COURSE TITLE: Concepts of Geometry   **COURSE NUMBER:** 1303

DEPARTMENT: Mathematics   **GRADE LEVEL(S) & PHASE:** 10 – 12, CP

LENGTH OF COURSE: Full Year

Course Description:

The foundation of this course is simple - students learn better by doing than by being shown. Thus, rather than teachers telling student what is true and then proving why it is so, students should, as much as possible, discover the important relationships of geometry through a variety of directed activities.

Connections among these relationships should be discussed and applications abound throughout the course. The course will focus on the following questions:

- What are the basic elements of geometry?
- How are these elements used to form a variety of two and three-dimensional shapes?
- What can I learn about these shapes from what I know about the basic elements?
- How can I apply algebra to determine specific measurement data about these shapes?
- How can this information be applied to situations around me?

Such an approach will assist students in becoming more confident in their ability to use mathematics and thus increase their appreciation of mathematics as an approach to problem solving. Throughout the course, mathematics as language will be emphasized by encouraging students to communicate their mathematical reasoning and comprehension in both oral and written form. The study of geometry helps students represent and make sense of the world. Geometric models provide a perspective from which students can analyze and solve problems, and geometric interpretations can help make an abstract (symbolic) representation more easily understood.

Objectives:

(Some are adapted from the Massachusetts Mathematics Curriculum Framework – November 2000)

At the end of the course, students should be able to:

A. Recognize special types of polygons, apply properties of sides, diagonals and angles, determine interior angles for regular polygons, and detect symmetries of geometric figures.
B. Determine when figures are congruent or similar or when lines are parallel or perpendicular and write convincing arguments for these.
C. Apply properties of angles, parallel lines, arcs, radii, chords, tangents and secants to solve problems.
D. Apply congruence correspondences and properties of figures to find missing parts of triangles and provide logical justification.
E. Solve simple triangle problems using the triangle angle sum property and/or the Pythagorean Theorem.
F. Use the properties of special triangles to solve problems.
G. Demonstrate an understanding of the relationship among various representations of a line.
H. Determine a line's slope and x- and y-intercepts from its graph or from a linear equation that represents the line.
I.   Find linear equations that represent lines either perpendicular or parallel to a given line and through a given point using either point slope or slope intercept form.
J. Using rectangular coordinates, calculate midpoints of segments, slopes of lines or segments, and distances between two points, and apply the results to the solution of problems.
K. Demonstrate an understanding of the relationship between geometric and algebraic representations of circles.
L. Draw the results and interpret transformations on figures in the coordinate plane. Apply transformations to the solutions of everyday problems.
M. Demonstrate the ability to visualize solid objects and recognize their projections and cross sections.
N. Use vertex-edge graphs to model and solve problems.
O. Calculate perimeter, circumference, and area of common geometric figures.
P. Given the formula, apply formulas for lateral area, surface area, and volume of prisms, pyramids, spheres, cylinders and cones.
Q. Relate changes in the measurement of one attribute of an object to changes in other attributes.
R. Describe the effects of approximate error in measurement and rounding on measurements and on computed values from measurements.
S. Use dimensional analysis for unit conversion and confirm that expressions and equations make sense.

These objectives address the Academic Expectations relating to effective communication, mathematical competency and problem solving skills.

Materials and Activities:

Text(s): Geometry: Tools for a Changing World
By: Laurie E. Bass, Art Johnson, Basia Rinesmith Hall and Dorothy F. Wood
Prentice Hall: Needham, MA 1998
Students are expected to have and use a scientific calculator in class and when doing assignments.

- Discovery activities to introduce new concepts and to provide hands-on experience concerning the usefulness of these concepts.
- Lecture and class discussion to explain concepts and processes.
- Individual and group work to practice skills presented in class, to apply them to various problem-solving situations and to develop their ability to work cooperatively in such situations.
- Student assignments to develop proficiency in those skills and processes presented and practiced in class.
- Group and individual investigations related to understanding and applying the concepts in the Central Objectives.

Scope and Sequence:

The following units will be covered during this course. At the end of each unit, the student should understand the concepts and terms listed below. In addition, the student should be able to solve various types of problems using Geometry skills, Algebraic Skills or a combination of the two. The textbook is used as one of the support resources for the units. Other resources may include worksheets, class work, the Internet, outside readings, manipulatives, and constructions using compasses, protractors, and straight edges.

