



GEOMETRY AND MEASUREMENT

92.227

Mondays and Wednesdays, 11:00-12:15 pm/O'Leary 528

Spring 2012

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COURSE OVERVIEW/RATIONALE

This is a mathematics content course for elementary and middle school teachers that covers the geometry/measurement strands of the Massachusetts Curriculum Frameworks in Mathematics at a collegiate level. The goal of the course is to lay the groundwork for graduate level work in elementary mathematics education. The course centers around the following “Big Ideas” of geometry and measurement:

- **Equivalence:** understanding abstractions of equality including congruence and similarity;
- **Proportionality:** making sense of the relation between objects subject to linear variation;
- **Transformations:** applying changes to objects in space and understanding the effects of such changes on the measure of objects
- **Representation & Classification:** describing and analyzing properties of shapes and solids.

These ideas will be studied in-depth through geometric theorems, problems, and applications. Students will develop problem-solving skills by reasoning about spatial

objects and constructing arguments about the relationships within and between geometric figures. Students will also develop a conceptual understanding of the course material in a learning environment that models the pedagogical foundations of the Mathematics Curriculum Frameworks based on the Common Core State Standards for Elementary Mathematics.

INTENDED LEARNING OUTCOMES

Upon successful completion of this course, students will be able to address the following questions, centered on problems of geometry and measurement:

1. How do we know that the interior angles of a triangle add up to 180° ?
2. If you know the area of a plot of land, what do you know about its perimeter?
3. How do you draw a circle that passes through the three vertices of a triangle?
4. How do we classify objects using symmetry? Why is this kind of classification useful?
5. What triangles can be divided into two isosceles triangles?
6. How is geometry on the surface of the Earth different from Euclidean geometry?
7. What are the conic sections? How are they evident in our natural and man-made worlds?
8. How do you measure the shortest distance between two geometric objects?
9. If you double the three dimensions of a rectangular box, what happens to its volume and its surface area?
10. How are the volume and surface area of a sphere related?
11. One-, two-, and three- dimensional objects are familiar, but how can an object have a fractional dimension?

ASSESSMENT OF LEARNING OUTCOMES

Rubrics that outline expectations for homework, group work/class activities, projects, and your participation in this course will be handed out in class.

HOMEWORK

Homework will be assigned weekly to reinforce and extend concepts learned in class. In class, time will be allotted to review questions from the week's problem sets. However, if you need more extensive support, please visit me during the office hours or make an appointment if you cannot make any of these times.

Homework will comprise **20%** of your final grade in this course.

GROUP WORK/CLASS ACTIVITIES

There will be class activities during which you will have an opportunity to work with one another. Some of these activities will require a formal write up, to be turned in as a group.

Group work/Class activities turned in will comprise **5%** of your final grade in this course.

PROJECT

You will prepare a project on a topic covered in class, with an emphasis on ways to deepen one's conceptual understanding of the particular topic chosen. In preparing this project, you will create and organize materials to reflect the following:

- A deep understanding of the concept studied;
- Ways in which the concept might be taught in school, through activities, use of manipulatives, or class problems/projects;
- The real-life relevance of the concept studied, including a brief historical overview documenting its origin;
- Possible misconceptions of the concept along with strategies for addressing them.

The project will comprise **20%** of your final grade in this course.

PARTICIPATION

You are expected to actively engage in class by attending regularly and coming on time; contributing your ideas; asking questions when needed; collaborating with your peers, and coming prepared to class.

Participation will comprise **5%** of your final grade in this course.

SERVICE COMPONENT

As part of the course this semester, there is a service component of tutoring 5th and 6th grade students at the Innovation Academy Charter School in Tyngsboro. Each student is responsible for tutoring students 3 times during the semester at the school. After school hours are 3-4 pm. Prior to entering the school setting, you must go to the school with proper identification and fill out a CORI form. Each student will need to do this during the first week of the term since approval to enter the setting will take an average of 2-3 weeks. Additional information will be provided in class.

Service will comprise **10%** of your final grade in this course.

MIDTERM EXAM

The midterm exam is scheduled for Wednesday, March 7, and will assess your understanding of the course material explored up to this date.

The midterm exam will comprise **20%** of your final grade in this course.

FINAL EXAM

Our *comprehensive* final exam is scheduled during the final exam period (May 9-17).

The final exam will comprise **20%** of your final grade in this course.

COURSE POLICIES

Attendance

You are expected to attend all of the class sessions and to participate fully in class. In the event that you must miss a class or part of a class, please let me know in advance so that we can set up a plan for making up work missed. If you have poor attendance or are consistently late to class, the assessment of your contribution to the class will be affected (points deducted from the overall participation grade).

I expect you to attend each class, be punctual, and engage meaningfully in our class activities. Up to 5 points from your final grade may be deducted if you do not uphold your commitment to the course.

Late Work

All assignments must be submitted on time. If you believe you will need to turn in an assignment after it is due, please be sure to let me know in advance. Points may be deducted from the overall grade of the assignment for lateness.

GRADES

Specific rubrics will be provided for the assignments outlined above. However, the overall grading system for the course is specified below.

A	Superior Work: Highest Quality	4.0
A-	High Honors Quality	3.7
B+	High Quality	3.3
B	Basic Honors Quality	3.0
B-	Below Honors Quality	2.7
C+	Above Satisfactory Quality	2.3
C	Satisfactory	2.0
C-	Below Satisfactory Quality	1.7

D+	Above Minimum Passing	1.3
D	Minimum Passing	1.0
F	Failed	0.0
FX	Failed due to Academic Misconduct (may not be replaced or deleted)	0.0

For additional information on the university's grading policies, see http://www.uml.edu/catalog/undergraduate/policies/grading_policies.htm

Note that UMass Lowell's policy on [Academic Dishonesty, Cheating and Plagiarism](#) applies to this course.

