NEW MILFORD PUBLIC SCHOOLS
New Milford, Connecticut

Practical Math – Applications of Measurement
June 2016

Approved by BOE November 2016

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.

Practical Math: Applications of Measurement Overview

This is a one-semester course designed to give students exposure to real-world applications of measurement and measurement systems. Because this is a course in practical math; standards will focus on the <u>Standards for Mathematical Practice</u> and assessments will often be practical in nature

From the Program of Studies: The goal of this course is to provide a review of foundational skills and concepts related to measurement, including indirect measurement, before exploring how the concept is used in a variety of fields. Skills to be reviewed will include but are not limited to measuring using rulers, protractors, and other devices; arithmetic, including with fractions and decimals; solving equations; using formulas to find area, volume. Applications that will be discussed include but are not limited to surveying and construction, how indirect measurement can be used to measure items that are very large (ex. height of the flag pole), and how math is used in the culinary field.

Pacing Guide

Unit Title	# of Weeks
Measurement and Measurement Systems	4 Weeks
Units of Measure (Standard and Non-Standard)	5 Weeks
Applications of Direct Measurement	4 Weeks
Applications of Indirect Measurement	5 Weeks
Review and Exams	2 Weeks

Committee Member(s): Ryan Fitzsimmons Unit Title: Measurement and Measurement Systems	Course/Subject: Practical Math: Applications of Measurement Grade Level: 11-12 # of Weeks: 4
Identify Desired Results	
Common Core Standards	

- CCSS.Math.Practice.MP1 Make sense of problems and persevere in solving them.
- CCSS.Math.Practice.MP2 Reason abstractly and quantitatively.
- CCSS.Math.Practice.MP3 Construct viable arguments and critique the reasoning of others.
- CCSS.Math.Practice.MP4 Model with mathematics.
- CCSS.Math.Practice.MP5 Use appropriate tools strategically.
- CCSS.Math.Practice.MP6 Attend to precision.
- CCSS.Math.Practice.MP7 Look for and make use of structure.
- CCSS.Math.Practice.MP8 Look for and express regularity in repeated reasoning.
- CCSS.Math.Content.5.MD.A.1
  Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems.
- CCSS.Math.Content.5.MD.B.2
  Make a line plot to display a data set of measurements in fractions of a unit (1/2, 1/4, 1/8). Use operations on fractions for this grade to solve problems involving information presented in line plots.
- CCSS.Math.Content.4.MD.A.1
  Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit.

Enduring Understandings Generalizations of desired understanding via essential questions (Students will understand that …)	**Essential Questions** Inquiry used to explore generalizations
- Measurement is important for communication - Measurement transcends cultures - Different Measurement Systems use different units	- How do we measure? - Are there different ways to measure the same quantity? - Is there a better measurement system?

Expected Performances
What students should know and be able to do

Students will know the following:
- Units of measure from various systems
- Which units are used to measure certain quantities

Students will be able to do the following:
- Apply the correct unit to a situation
- Measure a quantity correctly
- Demonstrate proficiency with a ruler

Character Attributes

- Respect
- Responsibility
- Honesty
- Compassion
- Perseverance
- Citizenship
- Integrity
- Loyalty
- Courage
- Cooperation

Technology Competencies

- Ability to use a ruler in both customary and metric units of measure
- Ability to use a protractor to measure angles

Develop Teaching and Learning Plan

Teaching Strategies:
- Teacher will guide students to measure using both a ruler and a protractor
- Teacher will lead a discussion on the differences between the customary and metric systems of measurement

Learning Activities:
- Students will compare and contrast the units of measure in various systems
- Students will demonstrate precision when measuring with tools
- Students will be able to group units by system and convert units

Assessments	
Performance Task(s) 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: Create a Measurement System Role: Designer Audience: Co-Workers Situation: Create a system of measure to communicate units of measure Product or Performance: description of system Standards for Success: Communication Rubric for NMHS	• Practical Quiz on Ruler Reading • Quiz on Units of Measure • Research Paper on Units of Measure

Suggested Resources
• https://www.usa.gov/federal-agencies/weights-and-measures-division • Supplemental Worksheets • Supplemental Activities from http://www.yummymath.com

Committee Member(s): Ryan Fitzsimmons Unit Title: Units of Measure (Standard and Non-Standard)	Course/Subject: Practical Math: Applications of Measurement Grade Level: 11-12 # of Weeks: 5

Identify Desired Results
Common Core Standards

- CCSS.Math.Practice.MP1 Make sense of problems and persevere in solving them.
- CCSS.Math.Practice.MP2 Reason abstractly and quantitatively.
- CCSS.Math.Practice.MP3 Construct viable arguments and critique the reasoning of others.
- CCSS.Math.Practice.MP4 Model with mathematics.
- CCSS.Math.Practice.MP5 Use appropriate tools strategically.
- CCSS.Math.Practice.MP6 Attend to precision.
- CCSS.Math.Practice.MP7 Look for and make use of structure.
- CCSS.Math.Practice.MP8 Look for and express regularity in repeated reasoning.

