MATH 456 | GEOMETRY FOR TEACHERS | Winter 2019
TTh 4:20 - 6:10

Professor:	Dr. Chris Black
Office:	HEC #268 Des Moines Center, Building 29
Office Hours:	T/Th 3:30 - 4:00 pm and by arrangement
Email:	blackc@cwu.edu. Email is the most reliable way to reach me.

Required Text:	*Packets to be distributed in class.* See the NO TEXTBOOK RULE below.

Required Materials:	Straight-edge and compass. GeoGebra software, available free from `http://www.geogebra.org/download`.

COURSE GOALS:

The goal of this course is to prepare future middle school mathematics teachers to teach the geometry outlined by the Common Core State Standards. In order to do this, we need an understanding of the development of geometry from its roots in Ancient Greece to the present. Of course, Euclid is seen as the father of geometry, so we will begin our geometric explorations by studying his work in the *Elements*, and we will end by looking at geometry from a transformation perspective which is in line with the Common Core State Standards in mathematics. WE DO NOT HAVE A TEXTBOOK IN THIS COURSE – rather, we will work *collaboratively* to create our own body of work based on both historical and modern methods of geometry.

MATH 456 students will...

- demonstrate an understanding of the axiomatic structure of geometry, including definitions, axioms and theorems, and will reason using the language and structure of geometry, both orally and in writing.
- make conjectures based on inductive reasoning and justify and prove those conjectures using deductive reasoning based on the axiomatic structure of Euclidean geometry.
- establish congruence and similarity criteria and use them to prove congruence and similarity of polygonal figures. Students will recognize and use proportional relationships within similar figures to solve problems.
- investigate the connections between the traditional approach to geometry and a modern approach using transformational geometry. Students will perform reflection, rotation, translation, and dilation in the plane using traditional construction tools as well as using analytic formulas requiring the use of coordinate goemetry and matrix and vector operations.

PROBABLE COURSE TOPICS:

- ▷ Neutral geometry
- ▷ Euclidean results concerning congruence, area, circles & triangles
- ▷ Compass and straightedge constructions
- ▷ Geometric and analytic transformations of the plane

Course Philosophy & Methodology:

This is not a traditional lecture course. Just as you cannot learn to play violin by watching a recital, you cannot learn to do mathematics by watching me do mathematics. In this course, you will learn mathematics through discussion, presentation, and critical analysis, using pedagogical methods often labeled as 'Inquiry-Based Learning' (IBL).

For the first part of the course, each class session (after the first) will begin with student presentations. Roughly half of class time will be devoted to analysis of student work at the board. Students will volunteer to present their work, but I reserve the right to call any student to the board at any time. After student presentations have concluded, we will spend the remainder of the class period working through exercises that introduce the concepts in the upcoming section of material.

I will lecture only rarely, and we all need to be aware of the expectations placed upon us in this non-traditional model of learning.

What is Inquiry-based learning (IBL)? Inquiry-based learning is a set of pedagogical techniques that place student contributions at the center of the classroom interactions. There are many different ways to implement inquiry-based learning in the classroom. From my perspective, a successful IBL classroom is one in which the students are actively responsible for their own learning, under the guidance and mentorship of an expert.

What are the guiding principles of IBL?

1. Every student can and will do significant mathematics.
2. Students should be elevated from recipients of mathematical knowledge to creators of mathematical knowledge
3. The mathematics classroom should be a shared learning community in which the students are actively engaged in discussion and development of course material.
4. The course material should include a significant body of mathematical knowledge, at varying levels of difficulty.

What is the role of the professor in this IBL course? The professor will:

1. ... facilitate and encourage classroom discussion;
2. ... clarify points or questions raised by students during presentations;
3. ... not speak significantly more than other members of the class;
4. ... be available for outside help during office hours or via email.

What is the role of the student in this IBL course? Students are expected to:

1. ... honestly attempt to solve every problem assigned;
2. ... revisit problems for which no solution was obtained on the first try;
3. ... persevere and seek help when stuck on a solution;
4. ... participate actively in classroom discussions;
5. ... develop a critical eye when examining solutions of others;
6. ... ask questions when they arise, both of the professor and the other students;
7. ... be respectful both when critiquing the work of others and when having their own work critiqued;
8. ... have at least one problem ready to present each day of class.

