

Department of Mathematical Sciences Fall 2010

MATH 328: Curriculum and Technology in Secondary Mathematics II

Course Description: This course is designed for students preparing to teach mathematics in grades 7-12. Its focus will be on the teaching of geometry and measurement and connections to other content areas of the secondary mathematics curriculum. A variety of tools including computer software and hands-on manipulatives will be used to develop concepts and generate conjectures.

During the course you will be relearning (or learning for the first time) much of the high school geometry curriculum while you are also learning about teaching geometry. A major goal of the course is to improve your proficiency in writing geometric proofs.

Prerequisites: This course is intended for students seeking certification to teach mathematics in grades 7-12. You do not have to be admitted to the professional program but should have completed at least two semesters of calculus and a course in discrete mathematics (MATH 221 and MATH 218) or the equivalent.

"Students enrolled in this course who are seeking teacher certification should be aware that all professional education courses are guided by the Conceptual Framework of the School of Education and Professional Studies. Professional education courses prepare students to be active learners, reflective and collaborative practitioners, and facilitators of learning for all students. The complete Framework may be accessed at

http://www.education.ccsu.edu/SEPS_Conceptual_Framework.pdf
<http://www.education.ccsu.edu/SEPS_Conceptual_Framework.pdf> ."

Course Instructor: Dr. S. Louise Gould

Contact Information:

Office phone: 860-832-0047

Home phone: 860-224-6978 (up until 9 PM)

Email: goulds@ccsu.edu

The best way to reach me is via email or a message on my home phone.

Office: Marcus White, Room 103

Office Hours (Marcus White 103): Monday and Wednesday 3:30-5:00 PM,
Tuesday and Thursday 11:00 Am to Noon.

Class Meeting Times: Monday and Wednesday 5:15 – 6:45 PM Maria Sanford 321.

Required Text: Michael Serra, *Discovering Geometry: An Investigative Approach*, 4th edition, Key Curriculum Press, 2008.

Software: CCSU has a site license for Geometer's Sketchpad v. 4.03, which will be used extensively in this course. A special student discount rate is available at the campus bookstore if you wish to install this software on your home computer. Otherwise you may access the software from any computer on campus. You will be expected to master

this software.

Equipment: You should have good scissors and at least 7 colors of markers or colored pencils with you in class.

Course Requirements:

- Attend and participate in class regularly. Attendance will be taken at every class.
- Study the two “textbooks”: Serra (hardcover) and Euclid (on line).
- Complete homework assignments on a daily basis. Written assignments will be given weekly.
- Write a journal reflecting on your learning experiences (submitted 11 times). Each time (except the last) you should respond to the following prompts. What is the big idea we have talked about during the week? Are there any new vocabulary words, what do they mean in your own words? And finally, do you have any questions or observations or connections to make with the current material? Copy and past each week’s reflections into an email message and send to my email: Goulds@ccsu.edu. These will also be included in your electronic portfolio, see below.
- Maintain an electronic portfolio of your work for the course. A template and rubric for the portfolio will be distributed in advance.
- Write a plan for a 45-minute lesson on an assigned topic from Chapters 6, 11, or 12. Present a 25-minute segment of this lesson to the class, which will be video taped to facilitate reflection and feedback.
- Complete three projects: Euclid’s challenge, the Group Quadrilateral Project, and CCSU Math Trail
- Take midterm and final examinations.

Assessment. Grades for the course will be determined as follows:

11 Weekly Journals and Portfolio	15%
Class Attendance	5%
Euclid’s Challenge Project	10%
Group Quadrilateral Project	10%
CCSU Math Trail	10%
Lesson	20%
Plan 5%	
Presentation 10%	
Reflection 5%	
Midterm Exam (October 21)	15%

Final Exam (December 14)

15%

Total

100%

University Policies

1. 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.
2. In the event of a weather emergency which requires curtailment or cancellation of classes, listen to WTIC (1080 AM) or call (860) 832-3333 for the “general snow message.”
3. Last day to drop a course October 25. Forms are available in the Enrollment Center, Willard Hall. 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. Undergraduate full time students for whom dropping a course would reduce their credit load to fewer than 12 credits MUST apply for withdrawal.
4. The final examination has been scheduled by the University and must be taken on the date assigned, Monday, December 13.
5. During class cell phones and other electronic devices must be turned off unless used for work related to this course, and computers may be used only for work related to this course.

