Math 211, Fundamentals of Geometry and Measurement (XM)(4 credits)
Section 101C, MTWF 11:30 – 12:30 pm , Swart 302
Spring 2020 — University of Wisconsin Oshkosh

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Office Hours: I am available for drop-in help at my office (Swart 219) as follows:

. Mondays, 1:00 – 2:00 pm
. Wednesdays, 2:00 – 3:00 pm
. Fridays, 2:00 – 3:00 pm

Email me for an appointment if you need to meet outside of these times.

Course Description: Exploring, conjecturing, communicating and reasoning within the content domain of geometry. Foundational ideas of geometry including role of definitions, the idea of axioms, and the nature of mathematical objects. Measurement of length, area, volume and angle size. Prerequisite: Mathematics 110 with a grade of C or better. Prerequisite: Math 110, with a grade of C or better.

Core Learning Outcomes: Upon successful completion of this course, students should be able to:

- Create and use a variety of problem-solving strategies. These include reasoning from diagrams and using geometric models to find generalities and constraints.
- Communicate the problem-solving process and the resulting mathematics both orally and in writing using the language of mathematicians.
- Describe the limitation of geometric representations and distinguish between these representations and the ideal objects they represent.
- Distinguish between an explanation of how to solve a problem and an argument that explains why it works.
- Use logic and structure (rather than authority) to determine when a solution is correct and complete.
- Craft arguments using fundamentals of logical reasoning.
- Distinguish among a statement, its converse, and its contrapositive and identify which are logically equivalent.
- Discuss mathematical activity using the language of doing mathematics (e.g. conjecture, counter example, theorem, proof).
- Refute claims by creating and using counter examples.
- Distinguish between and use both inductive and deductive reasoning.
- Listen, evaluate and respond effectively to the mathematical ideas of peers.
- Build connections among, and work with, a variety of representations.
- Analyze children's understanding of polygons and other mathematical objects.

- Explain axioms and key theorems from Euclidean geometry (including parallel line theorems, sum of polygons' interior angle measures, and the Pythagorean Theorem), and use them in making mathematical arguments.
- Identify and justify properties of, and relationships among, triangles, quadrilaterals, and other polygons.
- Explain the ideas, processes, and limitations associated with the process of measuring angle, length, area, surface area, and volume, including why units matter.
- Describe processes for unit conversion and scaling of one- and two- dimensional measures using models, the idea of units, and the multiplicative relationship.
- Explain why our standard formulas for perimeters, areas, and volumes make sense.
- Gain an appreciation for the beauty and importance of geometry.

Explore Course Connections: This course is an Explore Nature course for the University Studies Program. The Explore classes are designed to provide a solid foundation for your liberal arts education. A liberal arts education provides you with broad knowledge about the world in which we live as well as skills that are transferable across all disciplines. These skills will be especially helpful to you in your future career as a teacher. Specifically, in this course, we will develop communication and problem solving skills in conjunction with the mathematics we learn.

Required Materials: For this course, you will need the following:

Textbook: The *Winter 2020* version of *Big Ideas in Mathematics for Future Elementary Teachers: Big Ideas in Geometry and Data*, by John Beam, Jason Belnap, Eric Kuennen, Amy Parrott, Carol Seaman, and Jennifer Szydlik; this is available at the bookstore.

Bridges Account (online): Some of the assignments & activities in the Math 110, 211, & 213 texts will require access to the K-5 Bridges curriculum—an online K-5 mathematics curriculum currently used by the Oshkosh Area School District. You can set up and use a free account (during your classes here) by visiting:

https://bridges.mathlearningcenter.org/user/register/?accountcode=ceuni76158

Once created, you can log into your account at any time by visiting:

https://bridges.mathlearningcenter.org

Canvas Access (online): Canvas will be used for email communication, essential course information, announcements, & assignments (e.g. discussion boards & uploaded documents), so please ensure you have access to Canvas and that your posted email is correct. Limited grade information may periodically be available through Canvas as well.

