NEW MILFORD PUBLIC SCHOOLS
New Milford, Connecticut

Geometry Academic

May 2012

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New Milford Board of Education

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New Milford's Mission Statement

The mission of the New Milford Public Schools, a collaborative partnership of students, educators, family and community, is to prepare each and every student to compete and excel in an ever-changing world, embrace challenges with vigor, respect and appreciate the worth of every human being, and contribute to society by providing effective instruction and dynamic curriculum, offering a wide range of valuable experiences, and inspiring students to pursue their dreams and aspirations.

Geometry Academic

This course is designed for students who have demonstrated quality work in Algebra I. Topics include geometric terminology, concept of a logical deductive proof, constructions, concept of congruence, similarity, parallelism, the study of polygons and circles, and appropriate word problems. Algebraic concepts will be stressed. CAPT-type applications will be emphasized. Calculators and/or computers will be used. A scientific calculator is required of all students in this course.

Common Core State Standards for Mathematics
Mathematics Standards for High School

Key for the Standards

G	Geometry
CO	Congruence
GPE	Expressing Geometric Properties with Equations
SRT	Similarity, Right Triangles and Trigonometry
GMD	Geometric Measurement and Dimension
MG	Modeling with Geometry
C	Circles

Pacing Guide

(based on a block schedule)

New Milford Public Schools

Committee Member: Ryan Fitzsimmons Unit 1: Foundations of Geometry	Course/Subject: Geometry Academic Grade Level: 10 # of Days: 20

Identify Desired Results

Common Core Standards

- G.CO.1: Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.
- G-CO.9: Prove theorems about lines and angles. *Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.*
- G-CO.12: Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). *Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.*
- G-GPE.5: Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).
- G GPE.7: Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.

Enduring Understandings Generalizations of desired understanding via essential questions (Students will understand that …)	**Essential Questions** Inquiry used to explore generalizations
• It is important to express geometric terms correctly. • Algebra is needed to solve geometric problems. • Conditional statements are the appropriate form for representation. • Angle relationships exist when parallel lines are intersected by a transversal. • Deductive reasoning can be applied to logically solve problems. • A variety of tools including technology can be used to construct specific geometry configurations.	• How does one express items in correct geometric terms? • How does one correctly measure segments and angles? • How is the structure of geometry different from algebra? • How is a good definition written? • How are statements structured? • How does one apply deductive reasoning in order to apply theorems? • How can one find the measure of special angle pairs given parallel lines?

• Proof is the highest level of mathematical argument.	• How does one perform a geometric construction? • How does one formulate a proof?

Expected Performances
What students should know and be able to do

Students will know the following:

- Point, line, and plane are the undefined terms from geometry
- The sum of angles in a triangle is 180 degrees
- Slope can be used to answer questions about segments as well as lines
- Distance and midpoint formulas can be used to complete calculations on segments
- Constructions can be made identify a locus of points

Students will be able to do the following:

- Use and apply patterns
- Identify and use vocabulary related to lines, segments, and planes
- Measure segments using the segment addition postulate
- Measure angles using the angle addition postulate
- Create basic constructions for bisectors and congruent figures
- Use and apply the distance and midpoint formulas
- Use and apply the formulas for perimeter and area of rectangles, squares, and triangles
- Use and apply the formulas for circumference and area of a circle
- Determine the hypothesis and conclusion of a conditional statement
- Create the converse given a conditional statement
- Prove and apply theorems about angles
- Use and apply the vertical angles theorem
- Identify special angle pairs and relationships given two lines and a transversal
- Find missing angle measures in a triangle
- Use and apply polygon angle sum theorem
- Use and apply exterior angle theorem
- Calculate slope given two points
- Recognize the slope given an equation in point-slope form
- Construct basic geometric figures including but not limited to: congruent angles, bisectors, parallel, and perpendicular lines
- Discover the relationship between the slopes of parallel and perpendicular lines

Character Attributes

- Cooperation
- Honesty
- Integrity
- Perseverance
- Respect
- Responsibility

Technology Competencies

- Students show graphic representation of data.
- Use graphing applications, students show the relationships among numbers in several ways.
- Students use software for problem solving and for illustration of thoughts and ideas (Geometer's Sketchpad).
- Students independently use appropriate technology tools to define problems and to propose hypothesis.