- CCSS.Math.Content.5.MD.A.1
  Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems.
- CCSS.Math.Content.5.MD.B.2
  Make a line plot to display a data set of measurements in fractions of a unit (1/2, 1/4, 1/8). Use operations on fractions for this grade to solve problems involving information presented in line plots.
- CCSS.Math.Content.4.MD.A.2
  Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale.
- CCSS.Math.Content.4.MD.A.1
  Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit.

Enduring Understandings Generalizations of desired understanding via essential questions (Students will understand that …)	Essential Questions Inquiry used to explore generalizations
• Anything can be a unit of measure with proper communication and standards • Standards exist for units of measure • We choose to use the most popular systems of measure for industry and proper communication	• Can my arm length be a unit of measure? • What units are used to measure various properties? • How do we know a pound is a pound?

Expected Performances
What students should know and be able to do

Students will know the following:
- Various units of measure in the customary and metric systems

Students will be able to do the following:
- Convert between two different units of measure
- Describe the similarities and differences between two measurement systems

Character Attributes

- Respect
- Responsibility
- Honesty
- Compassion
- Perseverance
- Citizenship
- Integrity
- Loyalty
- Courage
- Cooperation

Technology Competencies

- Ability to use a ruler in both customary and metric units of measure
- Ability to use a protractor to measure angles
- Use a calculator, when appropriate

Develop Teaching and Learning Plan

Teaching Strategies:	Learning Activities:
• Teacher will lead a discussion between the various systems of measure • Teacher will provide guidance in research about various systems	• Students will research various systems of measurement • Students will compare and contrast measuring between systems • Students will identify challenges when converting between systems

Assessments	
Performance Task(s) 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: Present measurement in a historical context Role: Researcher Audience: Peer (Student) Situation: Present a fellow student with information about a measurement system. Product or Performance: Research paper on the customary and metric systems, highlighting the challenges of the 1970's and the failure of the U.S. to switch to the metric system. Standards for Success: Assessment specific rubric	• Quiz on various units of measurement • Practical Quiz working with the various units of measure

Suggested Resources
• https://www.usa.gov/federal-agencies/weights-and-measures-division • http://time.com/3633514/why-wont-america-go-metric/ • http://www.cnbc.com/2015/06/04/why-the-us-hasnt-fully-adopted-the-metric-system.html • Supplemental Worksheets • Supplemental Activities from http://www.yummymath.com

Committee Member(s): Ryan Fitzsimmons Unit Title: Applications of Direct Measurement	Course/Subject: Practical Math: Applications of Measurement Grade Level: 11-12 # of Weeks: 4

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- CCSS.Math.Practice.MP1 Make sense of problems and persevere in solving them.
- CCSS.Math.Practice.MP2 Reason abstractly and quantitatively.
- CCSS.Math.Practice.MP3 Construct viable arguments and critique the reasoning of others.
- CCSS.Math.Practice.MP4 Model with mathematics.
- CCSS.Math.Practice.MP5 Use appropriate tools strategically.
- CCSS.Math.Practice.MP6 Attend to precision.
- CCSS.Math.Practice.MP7 Look for and make use of structure.
- CCSS.Math.Practice.MP8 Look for and express regularity in repeated reasoning.

- CCSS.Math.Content.5.MD.A.1
  Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems.
- CCSS.Math.Content.5.MD.B.2
  Make a line plot to display a data set of measurements in fractions of a unit (1/2, 1/4, 1/8). Use operations on fractions for this grade to solve problems involving information presented in line plots.
- CCSS.Math.Content.4.MD.C.5.a
  An angle is measured with reference to a circle with its center at the common endpoint of the rays, by considering the fraction of the circular arc between the points where the two rays intersect the circle. An angle that turns through 1/360 of a circle is called a "one-degree angle," and can be used to measure angles.
- CCSS.Math.Content.4.MD.C.6
  Measure angles in whole-number degrees using a protractor. Sketch angles of specified measure.
- CCSS.Math.Content.4.MD.A.2
  Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale.

Enduring Understandings Generalizations of desired understanding via essential questions (Students will understand that …)	Essential Questions Inquiry used to explore generalizations
• Area measures units in two dimensions • Surface Area measures two dimensional area on a three-dimensional surface • Volume measures the amount of space something occupies in three dimensions	• How do I measure area of room to carpet/tile/etc? • How do I find the surface area of this house to paint? • What is the volume of asphalt I need for this driveway?