Microsoft Office: Papers submitted to Canvas must be in Microsoft Word (MSWord) format. Students with a valid UWO email account can install Office 365 (including MSWord) for free by visiting:

https://www.microsoft.com/en-us/education/products/office/default.aspx

Construction Tools: From time to time, you will need a ruler, compass, protractor, tape, scissors, stapler, colored markers or pencils, graph paper, tracing paper, and a basic calculator (no cell phones, no graphing or scientific or programmable calculators will be allowed on individual assessments). Bring these to class each time, so that you can access them when you need.

Optional Materials: GeoGebra: GeoGebra (available on most computing and mobile platforms) may be useful for some geometry explorations. GeoGebra is a free program for creating and manipulating dynamic geometric objects and has many other uses as well (see https://www.geogebra.org/ for details).

Euclidea: Euclidea (optional) is a fun and free game available on some mobile devices that is based completely on ruler & compass constructions. Playing it can help you better understand and explore Euclidean geometry constructions.

Format & Attendance Policy: As a teacher, you will need to think mathematically, express and articulate your thinking & reasoning, and be able to solicit and understand the reasoning of others. To help you develop these abilities, most of class time will be spent working on & discussing interesting problems in small groups and as a class. You are always expected to fully participate in all activities by thinking about the problems, participating in their solutions, and communicating your ideas with others. As explained later, part of your grade is based on your contributions to team and whole-class work & discussions; thus too many absences (whether excused or not) can impact your grade. If you must miss class for any reason, it is your responsibility to inform me in a timely manner and make appropriate arrangements, if possible.

Making Mistakes: Making mistakes is an important (and expected) part of mathematical work and often provides powerful learning experiences, both for yourself and others. I encourage you to share your mistakes as well as your successes with our class during class time. Because mistakes are expected, your grade in this course is not fixed until the end of the semester.

Early Alert: During the 5th week of classes, you may receive an Early Alert email; it is important you read it carefully. Early Alert is a program providing you with an Early Grade Report from faculty. These reports will highlight any academic or attendance issues and indicate resources or steps available to help you improve. This will help you progress early-on, since students are commonly unaware of or over-estimate their performance.

Resources: There are many resources available to help you succeed in this course as well as thrive at UWO. If you are struggling with this course, please talk with your professor during office hours or make an appointment to meet outside of the scheduled times. Additionally, the following places are here to help you:

Center for Academic Resources: The Center for Academic Resources (CAR) provides free tutoring for students in most undergraduate classes on campus. CAR is located in the Student Success Center, Suite 102. Check the Tutor List page on CAR's website (*https://uwosh.edu/car*) for a list of tutors.

Writing Center: The Writing Center provides helpful feedback on your writing assignments. You may schedule an appointment by visiting their website: *https://uwosh.edu/writingcenter* drop-ins are also sometimes available.

Other Resources: Please check out *https://uwosh.edu/resources* for additional resources available to you.

Standards & Evaluation: This will be a standards-based class, meaning that all activities, assignments, and grades aim at providing you with opportunities to develop and demonstrate proficiency in our class' standards. Our class has two types of types of standards (both listed at the end of this syllabus): *practice standards* and *content standards*.

Practice Standards (i.e. *math practices*) describe values, characteristics, habits, and skills that are critical to mathematical thinking. Successful students develop these *math practices* through consistent & conscientious actions & choices—usually requiring the breaking of old habits & attitudes.

Content Standards describe the big mathematical ideas and procedures of this class. Successful students are able to recognize, explain, model, and apply these math ideas to new situations, *not* just mimic and repeat memorized procedures.

Activities and assignments (including group activities, class presentations & discussions, reading assignments, and problem sets) will be carefully chosen to help you develop math practices and a deep understanding of the content. Proficiency will be assessed through a diverse set of activities, including peer evaluations, written reflections, class observations, graded problem sets, problem write-ups, quizzes, and a comprehensive final exam (given in class on the last day of class).

Your performance on each standard will be determined as follows:

Practice Standards (except PS6): Your performance on the standard will be the percent (of all the times one of its benchmarks was assessed) that you successfully performed it—so the performance on all benchmarks are pooled together, rather than assessed separately.