Develop Teaching and Learning Plan

Suggested Teaching Strategies:

- Teacher identifies key terminology and notation.
- Teacher guides students in the use of segment addition and angle addition theorems.
- Teacher guides students in basic constructions of bisectors and congruent figures.
- Teacher leads a discussion about parallel and perpendicular lines.
- Teacher leads students through an exploration with slope, parallel, and perpendicular lines.

Suggested Learning Activities:

- Students will be able to create their own patterns to demonstrate knowledge.
- Students will use Geometers Sketchpad for discovery of properties of points, rays, segments, and lines.
- Students will use Geometers Sketchpad for discovery of angle properties.
- Students will construct the distance and midpoint formulas through discussion.
- Students will explore biconditional statements and the idea of a good definition.
- Students will discover relationships between special angle pairs through discovery.
- Students will use a discovery lesson to construct the polygon angle sum theorem.
- Students will use Geometers Sketchpad to discover properties of parallel lines.
- Students will perform and create a variety of constructions using a compass, straightedge, and pencil.

Assessments

Performance Task Authentic application to evaluate student achievement of desired results designed according to GRASPS (one per marking period)	**Other Evidence** Application that is functional in a classroom context to evaluate student achievement of desired results
Goal: To create a correct conditional statement and converse. **Role**: Marketing executive **Audience**: Advertising executive **Situation**: Students must create a conditional statement from a current magazine advertisement. **Product**: An advertisement with a correct conditional statement. **Standard for Success**: CAPT rubric	• Monitoring class work through board work, group work, questioning, and walk-arounds • Check for understanding via going over homework, board and white board activities, and medium such as reflections and exit tickets • Quizzes • Test (may include 10-20 multiple choice, 15-30 regular answer)

Suggested Resources

- Textbook: Bass, Laurie. *Geometry.* 1st ed. Upper Saddle River, NJ: Prentice Hall, 2007. Print.
- Geometers Sketchpad. Ver 4.05. Key Curriculum Press. Software.
- Bennett, Dan. Exploring Geometry with Geometers Sketchpad. Key Curriculum Press. 2005.

New Milford Public Schools

Committee Member: Ryan Fitzsimmons Unit 2: Triangles	Course/Subject: Geometry Academic Grade Level: 10 # of Days: 12

Identify Desired Results

Common Core Standards

- G.CO.7. Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.
- G-CO.8. Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.
- G-CO.10. Prove theorems about triangles. *Theorems include: measures of interior angles of a triangle sum to 180°; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.*
- G-SRT.4. Prove theorems about triangles. *Theorems include: a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity.*
- G-SRT.5. Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.

Enduring Understandings Generalizations of desired understanding via essential questions (Students will understand that …)	**Essential Questions** Inquiry used to explore generalizations
• There are theorems that prove triangle congruence. • Special properties apply to isosceles and equilateral triangles. • The special segments in triangles exhibit specific properties in the real world. • Congruent figures have the same size and shape. • The sum of any two sides of a triangle must be larger than the third. • Orientation of a triangle is not necessary for congruence if the corresponding parts are congruent.	• How does one know if triangles are congruent? • What effect do rotations have on the congruence criteria? • What distinguishes isosceles and equilateral triangles from other triangles? • What are the special segments in triangles? • How does one use criteria to prove congruence?