COURSE MATERIALS

Required Text (available through the UMass bookstore):

Benson, Steve (2004). *Ways to Think About Mathematics*. Corwin.

RELEVANT TOPICS IN THE MATHEMATICS CURRICULUM FRAMEWORKS AND MTEL

The purposes of this course are: to highlight the mathematical content that is used in teaching elementary school; and to provide pre-service teacher candidates the opportunity to learn and understand mathematical concepts needed to effectively teach mathematics at the elementary school level. However, this is not an MTEL (Massachusetts Test for Educator Licensure) prep course. The MTEL is designed to test the knowledge you will acquire through this course, but this course is not designed, specifically, for preparing you for that test.

TOPICS IN THE COMMON CORE STATE STANDARDS

GEOMETRY

- ✓ Name, describe, model, classify, and draw two- and three-dimensional shapes.
- ✓ Identify positions of objects in space and using coordinate systems
- ✓ Describe attributes and parts of two- and three- dimensional shapes
- ✓ Recognize and reason with similar and congruent shapes
- ✓ Identify symmetry in geometric shapes
- ✓ Relate geometric ideas to numbers
- ✓ Describe and construct intersecting, parallel, and perpendicular lines
- ✓ Describe and apply transformations to shapes

MEASUREMENT

- ✓ Demonstrate an understanding of length, area, and volume, and select the appropriate unit for measuring each attribute of a geometric object
- ✓ Estimate and find the area and perimeter of rectangles, triangles, and irregular shapes using models, diagrams, and grids
- ✓ Select and correctly use appropriate measuring tools

- ✓ Carry out unit conversions within a system of measurement

MTEL REQUIREMENTS FOR GEOMETRY AND MEASUREMENT

Among the competencies required for the grades 1-6 mathematics subject test are:

- ✓ Basic principles and concepts related to elementary school mathematics in the areas of measurement and geometry
- ✓ Euclidean geometry

IMPORTANT DATES

Friday, Jan. 27: Last day to add a course without a permission number

Friday, Feb. 3: Last day to add or drop a course or to change enrollment status

Monday, Feb. 20: President's Day (University Closed)

Midterm Exam: March 7

Friday, March 9: Spring Recess begins

Monday, March 19: Classes Resume

Projects due April 9

Monday, April 16: Patriot's Day (University Closed)

Friday, April 27: University Day (No Classes)

Monday, May 7: Last day of Spring Semester classes

Final Exam: scheduled between May 9 and May 17

COURSE SEQUENCE¹

WEEK STARTING ON...	TOPIC
January 23, 2012	Basic objects of Euclidean geometry: points, lines, circles, triangles, angles (complementary, supplementary), parallel and perpendicular lines; elementary constructions: perpendicular bisector of a line segment.
January 30, 2012	General polygons (including triangles and quadrilaterals); inscribed and circumscribed polygons, sums of interior angles, special triangles, golden rectangle, regular polygons.
February 6, 2012	Transformations: reflections, translations, rotations, dilations; tessellations; symmetry. Introduction to coordinate geometry.
February 13, 2012	Three-dimensional solids: regular polyhedra, pyramids and prisms, cylinders and cones.
February 20, 2012	(Monday is a holiday) Congruence and similarity of geometric figures, especially triangles and quadrilaterals
February 27, 2012	Congruence and similarity of geometric figures, especially triangles and quadrilaterals (continued)
March 5, 2012	Midterm Exam Week (& review)

WEEK STARTING ON...	TOPIC
March 19, 2012	Measurement: types of measures and units; standard and non-standard units; conversions; relationship between arc length and angle measure.
March 26, 2012	The Pythagorean Theorem and its converse (with proof); Pythagorean triples
April 2, 2012	The Pythagorean Theorem continued.
April 9, 2012	Properties of triangles: perimeter, area, midlines, medians, circumcenter.
April 16, 2012	(Monday is a holiday) Perimeter and area of common two-dimensional figures, including polygons and circles.
April 23, 2012	Surface area and volumes of three-dimensional figures, including cones, spheres, and cylinders. Effects of transformations on perimeter, area and volume. Comparing measures of similar geometric figures.
April 30, 2012	Self-similarity and fractals; notion of fractional dimension.
May 7, 2012	Last day of classes.

COURSE RESOURCES

Below is a short list of resources that might be useful to you in preparing your project. Some also provide additional explanations of concepts that complement the work we do in class.

NCTM Illuminations. Available online: <http://illuminations.nctm.org/>

Problems with a Point (problems for grades 6-12). Available online: <http://www2.edc.org/mathproblems/>

Purple Math. Available online: <http://www.purplemath.com/>

Math at Hand. Available online from Great Source:

http://www.greatsource.com/store/ProductCatalogController?cmd=Browse&subcmd=oadDetail&division=G01&level1Code=05&level2Code=050&level3Code=029&sortProductsBy=SEQ_TITLE

The National Library of Virtual Manipulatives. Available online: <http://nlmv.usu.edu/>

Discovering geometry: An Investigative approach, Michael Serra, Key Curriculum Press 2003.

Geometry by discovery, David Gay, John Wiley & Sons 1998.

Symmetry, shape, and space: An Introduction to mathematics through geometry, Kinsey & Moore, Key Curriculum Press 2001.

Technology Links

- ✓ Geogebra: open-source geometry software; found at <http://www.geogebra.org/cms>
- ✓ The Geometer's Sketchpad: commercial geometry software; can be purchased at <http://www.dynamicgeometry.com>