Practice Standard 6 (PS6): Your performance on the standard will be the average of your performance on each of its benchmarks, equally weighted.

Content Standards: Your performance on the standard will be the percent (of all the times a big idea was assessed) that you correctly demonstrated that knowledge—all pooled together, as with the practice standards.

Grades: Your final grade will be determined by your overall performance, which is the average of your performance on each standard (equally weighted). Cut-offs will be no stricter than:

	Grade +	Grade	Grade -
A	n/a	93%	90%
B	87%	83%	80%
C	77%	73%	n/a
D*	67%	64%	60%

* To pass with a D- or higher, performance on *all but 2 standards* must be 60% or higher.

Disclaimer: If any substantive changes are made in the course syllabus, notification will be provided in a timely manner and a revised syllabus will be made available.

Academic Integrity: According to university policy, students are responsible for "the honest completion and representation of their work, for the appropriate citation of sources, and for respect of others' academic endeavors." (UWS 14.01, Wisconsin Administrative Code) Taking credit for others' work or presenting others' ideas as your own is also a form of academic dishonesty. Violations of academic honesty may result in loss of credit for the work in question, failing grade, or even suspension from the University. Be honest in your work AND protect your work from others' dishonesty.

Work Sample Collection: Examining and discussing others' work & solutions (both correct & incorrect) are powerful ways to learn about mathematics & teaching. To provide these opportunities for students & educators, I sometimes collect samples of student work. Collected work might be used in future discussions, assignments, activities, teacher preparation programs, or (with appropriate approval & oversight) research presentations & publications. There will be no compensation for collected work.

Although confidentiality will be maintained by the removal of any identifying information, complete anonymity of *handwritten* work cannot be guaranteed. If you do *not* want your work collected, send me an email with your full name, clearly telling me so. There will be no repercussions for doing so.

A Word of Encouragement: This class is likely to be very different from others you have had. It will be challenging, but I truly believe that everyone is capable of being successful in our class. I recognize that math does not come easily for everyone, but please know that I am here to help you. Please contact me or stop by my office when you have questions, concerns, or just want to discuss your ideas.

Practice Standards & Key Benchmarks
PS1: Make sense of problems and persevere in solving them. A. Identifies, uses, and explains (as appropriate) a correct and complete understanding of the problem's assumptions and goals. B. Monitors (and articulates) one's problem solving process, including making intentional and purposeful choices, based on strategy, data, evidence, and reasoning–rather than jumping to unfounded conclusions. C. Effectively choose, create, and use a variety of problem solving strategies (e.g. direct modeling, generating & organizing data, observing numeric & geometric patterns). D. Appropriately and effectively uses these specific strategies: using geometric models, & reasoning from diagrams E. Generates and considers both a sufficient number and a sufficient diversity of examples during inductive work. F. Provides a solution that is both correct and complete.
PS2: Generate and utilize visual mathematical representations. A. Creates physical or visual models when appropriate or helpful. B. Captures intended relationships & concepts correctly and accurately. C. Uses and works with the representations in valid ways, recognizing the limitations of representations. D. Draws valid and relevant conclusions & interpretations from the models, distinguishing between representations and the ideal objects they represent.
PS3: Reason mathematically and construct viable arguments. A. Uses language that aims to convince & explain *why* it is correct, instead of *how* it was solved. B. Recognizes and appropriately argues situations justifiable by examples or counterexamples and those requiring a general argument. C. Recognizes and builds arguments upon complete sets of correct assumptions. D. Uses correct definitions effectively (when appropriate) to strengthen arguments. E. Uses correct theorems effectively (when appropriate) to strengthen arguments. F. Addresses a complete and appropriate exit strategy (i.e. sufficient criteria to argue the point). G. Justifies the solution fully by addressing all important details well enough to convince a reasonable skeptic.
PS4: Generate and utilize verbal and symbolic mathematical representations. A. Uses accurately all conventionally established representations & symbols (e.g. =). B. Performs meaningful algebraic manipulations accurately & without errors. C. Meaningfully creates, uses, and interprets conditional (if-then) statements, their converses, and their contrapositives. D. Uses & interprets other discipline-specific language and terminology accurately & conventionally (e.g. quantifiers & definitions.
PS5: Understand and critique the reasoning of others. A. Poses questions & problems that target or draw-out specific reasoning or understanding. B. Demonstrates understanding of others' explanations or approaches. C. Recognizes & identifies the correct and incorrect ideas, approaches, & reasoning of others. D. Uses language that values & encourages others' valid mathematical ideas & approaches.