Expected Performances
What students should know and be able to do

Students will know the following:

- Vocabulary: triangle, acute, obtuse, right, isosceles, scalene, equilateral, equiangular, interior angle, exterior angle, median, altitude, angle bisector, perpendicular bisector, centroid
- The four criteria used to prove triangles congruent
- The sum of interior angles in a triangle is 180 degrees
- The four special segments in triangles: median, altitude, angle bisector, perpendicular bisector
- The triangle inequality theorem states that the sum of any two sides must be longer than the third
- The longest side in a triangle is across from the largest angle and the shortest side is across from the smallest angle

Students will be able to do the following:

- Identify which theorem can be used to prove or disprove triangles congruent
- Identify congruent angles and sides in an isosceles or equilateral triangle
- Apply properties of special segments in triangles to problems using algebraic thinking
- Calculate the length of a mid-segment in a triangle

Character Attributes

- Cooperation
- Integrity
- Perseverance
- Respect
- Responsibility

Technology Competencies

- Students show graphic representation of data.
- Use graphing applications, students show the relationships among numbers in several ways.
- Students use software for problem solving and for illustration of thoughts and ideas (Geometer's Sketchpad).
- Students independently use appropriate technology tools to define problems and to propose hypothesis.

Develop Teaching and Learning Plan

Suggested Teaching Strategies:

- Teacher models a proof using one of the theorems of congruence.
- Teacher introduces the methods that do and do not prove triangles congruent.
- Teacher leads students through a discovery activity involving equilateral and isosceles triangles.
- Teacher demonstrates properties of special segments in triangles (i.e., the centroid is the center of gravity).

Suggested Learning Activities:

- Students will use an inquiry approach (Geometer's Sketchpad Activity) to determine which combinations will work to prove triangles congruent.
- Students will use Geometers Sketchpad to prove the polygon angle-sum theorems.
- Students will use Geometers Sketchpad or Green Globs Computer Program to reinforce the concepts of slope for parallel and perpendicular lines.
- Students will use Geometers Sketchpad to construct a variety of regular polygons.
- Students will use hands-on approach to construct concurrent lines in triangles (i.e., 3 medians and locate their common point of intersection).
- Students will discover the 2:1 distance relationship between segments of the centroid.
- Students will use Geometers Sketchpad to discover properties of medians, altitudes, perpendicular bisectors, and angle bisectors.
- Students will discover triangle inequality theorem using linguine activity.

Assessments

Performance Task Authentic application to evaluate student achievement of desired results designed according to GRASPS (one per marking period)	**Other Evidence** Application that is functional in a classroom context to evaluate student achievement of desired results
Goal: To construct the Euler Segment **Role**: Mechanical engineer **Audience**: Director of Product Development **Situation**: Your boss has asked you to take your company's triangular prototype and construct a segment which divides the triangle equally. **Product**: A diagram with full constructions and Euler Segment sketched appropriately **Standard for Success**: CAPT rubric	• Monitoring class work through board work, group work, questioning, and walk-arounds • Quizzes • Test on unit two (may include 3-5 multiple choice, 25 regular answer, one essay) • Review quiz on material covered in units one and two

Suggested Resources

- Textbook: Bass, Laurie. *Geometry.* 1st ed. Upper Saddle River, NJ: Prentice Hall, 2007. Print.
- Geometers Sketchpad. Ver 4.05. Key Curriculum Press. Software.
- Green Globs. Ver 3. Sunburst. Software Program
- Bennett, Dan. Exploring Geometry with Geometers Sketchpad. Key Curriculum Press. 2005.

New Milford Public Schools

Committee Member: Ryan Fitzsimmons Unit 3: Quadrilaterals	Course/Subject: Geometry Academic Grade Level: 10 # of Days: 12

Identify Desired Results

Common Core Standards

- G-CO.3. Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.
- G-CO.11. Prove theorems about parallelograms. *Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals.*
- G-GPE.4. Use coordinates to prove simple geometric theorems algebraically. *For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; prove or disprove that the point (1, √3) lies on the circle centered at the origin and containing the point (0, 2).*
- G.SRT.1. Verify experimentally the properties of dilations given by a center and a scale factor:
    a. A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged.
    b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.

Enduring Understandings Generalizations of desired understanding via essential questions (Students will understand that …)	**Essential Questions** Inquiry used to explore generalizations
• Properties of parallelograms work from specific (square) to general (parallelogram). • Parallelograms use properties of parallel lines. • One can determine the quadrilateral through the slope and distance formula. • A square is a rectangle, but a rectangle is not necessarily a square. • Trapezoids and kites are special quadrilaterals which do not have the properties of parallelograms. • There is a center and a radius for every dilation.	• What distinguishes the types of quadrilaterals? • How does a square differ from a rectangle? • How can one prove which quadrilateral one has? • What are the properties of a trapezoid and kite which separate it from a parallelogram? • How are the properties of a figure preserved during a dilation?

