

**MATH 537 Teaching Geometry and Measurement in the Middle Grades**

**Prerequisite:** Admission to the M.S. program for certified elementary teachers or permission of the instructor.

**Course Description:** NCTM Standards-based instructional practices that promote understanding of key concepts in geometry and measurement in the middle grades.

**Course Objectives:**

1. To deepen understanding of geometry and measurement concepts included in the curriculum for grades 5–8
2. To develop an understanding of instructional strategies for geometry and measurement which are developmentally appropriate for students in grades 5–8
3. To become proficient in using geometric software and concrete manipulatives in teaching geometry and measurement topics.
4. To design lessons on geometry and measurement topics appropriate for students in grades 5–8.

**Course Instructor: Prof. Timothy V. Craine**

**Contact Information:**

Phone: 860-794-7384

Email: tim\_craine@hotmail.com

Office: Maria Sanford 219

**Office Hours:**

Monday 12:15 – 1:45 PM and 3:30 – 4:00 PM

Wednesday 3:30 – 4:00 PM and 6:45 – 7:15 PM

Other times by appointment

**Class Meeting Times:** Wednesday 4:00–6:40 PM in Maria Sanford 204.

**Textbooks**

Wyatt, Lawrence, and Foletta. *Geometry Activities for Middle School Students with Geometer's Sketchpad*. Emeryville, CA: Key Curriculum Press, 2004. (GAMSS)

Picciotto, Henry. *Geometry Labs: Activities for Grades 8-11*. Emeryville, CA: Key Curriculum Press, 2004. (GL)

**Other Resources**

*Common Core State Standards for Mathematics*. [www.corestandards.org](http://www.corestandards.org). (CCSSM)

*Understanding Geometry for a Changing World: 71<sup>st</sup> yearbook*, National Council of Teachers of Mathematics (UGCW)

*Mathematics Teaching in the Middle School*, NCTM publication. (MTMS)

**Attendance:** Attendance at every class session is required. You are expected to arrive on time, stay for the entire class period, and actively participate in group work and class discussion. In the event of an emergency that precludes your attending class please contact me by phone or email as soon as possible, preferably before the start of class. Poor attendance will adversely affect the class participation grade (as well as leaving you unprepared for tests).

**Assignments:**

- **Weekly Assignments.** You will be given weekly assignments to be turned in and graded. These will include exercises on the content covered in class, problems to be solved with Geometer's Sketchpad, and prompts in which you will be asked to write about what you have learned as well as problems.
- **Article Review.** You will find one article in *Mathematics Teaching in the Middle School* related to the teaching of geometry and measurement. You will write a summary of the article and a critical analysis of the main ideas. (Due September 29)
- **Web Site Review.** You will find a web site with an activity designed for teaching geometry or measurement concepts to middle school students. You'll evaluate the effectiveness of this site as a teaching tool. More detailed instructions will be given later. (Due October 20)
- **Geometer's Sketchpad Project.** You will complete a project using Geometer's Sketchpad. Many ideas for projects are included in GAMSS, but your choice of project is not limited. Your project will include a GSP sketch to be submitted to the instructor. More detailed instructions will be given later. (Due November 17)
- **Unit Plan.** You will plan a two-to-three week unit of instruction on a geometry/measurement topic for one of the middle grades (4-8). The plan will include learning outcomes, activities for the classroom, homework assignments and assessments. More detailed instructions will be given later. (Due December 8)

**Assessment:**

Midterm Test (October 13)	20%
Final Exam (December 16)	20%
Weekly Homework	12%
Article Review	8%
Web Site Review	8%
Geometer's Sketchpad Project	10%
Unit Plan	12%
Class Participation	10 %
Total	100%

## University Policies:

1. You must take the final examination at the time specified in the course selection book. The time scheduled for this class is Wednesday, December 15, 4:00-6:00 PM. Do not make vacation plans that conflict with this time.
2. If you need course adaptations or accommodations because of a disability, if you have emergency medical information to share with me, or if you need special arrangements in case the building must be evacuated, please make an appointment with me as soon as possible. My telephone numbers and office hours are given above. I will need a copy of the accommodation letter from Student Disability Services in order to arrange your class accommodations. Contact Student Disability Services, room 241, Copernicus Hall, if you are not already registered with them. Student Disability Services maintains the confidential documentation of your disability and assists you in coordinating reasonable accommodations with your faculty.
3. In the event of a weather emergency which requires curtailment or cancellation of classes, listen to WTIC (1080 AM), visit [www.ccsu.edu](http://www.ccsu.edu), or call (860) 832-3333 for the "general snow message."
4. The last day to withdraw from a course is Monday, October 25. Approvals for withdrawal are not required; however, it is strongly recommended that students consult with their academic advisors prior to deciding to withdraw. Cessation of attendance, notice to the instructor, or telephone calls to the Enrollment Center are not considered official notice of a student's intention to drop the course. After October 25 withdrawals are allowed only under extenuating circumstances and require approval of the course instructor, department chair and dean of the School of Arts and Sciences. Poor academic performance is not considered an extenuating circumstance.
5. You are responsible for understanding and abiding by the University's policy on academic integrity. Information on the policy may be found at <http://www.ccsu.edu/AcademicIntegrity/>. This policy is rigorously enforced by the Department of Mathematical Sciences.