No Textbook Rule:

You are not allowed to use outside resources for this course. You are only allowed to talk to students currently enrolled in the course and to the professor. **All other resources, including texts and the internet, are strictly forbidden.** In this course, you are doing research at your level, just as professional mathematicians do research. The only difference is that you are doing research where the answers are already known to experts. Looking for answers to these questions circumvents the learning process and counts as academic dishonesty. Help will always be available to those who ask.

Grading:

Homework:	Scale to 350 points
Portfolio:	50 points
Take-Home Exams:	200 points (2 @ 100 points each)
Final Exam:	150 points
Participation:	15 points
Citizenship:	15 points

Homework:

For the first half of this course, your standing assignment is to write up solutions to the problems given in the packets. There will be roughly 5-8 of these per day of class. You are expected to be ready to present at least one solution each day of class. Ideally, you will have solutions to every problem before arriving in class. You will submit two problems to me each day to be graded: one that you presented to the class (if possible) and a second problem of your choosing. This second problem should be one that you are proud to have solved, and must be submitted before presentations begin for that day.

Homework problems may be rewritten **one time** if resubmitted within one week of being returned to you, but re-submitted homework has a maximum score of 90%.

For the second half of the course, your assignments are designed to help you link modern transformational approaches to geometry to the traditional methods learned in the first part of the course, and some assignments will include the use of GeoGebra software as well as physical manipulatives and tools. Details on these assignments will be distributed in class.

Course Portfolio:

The course portfolio, due on the day of the final exam and checked for progress before each exam, is worth 50 points. The portfolio is a well-organized and neatly-written 3-ring binder containing the course packet, the collective work of the class on the problems, the glossary, and some written analysis of the material. As there is no text, this portfolio will be your only record of this class. You will receive an additional handout describing the requirements and grading criteria for the course portfolio.

Exam & Final Exam:

Exams will be given as take-home exams, during which the only allowed sources are the professor and the course notes. For each take-home exam, one day of class will be used for individual work time. Use of the internet, any other written source, or any person other than the professor is considered plagiarism and will result in a score of 0 on the exam. The first two take-home exams will address traditional Euclidean geometry, and the final exam will address modern transformational geometry, and connections between the two approaches. The exams are each worth 100 points, and the final exam is worth 150 points.

Participation:

We will spend a portion of most class sessions working in small groups on activities and proofs. Your participation will be graded based on your interactions with your peers, your activity level and focus during class, and how often you volunteer to present your solutions.

Citizenship:

Discussion, interaction, and group problem solving will all be important aspects of this course, which necessitate your cooperation. Citizenship addresses your behavior and comportment with class members and the instructor. We each need to be respectful of other students, other cultures, and differing ideas within our learning community.

Academic Honesty and Respect:

Each of us should consider our placement at this institution to be a privilege. We need to have respect for one another, and for ourselves. In light of these facts, cheating in any form will not be tolerated. You are encouraged to work together on homework problems, however anything you turn in with your name on it should have been written by you alone. In a course where much of your grade is determined by your proof writing, plagiarism is a concern. The word "plagiarize" is defined by the New Oxford American Dictionary as "the practice of taking someone else's work or ideas and passing them off as one's own." Plagiarism includes but is not limited to:

- Copying another student's work and submitting it as your own
- Submitting a proof copied from the internet
- Submitting a proof copied from another text
- Consulting **any** source other than your class notes, texts previously assigned by Dr. Black for other courses, or the professor on a take-home exam

Any incidence of plagiarism will not be tolerated.

Disability Services:

Students with disabilities wishing to use academic adjustments in their CWU classes must be registered with Disability Services (DS). Information about the DS intake process may be obtained by emailing cds@cwu.edu or calling (509) 963-2171. Qualified students with disabilities may establish academic adjustments in this class by either sending me their official on-line accommodation request or speaking with me to establish the manner in which requested adjustments will be delivered.