• Within a special quadrilateral, there are rotations and reflections which preserve properties of the figure.	

Expected Performances
What students should know and be able to do

Students will know the following:

- Vocabulary: quadrilateral, parallelogram, rectangle, rhombus, square, trapezoid, kite, base, mid-segment, isosceles trapezoid
- Quadrilaterals can be broken into the more specific classifications: parallelograms, rectangles, rhombus, square, trapezoid, and kite
- In a parallelogram opposite angles and sides are congruent
- In a rectangle all angles are right angles
- In a rhombus all sides are congruent
- In a square all angles and sides are congruent
- In an isosceles trapezoid the legs are congruent
- How to identify the legs and bases in a trapezoid
- In a kite, there are two pairs of congruent adjacent sides
- In a trapezoid, the mid-segment connects the midpoints of the legs.

Students will be able to do the following:

- Prove the type of quadrilateral given information about the angles and sides
- Show the type of parallelogram by calculating slope and distance
- Identify the classification of parallelograms given the angle and side measurements
- Given a specific quadrilateral and coordinates (as variables), identify any missing coordinates (as variables)
- Apply properties of quadrilaterals to real-world problems.

Character Attributes

- Cooperation
- Integrity
- Perseverance
- Respect
- Responsibility

Technology Competencies

- Students show graphic representation of data.
- Use graphing applications, students show the relationships among numbers in several ways.
- Students use software for problem solving and for illustration of thoughts and ideas (Geometer's Sketchpad).
- Students independently use appropriate technology tools to define problems and to propose hypothesis.

Develop Teaching and Learning Plan

Suggested Teaching Strategies:

- Teacher introduces the family tree of quadrilaterals.
- Teacher guides students through a review of prior knowledge on quadrilaterals.
- Teacher shows students how to construct a two-column proof.
- Teacher leads students in a jigsaw activity involving real-world problems for squares, rectangles, rhombuses, trapezoids, and parallelograms.

Suggested Learning Activities:

- Students will use hands-on activities to discover properties of quadrilaterals through measurement of angles and sides.
- Students will use Geometers Sketchpad to construct various quadrilaterals and confirm beliefs about sides, angles, etc.
- Students will construct a proof of any of the following in the coordinate plane:
  - a rectangle is a parallelogram
  - a square is a rectangle
  - a rhombus is a parallelogram
- Students will identify that a given figure is a rhombus, rectangle, square, or trapezoid given the coordinates (to use slope and distance formula).
- Students will use Geometers Sketchpad to discover properties of parallelograms, rectangles, rhombuses, and squares.
- Students will use Geometers Sketchpad to construct midpoint quadrilaterals and discover their unique properties.

Assessments

Performance Task Authentic application to evaluate student achievement of desired results designed according to GRASPS (one per marking period)	**Other Evidence** Application that is functional in a classroom context to evaluate student achievement of desired results
Goal: To correct student mistakes **Role**: Teacher **Audience**: Student **Situation**: Students will be given an incorrect proof. It will be their job to correct the mistakes and to provide feedback. **Product**: A completed worksheet with corrections clearly labeled with explanations. **Standard for Success**: CAPT rubric	• Monitoring class work through board work, group work, questioning, and walk-arounds • Quizzes • Test (approximately 5-10 multiple choice, 10-15 regular answer, one explanation) • Review quiz on material covered in units one and two

Suggested Resources

- Textbook: Bass, Laurie. *Geometry.* 1st ed. Upper Saddle River, NJ: Prentice Hall, 2007. Print.
- Geometers Sketchpad. Ver 4.05. Key Curriculum Press. Software.
- Bennett, Dan. Exploring Geometry with Geometers Sketchpad. Key Curriculum Press. 2005.