Additional Resources - Some mentioned/used in class, others for student reference:

- [1] Abbott, E.A. and Banchoff, T. *Flatland: A Journey of Many Dimensions*. Film on DVD. Flatworld Productions. Llc. 2007
- [2] Bennett, Dan. *Exploring Geometry with the Geometer's Sketchpad*, Key Curriculum Press, 1999.
- [3] Belcastro, Sarah-Marie and Yackel, Carolyn, ed. *Making Mathematics with Needlework*. A K Peters, Wellesley Massachusetts. 2008.
- [4] Conway, John H.; Burgiel, Heidi; Goodman-Strauss, Chaim. *The Symmetries of Things*. A K Peters, Wellesley Massachusetts. 2008.
- [5] Coxeter, H. S. M. *Introduction to Geometry*. John Wiley and Sons, Inc. 1961.
- [6] Coxford, Arthur F., Jr., ed. *Geometry from Multiple Perspectives*. National Council of

Teachers of Mathematics, 1991.

- [7] Craine, Timothy V. "Integrating Geometry into the Secondary Mathematics Curriculum," in Hirsch, ed., *The Secondary School Mathematics Curriculum*, 1985 Yearbook of the National Council of Teachers of Mathematics.
- [8] Craine, Timothy V. and Rubenstein, Rheta R. "A Quadrilateral Hierarchy to Facilitate Learning in Geometry," *Mathematics Teacher*, 86 (January 1993), pp. 30-36.
- [9] Craine, Timothy V. and Rubenstein, Rheta R. "Traveling toward Proof", *Mathematics Teacher* 93 (April 2000). ("Euclid Airlines")
- [10] Craine, Timothy V. and Rubenstein, Rheta R. eds. *Understanding Geometry for a Changing World*, Seventy-first Yearbook, National Council of Teachers of Mathematics. 2009.
- [11] DeVilliers, Michael D. *Rethinking Proof*. Key Curriculum Press, 2003.
- [12] Demaine, Erik D. and O'Rourke, Joseph. *Geometric Folding Algorithms: Linkages, Origami, Polyhedra*. Cambridge University Press, NY. 2007.
- [13] Ehlinger, Ladd. *Flatland*. Film on DVD Messiah Incorporated. 2007.
- [14] Frederickson, Greg. N. *Dissections: Plane and Fancy*. Cambridge University Press. 1997.
- [15] Fuys, David; Geddes, Dorothy; and Tischler, Rosamond, *The Van Hiele Model of Thinking in Geometry among Adolescents*, JRME Monograph Number 3, National Council of Teachers of Mathematics, 1988.
- [16] Gould, S. Louise. "The Tellem Weavers Meet the Graphing Calculator", *Mathematics Teacher*, Volume 99, Number 4, November. Pages 230-236. NCTM 2005.
- [17] Gould, S. Louise. "Baskets for the Mathematics Classroom." *Bridges Donostia: Mathematical Connections in Art, Music, and Science Proceedings 2007*. Sarhangi, Reza and Barrallo, Javier. Eds. Pages 115-122. Tarquin Books, 2007
- [18] Gould, S. Louise. "Using Geometer's Sketchpad to Construct Pop-up Polyhedra as a Tool for Classroom Study of Geometry" *Renaissance Banff II Bridges Banff: Proceedings 2009*. Kaplan, Craig S. and Sarhangi, Reza Eds. Pages 351-354. Tarquin Books, 2009.
- [19] Green Fuse Films, *Between the Folds: The Science of Art. The Art of Science*. 2009. On DVD.
- [20] Gjerde, Eric. *Origami Tessellations: Awe-Inspiring Geometric Designs*. A K Peters,

Ltd. Wellesley, Massachusetts, 2009.

[21] Joyce, David. *Euclid's Elements* with commentary.
<http://aleph0.clarku.edu/~djoyce/java/elements/elements.html>

[22] Lindquist, Mary M., ed. *Learning and Teaching Geometry, K-12*, 1987 yearbook of the National Council of Teachers of Mathematics.

[23] Loomis, Elisha Scott. *The Pythagorean Proposition: Its Demonstrations Analyzed and Classified*. Reprinted from a 1907 edition by NCTM as the first title in a series of Classics in Mathematics Education. 1968.

[24] Mamman, Carmelo and Villani, Vinicio. *Perspectives on the Teaching of Geometry for the 21st Century*, Kluwer Academic Publishers, 1998.

[25] National Council of Teachers of Mathematics, *Principles and Standards for School Mathematics*, NCTM, 2000. Available online at www.nctm.org.
(Especially Chapter 2. Principles for School Mathematics, and Chapters 6 and 7 as they pertain to geometry, measurement, problem solving, reasoning and proof, communication, connections and representation for grades 6-12.)

[26] NCTM Publications especially *Mathematics Teacher* and *Mathematics Teaching in the Middle School*. Also visit www.nctm.org.

[27] Picciotto, Henri. *Geometry Labs*, Key Curriculum Press, 1999.

[28] Rubenstein, Rheta R.; Craine, Timothy V.; and Butts, Thomas R. *Integrated Mathematics 1-3*, McDougal Littell, 2002.