Unit A: Introduction to Geometry – Points, Lines, and Planes
At the end of this unit, students should understand the concepts and terms listed below and be able to solve various types of related problems using geometry skills, algebraic skills of a combination of the two:

- Points
- Lines
- Planes
- Collinear
- Coplanar
- Line Segment
- Rays
- Length
- Midpoint
- Bisectors
- Congruent Segments
- Betweeness
- Parallel
- Skew
- Intersections
- Naming Conventions
- Pattern Recognition
- Absolute Value's relation to Geometry
- Number Line's relation to Geometry
- Venn Diagrams
- Student should be able to use the above terminology and concepts to sketch the geometric figures created with points, lines, and planes. Interpret sketches that include these concepts and understand verbal sentences involving the above terms.

Unit B: Angles
At the end of this unit, students should understand the concepts and terms listed below and be able to solve various types of related problems using geometry skills, algebraic skills of a combination of the two:

- Naming Convention for Angles
- Vertex and Sides
- Interior
- Exterior
- Right
- Acute
- Obtuse

- Angle Bisector
- Vertical Angles
- Perpendicular
- Adjacent
- Complimentary
- Supplementary
- Linear Pair
- Protractor Skills
- Figuring Angles on Simple and Complex Sketches
- Student should be able to use the above to measure angles with a protractor, draw angles with a protractor.
- Student should be able to solve verbal and visual problems involving angles with Geometry and Algebra skills.

Unit C: Parallel Lines
At the end of this unit, students should understand the concepts and terms listed below and be able to solve various types of related problems using geometry skills, algebraic skills of a combination of the two:
- Parallel
- Transversal
- Interior Angles
- Exterior Angles
- Same Side Angles
- Alternate Angles
- Corresponding Angles
- Line Equation Review Including Slope and Y-Intercept.
- Relating Algebra of Lines to Geometry
- Graphing of Lines
- Identify pairs of angles formed by two lines and a transversal.
- Relate the measures of angles formed by parallel lines and transversal.
- Recognize conditions that result in lines being parallel.
- Construct parallel and perpendicular lines
- Student should be able to solve Simple and Complex Parallel Line Diagrams for various Angles with and without Algebra

Unit D: Polygons (including Triangle Properties)
At the end of this unit, students should understand the concepts and terms listed below and be able to solve various types of related problems using geometry skills, algebraic skills of a combination of the two:
- Definition of what is and what is not a Polygon
- Polygon Classification
- Vertices
- Sides
- Endpoints
- Consecutive
- Adjacent
- Opposite and Non-consecutive
- Diagonals
- Convex
- Concave
- Classifying Polygons by number of sides
- Learning Greek pre-fixes for number of sides
- Equilateral
- Equiangular
- Regular
- Interior and Exterior Angles
- Naming Conventions
- Formula for Sum of the Interior Angles and its relation to triangle subdivision
- Sum of Exterior Angles and Formula for Exterior Angles of a Regular Polygons
- Relation between Interior and Exterior Angles in a Polygon

- Solving for sides and angles of polygons
- Scalene Triangles
- Isosceles Triangles
- Equilateral Triangles
- Hypotenuse and Legs of a Right Triangle
- Base, Base Angles, and Legs of an Isosceles Triangle
- Vertex vs. Vertex Angle
- Use properties of mid-segments to solve problems.
- Use inequalities involving triangle side lengths and angle measures to solve problems
- Student should be able to be able to solve problems involving polygons for lengths of sides and measure of various angles.
- Student should be able to solve for sides and angles in Isosceles and Equilateral Triangles with and without Algebra

Unit E: Transformations:
At the end of this unit, students should understand the concepts and terms listed below and be able to solve various types of related problems using geometry skills, algebraic skills of a combination of the two:
- Review of Graphs, Coordinates, locating points, X and Y Axes, Graphing Conventions
- Vectors and Vector Notation
- Image and Pre-Image (A vs. A') as well as Parent and Offspring
- Translation
- Reflections over axes and lines
- Rotations
- Dilations (Enlarging and Shrinking)
- Symmetry
- Identify types of symmetry in figures.
- Identify figures that tessellate.
- Identify symmetries of tessellations.
- Student should be able to use Algebra and/or Graphing methods to perform transformations and solve problems involving transformations.