New Milford Public Schools

Committee Member: Ryan Fitzsimmons Unit 4: Similarity, Right Triangles, and Trigonometry	Course/Subject: Geometry Academic Grade Level: 10 # of Days: 18

Identify Desired Results

Common Core Standards

- G-SRT.2. Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.
- G-SRT.3. Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.
- G-SRT.6. Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.
- G-SRT.7. Explain and use the relationship between the sine and cosine of complementary angles.
- G-SRT.8. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.

Enduring Understandings Generalizations of desired understanding via essential questions (Students will understand that …)	**Essential Questions** Inquiry used to explore generalizations
• Similarity refers to any objects which have the same shape. • Ratio and proportion can be used often to find missing sides in similar figures. • Special right triangles have formulas to identify exact values for side lengths. • Ratios are used in all right triangles using the sine, cosine, or tangent of an angle. • Sine and cosine of complementary angles are congruent. • The Golden Ratio is a naturally occurring ratio known for its aesthetic beauty.	• How can one find the length of the side in a right triangle without Pythagorean Theorem? • How can one find the missing parts of a right triangle? • How can one use ratios to find missing parts of triangles? • How does one apply the shortcuts for special right triangles? • What is the Golden Ratio?

Expected Performances
What students should know and be able to do

Students will know the following:

- Vocabulary: Right triangle, hypotenuse, adjacent leg, opposite leg
- Ratios are used to find missing parts of similar figures
- Similar figures may be congruent, but congruent figures are always similar
- 30-60-90 and 45-45-90 are the most common configurations of right triangles
- Using the Pythagorean Theorem one can prove shortcuts to find exact lengths of sides for special right triangles
- Sine and cosine of complementary angles are congruent

Students will be able to do the following:

- Use SOHCAHTOA to find a missing side or a missing angle in a right triangle
- Use special right triangles to find the exact value of a side in a right triangle
- Apply similarity to find the length of real-world objects like the height of an outdoor flagpole
- Prove similarity in triangles with the AA similarity criterion
- Identify three natural locations where the Golden Ratio appears
- Apply the Pythagorean Theorem and its converse to triangles
- Apply the sine, cosine, and tangent ratios to real-world application problems
- Classify and solve problems involving angles of elevation and depression

Character Attributes

- Cooperation
- Integrity
- Perseverance
- Respect
- Responsibility

Technology Competencies

- Students show graphic representation of data.
- Use graphing applications, students show the relationships among numbers in several ways.
- Students use software for problem solving and for illustration of thoughts and ideas (Geometer's Sketchpad).
- Students independently use appropriate technology tools to define problems and to propose hypothesis.

Develop Teaching and Learning Plan

Suggested Teaching Strategies:

- Teacher guides students in application of similar figures and ratios.
- Teacher leads students in a discussion of estimation of side lengths leading to a discovery lesson.
- Teacher introduces students to the acronym SOHCAHTOA and how to use it to set up proportions for right triangles.

- Teacher leads students in the derivation of special right triangle proportions from the Pythagorean Theorem.

Suggested Learning Activities:

- Students will use discovery to identify the sine, cosine, and tangent ratios.
- Students will complete a hands-on activity to determine the height of the flagpole outside the school.
- Students will use a map to estimate distance using ratio and proportion.
- Students will solve application problems for right triangles using Pythagorean Theorem, SOHCAHTOA, and special right triangles.
- Students will use Geometers Sketchpad to prove the Pythagorean Theorem.
- Students will verify the lengths of sides in a special right triangle by using the decimal approximation.
- Students will discover the converse of the Pythagorean Theorem by categorizing examples.
- Students will apply trigonometry to real-world problems involving angles and sides in right triangles.