Practice Standards & Key Benchmarks continued....

PS6: Contribute to our mathematical communities.

A. Attends class regularly.
B. Comes prepared for class, having completed all required preparations.
C. Collaborates by: listening to, respecting, & considering others' contributions; sharing own thoughts, ideas, & reasoning; asking & answering questions; and being on-task & working well with group members.
D. Engages in whole-class discussion by: presenting problems at the board; asking & answering questions; and listening & responding to peers' questions & ideas.
E. Contributes meaningfully to the class or broader math community through other means.

Content Standards & Big Ideas

CS1: Lines, Circles, & Angles

A. Demonstrates (by modeling and explanation) an understanding of the properties of fundamental geometric objects, including: points, lines, rays, line segments, angles, & circles.
B. Recognizes, models, explains, and uses the relationships among lines, including when lines are parallel or perpendicular and when a line is a transversal.
C. Recognizes, models, explains, and uses properties of and relationships among angles, including when angles are: acute, right, obtuse, adjacent, vertical, complementary, and supplementary.
D. Demonstrates (via explanation, correct use of terminology, and example/non-example generation) a correct understanding of the following and their relation to circles: radius, diameter, chord, sector, central angle, tangent line, and secant line.
E. Demonstrates (by modeling, explanation, and application) an understanding of these theorems: vertical angles theorem and parallel line theorems.

CS2: Triangles, Quadrilaterals, & Other Polygons

A. Demonstrates (by modeling and explanation) an understanding of the fundamental polygonal features, including: vertices, edges, vertex angles, diagonals, exterior angles, & central angles.
B. Use properties to classify polygons, including number of sides, side lengths, angles, diagonals (e.g. concave, convex, regular, hexagon, pentagon, triangle, quadrilateral).
C. Use properties & definitions to classify triangles, including side lengths (e.g. scalene, isosceles, & equilateral) and angles (e.g. acute, right, & obtuse).
D. Use properties and definitions to classify quadrilaterals, including side lengths and angles (e.g. squares, rectangles, rhombi, parallelograms, & trapezoids).
E. Determine relationships among a polygon's properties.
F. Determine relationships among the various classes of polygons.
G. Demonstrates (by modeling, explanation, and application) an understanding of these theorems: vertex angle sums, Pythagorean theorem and its converse.

Content Standards & Big Ideas continued....
CS3: Measurement in the Plane A. Demonstrate (by modeling & explanation) an understanding of processes for measuring & estimating angles, length, and area. B. Use appropriate units and tools (e.g. ruler, protractor, tiles) when measuring the properties of angle, length, & area. C. Create, justify, and use formulas for the perimeter and area of common shapes (e.g. rectangles, triangles, parallelograms) D. Demonstrate (by computation & explanation) an understanding of the definition of pi and its relation to the circumference and area of circles. E. Determine relationships among units for angles, length, and area and use these relationships to perform unit and scale conversions. F. Demonstrate (by modeling & explanation) an understanding of scale models and the differences in how length and area scale.
CS4: Measurement in Space A. Demonstrates (by modeling and explanation) an understanding of the fundamental features of polyhedra, including: vertices, edges, faces, and nets. B. Use properties to classify polyhedra, including number, shape, and position of faces (e.g. regular, pyrmaid, prism). C. Create and use accurate nets to represent and work with 3-dimensional objects. D. Demonstrate (by modeling & explanation) an understanding of processes for measuring, estimating, & calculating the surface area and volume of 3-dimensional objects. E. Create, justify, and use formulas for the surface area and volume of common 3-dimensional shapes. F. Demonstrate (by modeling & explanation) an understanding of scale models and the differences in how dimension, surface area, and volume scale.