## Additional Policies for This Instructor:

1. Cell phones and other communication devices must be turned off at all times during class.
2. Make up tests. If you must miss one of the scheduled tests (October 13 or December 15) you must contact me immediately to arrange to make it up. Make up tests will only be given within 48 hours of the originally scheduled time.
3. Class will be scheduled in the Mac or PC Classroom in the Computing Center on one or more days, which will be announced in advance. On these days you must bring your CCSU ID to the Computer Center in order to be admitted to class.
4. I encourage collaborative learning, and you are welcome to work with a partner on homework assignments as long as you acknowledge his or her contribution. The other assignments including the article and web site reviews, the Geometer's Sketchpad project, the Unit Plan, and of course the midterm and final exams must be your work alone.

Topical Timetable for MATH 537. Important Dates are in **Bold**.

Date	Topic	Core Standards	Resources
Sept. 1	Introduction, Pretest		
Sept. 8	Geometer's Sketchpad Lab: Points, Lines, Angles	4MD-5 4MD-6 4MD-7 4G-1	GAMSS 35, 37, 38 GL 3-6 UGCW 127
Sept. 15	Classification of Geometric Figures	4G-2 5G-3 5G-4	GAMSS 67, 69, 93, 96 GL 25-32, 89-95 UGCW 205
Sept. 22	Measuring Area and Perimeter	4MD-1 4MD-3 5MD-1 6G-1 7G-4	GL 105-114 UGCW 297
<b>Sept. 29 Article Review</b>	Visualizing Three Dimensional Figures and Finding Surface Area	6G-4 7G-3 7G-6	GAMSS 194 GL 96 UGCW 141
Oct. 6	Measuring Volume	5MD-3 5MD-4 5MD-5 6G-2 7G-6 8G-9	Additional resources will be provided.
<b>Oct. 13</b>	<b>Midterm Test</b>		
<b>Oct. 20 Web Site Review</b>	Transformations and Symmetry	4G-3 8G-1	GAMSS 116, 145, 147, 154 GL 67-87
Oct. 27	Coordinate Geometry	5G-1 5G-2 6G-3	GAMSS 150
Nov. 3	Transformations and Congruence	8G-2	GAMSS 149 GL 90
Nov. 10	Transformations and Similarity	8G-3 8G-4 7G-1	GAMSS 155, 158 GL 131-142
<b>Nov. 17 GSP Project</b>	Constructions	8G-2	GAMSS 174-190
Nov. 24	No class		
Dec. 1	Informal Proof	7G-5 8G-5	GAMSS 42, 98, 101
<b>Dec. 8 Unit Plan</b>	Pythagorean Theorem	8G-6 8G-7 8G-8	GAMSS 71 GL 115, 123-126
<b>Dec. 15</b>	<b>Final Exam</b>		

# Common Core Standards for Grades 4-8: Geometry and Measurement Understandings

## Grade 4

### Measurement and Data

*Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit.*

4MD-1. Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table. For example, know that 1 ft is 12 times as long as 1 in. Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), (3, 36).

4MD-3. Apply the area and perimeter formulas for rectangles in real world and mathematical problems. For example, find the width of a rectangular room given the area of the flooring and the length, by viewing the area formula as a multiplication equation with an unknown factor.

*Geometric measurement: understand concepts of angle and measure angles.*

4MD-5. Recognize angles as geometric shapes that are formed wherever two rays share a common endpoint, and understand concepts of angle measurement:

- An angle is measured with reference to a circle with its center at the common endpoint of the rays, by considering the fraction of the circular arc between the points where the two rays intersect the circle. An angle that turns through  $\frac{1}{360}$  of a circle is called a “one-degree angle,” and can be used to measure angles.
- An angle that turns through  $n$  one-degree angles is said to have an angle measure of  $n$  degrees.

4MD-6. Measure angles in whole-number degrees using a protractor. Sketch angles of specified measure.

4MD-7. Recognize angle measure as additive. When an angle is decomposed into non-overlapping parts, the angle measure of the whole is the sum of the angle measures of the parts. Solve addition and subtraction problems to find unknown angles on a diagram in real world and mathematical problems, e.g., by using an equation with a symbol for the unknown angle measure.