Assessments

Performance Task Authentic application to evaluate student achievement of desired results designed according to GRASPS (one per marking period)	**Other Evidence** Application that is functional in a classroom context to evaluate student achievement of desired results
Goal: Calculate the height of the flagpole outside the high school. **Role**: Engineer **Audience**: Board of Education **Situation**: The Board of Education would like to purchase a new flagpole and would like to know the height of the current flagpole. **Product**: Work shown with diagram and written summary about which size pole to purchase **Standard for Success**: CAPT rubric	• Monitoring class work through board work, group work, questioning, and walk-arounds • Quizzes • Test (approximately 20 regular answer, three explanation)

Suggested Resources

- Textbook: Bass, Laurie. *Geometry.* 1st ed. Upper Saddle River, NJ: Prentice Hall, 2007. Print.
- Geometers Sketchpad. Ver 4.05. Key Curriculum Press. Software.
- Bennett, Dan. Exploring Geometry with Geometers Sketchpad. Key Curriculum Press. 2005.

New Milford Public Schools

Committee Member: Ryan Fitzsimmons Unit 5: Area, Surface Area, and Volume	Course/Subject: Geometry Academic Grade Level: 10 # of Days: 15

Identify Desired Results

Common Core Standards

- G-GMD.1. Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone.
- G-GMD.3. Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.
- G-GMD.4. Identify the shapes of two-dimensional, cross-sections of three-dimensional objects and identify three-dimensional objects generated by rotations of two-dimensional objects.
- G-MG.1. Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
- G-MG.2. Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).
- G-MG.3. Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).

Enduring Understandings Generalizations of desired understanding via essential questions (Students will understand that …)	**Essential Questions** Inquiry used to explore generalizations
• Surface area uses square units. • Volume uses cubic units. • The base must be identified to classify solids. • Lowercase “b” refers to base height, whereas uppercase “B” refers to the height of the solid. • The units which are reported in an answer are critical to the accuracy of an answer. • Many careers utilize scales and design with measurement, area, and volume.	• How does one identify a solid? • What is the base or height of a solid? • When does one use surface area and when does one use volume? • How can one derive the formulas for volume from the area formulas?

Expected Performances
What students should know and be able to do

Students will know the following:

- Vocabulary: triangle, height, base, apothem, slant height, lateral area, surface area, volume, face, vertex, side
- Formulas for area of two-dimensional figures
- The relationship between volume of pyramids and prisms as well as cylinders and cones

Students will be able to do the following:

- Apply the formulas for surface area and volume of prisms, pyramids, cylinders, spheres
- Apply the formulas for area of two-dimensional figures: quadrilaterals, triangles, etc.
- Transform an expression in one unit into another (i.e., feet per second to yards per hour).

Character Attributes

- Cooperation
- Integrity
- Perseverance
- Respect
- Responsibility

Technology Competencies

- Students show graphic representation of data.
- Use graphing applications, students show the relationships among numbers in several ways.
- Students use software for problem solving and for illustration of thoughts and ideas (Geometer's Sketchpad).
- Students independently use appropriate technology tools to define problems and to propose hypothesis.

Develop Teaching and Learning Plan

Suggested Teaching Strategies:

- Teacher guides students through a demonstration of the volume of pyramids and cones as they relate to prisms and cylinders.
- Teacher guides students through the derivation of area formulas.
- Teacher brainstorms with students how to determine if a problem is asking for area, surface area, or volume.
- Teacher has students work in groups to create and solve their own application problems for surface area and volume.

Suggested Learning Activities:

- Students will practice measuring skills by calculating the surface area and volume for a wide range of three-dimensional solids. This will be in a laboratory format.
- Students will apply area formulas to solve both single and compound areas. The compound area problems will appear in a real-world application type format.
- Students will compare homework answers to check each other's work and justify their answers.
- Students will explore various occupations that use these formulas and perform some of the calculations.
- Students will use Geometers Sketchpad to prove the formulas for area of parallelograms and triangles.

