedron Formula (Euler) https://americanhistory.si.edu/collections/search/object/nmah_694651
9 10/27	Euler (2 of 3) • Dunham Chapter 9. The Extraordinary Sums of Leonhard Euler (1734)
10	Euler (3 of 3)

11/3	• Dunham Chapter 10. A Sampler of Euler's Number Theory (1736)
11 11/10	Cantor (1 of 2) • Dunham Chapter 11. The Non-Denumerability of the Continuum (1874) • A glimpse of Cantor's paradise • https://plus.maths.org/content/os/issue47/features/macgregor/index
12 11/17	Cantor (2 of 2) • Dunham Chapter 12. Cantor and the Transfinite Realm (1891) • Cantor and Cohen: Infinite investigators part I https://plus.maths.org/content/os/issue47/features/elwes1/index Cantor and Cohen: Infinite investigators part II https://plus.maths.org/content/os/issue47/features/elwes2/index
13 11/24	Thanksgiving Break NO CLASS
14 12/1	Limits of Mathematical Proof (1 of 2) • This is not a carrot: Paraconsistent mathematics https://plus.maths.org/content/not-carrot • Gödel and the limits of logic https://plus.maths.org/issue39/features/dawson/index.html • Searching for the missing truth https://plus.maths.org/content/searching-missing-truth • Picking holes in mathematics https://plus.maths.org/content/picking-holes-mathematics
15 12/8	Limits of Mathematical Proof (2 of 2) • We must know, we will know https://plus.maths.org/issue41/features/morris/index.html • What computers can't do https://plus.maths.org/issue5/turing/index.html • The origins of proof III: Proof and puzzles through the ages https://plus.maths.org/content/origins-proof-iii-proof-and-puzzles-through-ages • The future of proof https://plus.maths.org/content/future-proof