[29] Tamina, Daina. *Crocheting Adventures with Hyperbolic Planes*. A.K. Peters, Ltd. Wellesley, Massachusetts. 2009. Note, the title may surprise, but the content includes an extensive history of Euclidean and Non-Euclidean geometry.

[30] Washburn, Dorothy K. and Crowe, Donald W. *Symmetries of Culture: Theory and Practice of Plane Pattern Analysis*. University of Washington Press, 1988.

[31] Winter, M.; Lappan, G.; Philips, E.; and Fitzgerald, W. *Middle Grades Mathematics Project: Spatial Visualization*. Addison-Wesley, 1986.

[32] Wenninger, Magnus J. *Polyhedron Models for the Classroom*. NCTM 1966.

Dr. Ron Eglash - situated design tools

http://www.ted.com/talks/ron_eglash_on_african_fractals.html

Dr. Daniel Orey - Math trails

<http://www.csus.edu/indiv/o/oreyd/Math%20Trail/trail.home.html>

Dr. Steven Strogatz – New York Times blog series on the Elements of Math
<http://opinionator.blogs.nytimes.com/2010/03/14/square-dancing/>

Dr. Carolyn Yackel, Dr. Sarah-Marie Belcastro and Dr. Daina Taimina all use needlework in various ways to illustrate geometric ideas. Most of their materials deal with more sophisticated geometry ideas.

Note: In the fall of 2009 the NCTM will published *Focus in High School Mathematics: Reasoning and Sense Making* to address the secondary school curriculum.

Here is the NCTM response to a national curriculum in general and thoughts about Geometry and Measurement specifically.

“A national curriculum for school mathematics is a topic of growing interest at state, national, and policy levels. The development of a common national curriculum and assessment in mathematics should be driven by the following basic principles for designing an excellent curriculum to avoid the risk of producing a negotiated list of standards that is merely an intersection of those that are currently addressed in each of the 50 states. Therefore, NCTM recommends the following guiding principles for the potential development of any set of common curricular expectations and assessments across the nation.”

“Geometry and Measurement

Geometry is a natural place for the development of students’ reasoning and justification skills, culminating in work with proof in the secondary grades. Geometric modeling and spatial reasoning offer ways to interpret and describe physical environments and can be important tools in problem solving. Geometric ideas are useful in representing and solving problems in other areas of mathematics and in real-world situations, so geometry should be integrated with these other areas. Geometric representations can help students make sense of area and fractions; histograms and scatter plots can give insights about data; and coordinate graphs can serve to connect ideas in geometry and algebra. The study of measurement is important in the mathematics curriculum from elementary through high school because of the practicality and pervasiveness of measurement in so many aspects of everyday life. The study of measurement offers an opportunity for learning and applying other mathematics, including number operations, geometric ideas, statistical concepts, and notions of function. It highlights connections within mathematics and connections between mathematics and areas outside mathematics, such as social studies, science, art, and physical education.”

You will be provided with a copy of the National Core Curriculum for Geometry. The State of Connecticut recently adopted this curriculum. It will work in tandem with the State of Connecticut’s revised secondary school program that by law will be fully implemented in 2018.

Here is a tentative schedule of events and assignments. It may be revised at any time.

				Note Material with ☞ is to be copied and pasted to your portfolio!
8/30/2010	M			Pretest and Euclid experiment
9/1/2010	W			Introduction. GSP, van Hiele Levels National Core Curriculum in Geometry – review syllabus and portfolio template before class. Topic: Transformations Read pages 368-388, pages 2-12 Written exercises –page 373 #9,10 (on geometer’s sketchpad) ; page 374 #17,18,19; 377 Investigation I; pages 380-1 #1-8, pages 385-5 Investigations 1 and 2. ☞ Use Geometer’s Sketchpad to construct #3 page 8 and #4 page 12. Copy your construction and paste into your portfolio.
9/6/2010	M		No Class Labor Day	
9/8/2010	W			Topic: More on Transformations ☞ Journal entry 1 Read p 389-393, pages 16-23. ☞ Create a knot design on geometer’s sketchpad ☞ Construct either the 8 pointed star or hexagon tile design on Geometer’s Sketchpad Written exercises p. 392 #3-10.
9/13/2010	M	*		Topic: regular and semi-regular tessellations ☞ Construct all 11 regular and semi-regular tessellations on Geometer’s Sketchpad. Discuss their vertex notations and describe their duals.
9/15/2010	W			Topic irregular tessellations ☞ Journal 2 Read p 394-412 ☞ Show that any quadrilateral can tessellate the plane (Use Geometer’s sketchpad with a general quadrilateral) ☞ Use a hexagon, square or parallelogram as a grid for a translation tessellation similar to the ones at the top of page 401. GSP ☞ Use a hexagon or equilateral triangle to do a tessellation using rotation similar to the ones on page 403 to 405 GSP ☞ Make a Conway tessellation using information pages 408-409 and the materials in class. GSP ☞ Use a kite or parallelogram grid to create a tessellation using a glide reflection. GSP
9/20/2010	M			Topic: Initial vocabulary ☞ Journal 3 Read Serra Chapter 1 pages 27-83. Written exercises: p 34 #18, 21, 28, 29-31. Page 37 #8 ; page 43 #7-20; page 44 #31-36; page 51-2 #9 #15-24; .page 57-8 #17-23; page 62 #12-14; Page 72-3 #2-9 Use the NCTM site below to create a sheet of isometric dot paper with 20 rows and 20 columns, standard paper, units centimeters, distance between dots 1 cm.