Assessments

Performance Task Authentic application to evaluate student achievement of desired results designed according to GRASPS (one per marking period)	**Other Evidence** Application that is functional in a classroom context to evaluate student achievement of desired results
Goal: Find the surface area of various solids **Role**: Manufacturing company **Audience**: Client **Situation**: Manufacturer must calculate the surface area of various three-dimensional objects for packaging purposes. **Product**: Calculations and conclusion about which solid to choose (many justifiable answers) **Standard for Success**: CAPT rubric	• Monitoring class work through board work, group work, questioning, and walk-arounds • Quizzes • Test (approximately 25-40 regular answer, approximately five graphs, 20-25 short answer)

Suggested Resources

- Textbook: Bass, Laurie. *Geometry.* 1st ed. Upper Saddle River, NJ: Prentice Hall, 2007. Print.
- Geometers Sketchpad. Ver 4.05. Key Curriculum Press. Software.
- Bennett, Dan. Exploring Geometry with Geometers Sketchpad. Key Curriculum Press. 2005.

New Milford Public Schools

Committee Member: Ryan Fitzsimmons Unit 6: Circles	Course/Subject: Geometry Academic Grade Level: 10 # of Days: 10 (as time permits)

Identify Desired Results

Common Core Standards

- G-C.1. Prove that all circles are similar.
- G-C.2. Identify and describe relationships among inscribed angles, radii, and chords. Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.
- G-C.3. Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.
- G-C.4. (+) Construct a tangent line from a point outside a given circle to the circle.
- G-C.5. Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector.
- G-GPE.1. Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.
- G-CO.13. Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.

Enduring Understandings Generalizations of desired understanding via essential questions (Students will understand that …)	**Essential Questions** Inquiry used to explore generalizations
• A circle is the set of all points equidistant from the center. • Arcs and angles are closely related, but the notation is different. • The area of a sector is a fractional piece of the area of the entire circle. • Central angles and inscribed angles will have different sized arcs. • Arc length is a fractional piece of the circumference.	• How does one use the equation of a circle? • What are the key terms for a circle? • How are arc measure and angle measure related? • How does one measure arc length? • How does the Pythagorean Theorem relate to a unit circle?

Expected Performances
What students should know and be able to do

Students will know the following:

- Vocabulary: circle, radius, diameter, chord, arc, sector, angle, intercepted arc, inscribed angle, central angle, tangent, secant
- Inscribed angle measures are half the measure of the arc
- Central angle measures are equal to the measure of the arc

Students will be able to do the following:

- Calculate measure of an arc
- Calculate measure of an interior angle
- Calculate measure of an inscribed angle
- Calculate an arc length
- Calculate the area of a sector
- Apply calculations to real-world problems

Character Attributes

- Cooperation
- Integrity
- Perseverance
- Respect
- Responsibility

Technology Competencies

- Students show graphic representation of data.
- Use graphing applications, students show the relationships among numbers in several ways.
- Students use software for problem solving and for illustration of thoughts and ideas (Geometer's Sketchpad).
- Students independently use appropriate technology tools to define problems and to propose hypothesis.

Develop Teaching and Learning Plan

Suggested Teaching Strategies:

- Teacher guides students in the definition of key terms.
- Teacher describes how tangents, secants, and line segments are related to circles.
- Teacher confirms with students the measure of angles using a protractor.
- Teacher describes the various situations where segments are divided on tangents and secants.

Suggested Learning Activities:

- Students will explore the measure of arc and angles using an activity to measure angles.
- Students will complete a hands-on activity to measure the lines, sectors, and angles involved in track and field.

- Students will use Geometers Sketchpad to discover properties of circles involving tangents, chords, arcs, and angles.
- Students will identify the relationship between central and inscribed angles.

Assessments

Performance Task Authentic application to evaluate student achievement of desired results designed according to GRASPS (one per marking period)	**Other Evidence** Application that is functional in a classroom context to evaluate student achievement of desired results
(if time permits) **Goal**: To create a playground blueprint **Role**: Surveyor **Audience**: Manager of a development company **Situation**: Given various situations, use the Laws of Sines and Cosines to calculate values that are otherwise non-measurable (e.g., calculate the distance between two landmarks that have a lake between them). **Product**: Calculated distances with solutions shown **Standard for Success**: CAPT rubric	• Monitoring class work through board work, group work, questioning, and walk-arounds • Quizzes • Test (approximately five regular answers, one explanation, and three application problems)

Suggested Resources

- Textbook: Bass, Laurie. *Geometry.* 1st ed. Upper Saddle River, NJ: Prentice Hall, 2007. Print.
- Geometers Sketchpad. Ver 4.05. Key Curriculum Press. Software.
- Bennett, Dan. Exploring Geometry with Geometers Sketchpad. Key Curriculum Press. 2005.