Unit F: Congruent Polygons:
At the end of this unit, students should understand the concepts and terms listed below and be able to solve various types of related problems using geometry skills, algebraic skills of a combination of the two:
- Triangle Congruence (Including SSS, SAS, ASA, AAS, HLT)
- Median of a Triangle
- Altitude of a Triangle
- Perpendicular Bisector
- Angle Bisector
- Congruent Polygons and Naming Conventions
- Student should be able to solve simple and complex congruence problems involving triangles and other polygons

Unit G: Quadrilaterals
At the end of this unit, students should understand the concepts and terms listed below and be able to solve various types of related problems using geometry skills, algebraic skills of a combination of the two:
- Rectangles
- Squares
- Parallelograms
- Rhombus
- Trapezoid
- Distance and Midpoint Formulas
- Slopes of parallel and Perpendicular Lines
- Student should be able to solve simple and complex problems involving quadrilaterals using algebra, geometry, and coordinate graphing techniques.

Unit H: Area and Perimeter

At the end of this unit, students should understand the concepts and terms listed below and be able to solve various types of related problems using geometry skills, algebraic skills of a combination of the two:

- Area Concept using grids
- Pythagorean Theorem (and it's inverse)
- Recognize the distance formula as an application of the Pythagorean Theorem.
- Use the properties of special right triangles.
- Areas of Rectangles and Squares
- Areas of Parallelograms
- Areas of Triangles
- Areas of Trapezoids
- Areas of complex shapes
- Areas of shaded regions within shapes
- Areas on coordinate graph systems
- Use geometric models to find the probability of events.
- Student should be able to calculate simple and complex areas involving the figures covered above.

Unit J: Volume, Total Surface Area, Lateral Surface Area
At the end of this unit, students should understand the concepts and terms listed below and be able to solve various types of related problems using geometry skills, algebraic skills of a combination of the two:

- Rectangular Prisms
- Right Circular Cylinders
- Pyramids
- Cones
- Spheres
- Nets of 3 dimensional figures
- Volumes of above shapes
- Total Surface Area of above shapes
- Lateral Surface area of above shapes
- Recognize nets of various space figures.
- Recognize composite space figures, which combine two or more simple figures.
- Student should be able to calculate simple and complex volume, total surface area, and lateral surface area of the figures covered above.

Unit K: Similarity
At the end of this unit, students should understand the concepts and terms listed below and be able to solve various types of related problems using geometry skills, algebraic skills of a combination of the two:

- Proportion
- Ratios
- Cross Multiplication
- Similarity vs. Congruence
- Student should be able to identify a similarity situation and use the skills covered to solve for lengths and proportions in such situations.

The following concepts will be emphasized throughout the above units in the course:

- Classify examples of reasoning as inductive or deductive.
- Use inductive and deductive reasoning to make conjectures.
- Recognize patterns presented in a variety of formats and determine rules by which the pattern could be continued.
- Understand the basic terms of geometry and be able to represent them appropriately.
- Understand the basic postulates of geometry and be able to explain their significance.
- Identify a good definition.
- Perform basic constructions
- Write and interpret different types of conditional statements.

Note: Certain topics may be taught out of sequence so that major categories that are part of the MCAS will be covered prior to the exam. The MCAS is usually scheduled for mid-May.

<u>Assessment:</u>

- Daily assignments to be evaluated in light of completeness, care of presentation and the student's ability to explain the results. Late or incomplete assignments can earn at most half credit. Generally, no credit will be given for any assignment not completed within one day of the time it was due.
- Individual and group classwork/investigations to be evaluated in light of their completeness, care of presentation, student participation in the process and the student's ability to discuss the results/conclusions.
- Frequent quizzes to assess the student's progress in achieving course objectives on a short-term basis.
- Chapter tests to assess the student's ability to synthesize several classes and achieve course objectives on a long-term basis.
- Semester exams given in January and June.
- Assessments designed to determine how the student has met the Academic Expectations relating to effective communication, mathematical competency and problem solving skills.

Revised 07/09