				http://illuminations.nctm.org/ActivityDetail.aspx?ID=205 Use the paper to sketch the figures 10-12 on page 78.
9/22/2010	W	*		Topic: The roots of proof Read Serra Chapter 2 pages 95-142 and section 13.2 pages 703-708, Euclid I. 1-1.6 Euclid Postulates and Common Notions Introducing ☞ Euclid's Challenge-Moving a segment (Individual reports of this group project will be due in class and copied to portfolio by October 4.)
9/27/2010	M	*		Topic: More about proof, basic constructions ☞ Journal 4 Read Euclid 1.7-1.15; Serra Chap 3 Written Exercises: Page 125 #4, 5; page 132-33 #4-7, #14-16; page 169 #11, 12. ☞ Use approved GSP tools only to show samples of copying an angle, constructing an angle bisector, constructing a perpendicular bisector of a segment, a line parallel to a line through a point not on the line.
9/29/2010	W			Topic: Properties of triangles Written exercises: P 203 # 8,9; P 209 #9.10; pages 218-19 #13-16; Pages 224-225 #4-9, 18,19; pages 229-230#4-9,19; p 247 #12. Euclid; I.16-1.26; Serra Chap. 4
10/4/2010	M			Topic: Properties of polygons ☞ Journal 5 Euclid' Challenge Due at the Beginning of Class Euclid I.27-I.32; Serra Chap. 5 Begin Quadrilateral Project
10/6/2010	W	*		Topic: Area - Tangrams Euclid I.33-I.37, I.41; Serra Chap. 8 Written exercises: page 427 #21-23; page 432 #20; page 444 # 13, 14; page 451 #9, 10; page 455 #2, 5, 6, 12; page 466 #7-10; page 472 #26-28.
10/11/2010	M			Topic: The Pythagorean Theorem ☞ Journal 6 Euclid I.46-I.48; Serra Chap. 9 Read Steven Strogatz Blog from the NY Times. Written Exercises: page 481 # 8-11; page 488 #23, page 493-494 #1-10; pages 504-5 # 5, 12-14,17; pages 509-511#3, 5, 8, 13,15.
10/13/2010	W	*		Discuss Individual Lesson Planning and Central Connecticut State University Math Trail project See Daniel Orey's Website and Ron Eglash's Website on culturally situated mathematics tools
10/18/2010	M			Review
10/20/2010	W			Midterm ☞ Quadrilateral Project due at the beginning of class
10/25/2010	M	*	Last day to withdraw/Midterm	Topic: Coordinate Geometry and conics ☞ Journal 7 Exercises to be determined.
10/27/2010	W	*		Topic: Three Dimensional Geometry and Volume Serra Chap. 10

				✚ Construct at least 2 more of the 5 regular polyhedra as pop-up models. Copy your construction to your portfolio and bring your pop-up models to the next class.
11/1/2010	M			Topic: Three Dimensional Geometry.
11/3/2010	W	*		✚ Journal 8 Lesson Plans Due Topic: Three Dimensional Geometry Written Exercises: Pages 533-534 #1- 6,12,13
11/8/2010	M	*		✚ Journal 9 Topic: Three Dimensional Geometry Written Exercises: Pages 540-541 #4-6, 13-15; pages 548-549 #2, 6, 7,14
11/10/2010	W	*		✚ Journal 10 Topic: Three Dimensional Geometry Written exercises: P559-560 #1-6, 11,16 page 564 #9,10
11/15/2010	M			Student Lessons
11/17/2010	W			Student Lessons
11/22/2010	M	*		✚ Journal 11 Reflection on the Reflections Student Lessons
11/24/2010	W		Thanksgiving - no class	
11/29/2010	M			Student Lessons
12/1/2010	W			✚ CCSU Math Trail Projects due Student Lessons
12/6/2010	M			Portfolio Due Student Lessons
12/8/2010	W			Lesson Reflections Due Review
12/13/2010	M		Final Exam 5-7 pm	Final Exam