### Geometry

*Draw and identify lines and angles, and classify shapes by properties of their lines and angles.*

4G-1. Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures.

4G-2. Classify two-dimensional figures based on the presence or absence of parallel or perpendicular lines, or the presence or absence of angles of a specified size. Recognize right triangles as a category, and identify right triangles.

4G-3. Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line-symmetric figures and draw lines of symmetry.

## Grade 5

### Measurement and Data

*Convert like measurement units within a given measurement system.*

5MD-1. Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems.

*Geometric measurement: understand concepts of volume and relate volume to multiplication and to addition.*

5MD-3. Recognize volume as an attribute of solid figures and understand concepts of volume measurement.

- A cube with side length 1 unit, called a “unit cube,” is said to have “one cubic unit” of volume, and can be used to measure volume.
- A solid figure which can be packed without gaps or overlaps using  $n$  unit cubes is said to have a volume of  $n$  cubic units.

5MD-4. Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft, and improvised units.

5MD-5. Relate volume to the operations of multiplication and addition and solve real world and mathematical problems involving volume.

- Find the volume of a right rectangular prism with whole-number side lengths by packing it with unit cubes, and show that the volume is the same as would be found by multiplying the edge lengths, equivalently by multiplying the height by the area of the base. Represent threefold whole-number products as volumes, e.g., to represent the associative property of multiplication.
- Apply the formulas  $V = l \times w \times h$  and  $V = b \times h$  for rectangular prisms to find volumes of right rectangular prisms with whole-number edge lengths in the context of solving real world and mathematical problems.
- Recognize volume as additive. Find volumes of solid figures composed of two non-overlapping right rectangular prisms by adding the volumes of the non-overlapping parts, applying this technique to solve real world problems.

### Geometry

*Graph points on the coordinate plane to solve real-world and mathematical problems.*

5G-1. Use a pair of perpendicular number lines, called axes, to define a coordinate system, with the intersection of the lines (the origin) arranged to coincide with the 0 on each line and a given point in the plane located by using an ordered pair of numbers, called its coordinates. Understand that the first number indicates how far to travel from the origin in the direction of one axis, and the second number indicates how far to travel in the direction of the second axis, with the convention that the names of the two axes and the coordinates correspond (e.g., x-axis and x-coordinate, y-axis and y-coordinate).

5G-2. Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation.

*Classify two-dimensional figures into categories based on their properties.*

5G-3. Understand that attributes belonging to a category of two-dimensional figures also belong to all subcategories of that category. For example, all rectangles have four right angles and squares are rectangles, so all squares have four right angles.

5G-4. Classify two-dimensional figures in a hierarchy based on properties.

## Grade 6

### Geometry

*Solve real-world and mathematical problems involving area, surface area, and volume.*

6G-1. Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems.

6G-2. Find the volume of a right rectangular prism with fractional edge lengths by packing it with unit cubes of the appropriate unit fraction edge lengths, and show that the volume is the same as would be found by multiplying the edge lengths of the prism. Apply the formulas  $V = l w h$  and  $4V = b h$  to find volumes of right rectangular prisms with fractional edge lengths in the context of solving real-world and mathematical problems.

6G-3. Draw polygons in the coordinate plane given coordinates for the vertices; use coordinates to find the length of a side joining points with the same first coordinate or the same second coordinate. Apply these techniques in the context of solving real-world and mathematical problems.

6G-4. Represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures. Apply these techniques in the context of solving real-world and mathematical problems.

## Grade 7

### Geometry

*Draw construct, and describe geometrical figures and describe the relationships between them.*

7G-1. Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.

7G-2. Draw (freehand, with ruler and protractor, and with technology) geometric shapes with given conditions. Focus on constructing triangles from three measures of angles or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle.

7G-3. Describe the two-dimensional figures that result from slicing three-dimensional figures, as in plane sections of right rectangular prisms and right rectangular pyramids.

*Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.*

7G-4. Know the formulas for the area and circumference of a circle and use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle.

7G-5. Use facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem to write and solve simple equations for an unknown angle in a figure.

7G-6. Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.

## Grade 8

### Geometry

*Understand congruence and similarity using physical models, transparencies, or geometry software.*

- 8G-1. Verify experimentally the properties of rotations, reflections, and translations:
- o a. Lines are taken to lines, and line segments to line segments of the same length.
  - o b. Angles are taken to angles of the same measure.
  - o c. Parallel lines are taken to parallel lines.

8G-2. Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them.

8G-3. Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.

8G-4. Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two-dimensional figures, describe a sequence that exhibits the similarity between them.

8G-5. Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. For example, arrange three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so.

*Understand and apply the Pythagorean Theorem.*

8G-6. Explain a proof of the Pythagorean Theorem and its converse.

8G-7. Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.

8G-8. Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.

*Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.*

8G-9. Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.