Third Generation CAPT Scoring Rubric

Score 3
The student has demonstrated a **full and complete** understanding of all concepts and processes essential to this application. The student has addressed the task in a mathematically sound manner. The response contains evidence of the student's competence in problem-solving and reasoning, computing and estimating, and communicating to the full extent that these processes apply to the specified task. The response may, however, contain minor arithmetic errors that do not detract from a demonstration of full understanding. Student work is shown or an explanation is included.

Score 2
The student has demonstrated a **reasonable** understanding of the essential mathematical concepts and processes in this application. The student's response contains most of the attributes of an appropriate response including a mathematically sound approach and evidence of competence with applicable mathematical processes, but contains flaws that do not diminish the evidence that the student comprehends the essential mathematical ideas addressed in the task. Such flaws include errors attributed to faulty reading, writing, or drawing skills; errors attributed to insufficient, non-mathematical knowledge; and errors attributed to careless execution of mathematical processes or algorithms.

Score 1
The student has demonstrated a **partial** understanding of some of the concepts and processes in this application. The student's response contains some of the attributes of an appropriate response, but lacks convincing evidence that the student fully comprehends the essential mathematical ideas addressed by this task. Such deficits include evidence of insufficient mathematical knowledge; errors in fundamental mathematical procedures; and other omissions or irregularities that bring into question the extent of the student's ability to solve problems of this general type.

Score 0
The student has demonstrated **merely an acquaintance** with the topic. The student's response is associated with the task in the item but contains few attributes of an appropriate response. There are significant omissions or irregularities that indicate a lack of comprehension in regard to the mathematical ideas and procedures necessary to adequately address the specified task. No evidence is present to suggest that the student has the ability to solve problems of this general type.

NMHS Mathematics Department Rubric for Open-Ended Questions

Item	Insufficient	Fair	Proficient	Exemplary
Understand Mathematical Concepts and Practices	There are significant omissions or anomalies that indicate a basic lack of comprehension in regard to the mathematical ideas necessary to adequately address the specified task.	The answer contains some of the attributes of an appropriate response. There is some evidence that the student comprehends the essential mathematical ideas addressed by the problem.	There is a mathematically sound approach. There is significant evidence of understanding and errors that may be present, but do not affect comprehension.	The selected strategy is based on sound conceptual understanding and is successfully implemented.
	Information is either inaccurate or irrelevant.	Some of the relevant information is used.	Most of the relevant information is used.	All of the relevant information is used.
	Math terminology is incorrect.	Most math terminology is used correctly.	Math terminology is used correctly.	Math terminology is used correctly and precisely.
	Unable to recognize patterns and relationships.	Recognizes some patterns and relationships	Recognizes important patterns in relationships.	Creates a general rule or formula that describes the patterns or relationships.
Use of Computations and Procedures	Errors in computation are serious enough to flaw solution.	There is evidence of rationality and purpose in the computation although there may be some computational errors. Inefficient choice of procedures impeded success but did not prevent finding a reasonable solution.	Computations were essentially accurate but may contain a minor calculation error that does not alter the accuracy of the answer.	All aspects of the solution are completely accurate. May use multiple ways to compute answer.
Communicates Mathematical Thinking and Reasoning	There is no evidence of how the solution was found.	Evidence for the solution is present but may be inconsistent or unclear.	Work clearly supports the solution.	Work clearly supports a thoughtful solution and a rationale is provided that includes criteria (i.e., efficiency, creativity) for the final choice that was made.
	Explanation is either not present or unsound	Explanation may be vague but is understandable.	There is a clear explanation of the work.	Explanation is clear, concise, and logical.
	Mathematical representations did not help clarify thinking.	Mathematical representations are somewhat helpful in clarifying thinking.	Mathematical representations helped clarify the solution.	Mathematical representations clarified the solution and were thorough and complete.