Expected Performances
What students should know and be able to do

Students will know the following:
- Area and Surface Area are two dimensional measurements
- Volume is a three-dimensional measurement

Students will be able to do the following:
- Calculate the Area and Surface Area of a figure
- Calculate the Volume of a figure
- Correctly choose between Surface Area and Volume based on a specific application

Character Attributes

- Respect
- Responsibility
- Honesty
- Compassion
- Perseverance
- Citizenship
- Integrity
- Loyalty
- Courage
- Cooperation

Technology Competencies

- Ability to use a ruler in both customary and metric units of measure
- Ability to use a protractor to measure angles
- Use a calculator, when appropriate

Develop Teaching and Learning Plan	
Teaching Strategies: • Lead students through a discussion of surface area vs. volume applications • Compare and contrast various methods of measurement • Lead students through the measurement of surface Area and Volume Measurement Lab	Learning Activities: • Students will classify a specific situation as Area, Surface Area or Volume • Students will take large direct measurements in the school • Students will take direct measurements for surface area and volume in a lab activity

Assessments	
Performance Task(s) 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: Take correct measurements of surface area and volume Role: Scientist Audience: Employer Situation: You must take correct measurements of surface area and volume on a variety of three-dimensional objects Product or Performance: A completed Lab Report Standards for Success: Assessment specific rubric	• Group Measurement Activity in School • Classification quiz • Quiz on basic area calculations

Suggested Resources
• https://www.usa.gov/federal-agencies/weights-and-measures-division • Supplemental Worksheets • Supplemental Activities from http://www.yummymath.com

Committee Member(s): Ryan Fitzsimmons Unit Title: Applications of Indirect Measurement	Course/Subject: Practical Math: Applications of Measurement Grade Level: 11-12 # of Weeks: 5

Identify Desired Results
Common Core Standards

- CCSS.Math.Practice.MP1 Make sense of problems and persevere in solving them.
- CCSS.Math.Practice.MP2 Reason abstractly and quantitatively.
- CCSS.Math.Practice.MP3 Construct viable arguments and critique the reasoning of others.
- CCSS.Math.Practice.MP4 Model with mathematics.
- CCSS.Math.Practice.MP5 Use appropriate tools strategically.
- CCSS.Math.Practice.MP6 Attend to precision.
- CCSS.Math.Practice.MP7 Look for and make use of structure.
- CCSS.Math.Practice.MP8 Look for and express regularity in repeated reasoning.

- CCSS.Math.Content.5.MD.A.1
  Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems.
- CCSS.Math.Content.5.MD.B.2
  Make a line plot to display a data set of measurements in fractions of a unit (1/2, 1/4, 1/8). Use operations on fractions for this grade to solve problems involving information presented in line plots.

Enduring Understandings Generalizations of desired understanding via essential questions (Students will understand that …)	**Essential Questions** Inquiry used to explore generalizations
- There are methods for taking large measurements if they cannot be taken directly - Angles and proportions can help us to take measurements - Methods can be used to mark large areas like sports fields	- How do I estimate a large distance? - Is there a method to take measurements if I cannot use a tool directly? - How accurate are indirect measurements? - How could I make taking large measurements easier?

Expected Performances What students should know and be able to do

Students will know the following:
- Proportions and angles are used to take various indirect measurements
- Alternate Methods can be used to mark large areas like sports fields

Students will be able to do the following:
- Take indirect measurements across large spans and of objects which are

elevated.
- Understand the processes used in marking sports fields

Character Attributes

- Respect
- Responsibility
- Honesty
- Compassion
- Perseverance
- Citizenship
- Integrity
- Loyalty
- Courage
- Cooperation

Technology Competencies

- Ability to use a ruler in both customary and metric units of measure
- Ability to use a protractor to measure angles
- Use a calculator, when appropriate

Develop Teaching and Learning Plan

Teaching Strategies:	Learning Activities:
- Guide students in the creation of proportions which help to measure the height of the flagpole - Lead a discussion where students brainstorm how a sports field and its markings are constructed - Apply estimation skills to indirect measurement around the NMHS campus.	- Measure the height of the flagpole indirectly - Estimate and measure various other objects on campus indirectly - Take various large sports field measurements

Assessments	
Performance Task(s) 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: Determine height of flagpole Role: Concerned Student Audience: Mr. Shugrue and the BOE Situation: As a student, you are concerned that the flagpole has become unsafe and we should order a new one. You must justify your calculations for the height of the pole that should be ordered. Product or Performance: Mathematical findings, proposal and invoice Standards for Success: Correct height within two feet using two different methods	- Activity on sports field markings - Various measurements inside of NMHS - Accurate estimations for height
Suggested Resources	

- https://www.usa.gov/federal-agencies/weights-and-measures-division
- Supplemental Worksheets
- Supplemental Activities from http://www.yummymath.com

Committee Member(s): Ryan Fitzsimmons Unit Title: Course Review and Exam	Course/Subject: Practical Math: Applications of Measurement Grade Level: 11-12 # of Weeks: 2

Identify Desired Results
Common Core Standards

- CCSS.Math.Practice.MP1 Make sense of problems and persevere in solving them.
- CCSS.Math.Practice.MP2 Reason abstractly and quantitatively.
- CCSS.Math.Practice.MP3 Construct viable arguments and critique the reasoning of others.
- CCSS.Math.Practice.MP4 Model with mathematics.
- CCSS.Math.Practice.MP5 Use appropriate tools strategically.
- CCSS.Math.Practice.MP6 Attend to precision.
- CCSS.Math.Practice.MP7 Look for and make use of structure.
- CCSS.Math.Practice.MP8 Look for and express regularity in repeated reasoning.

- CCSS.Math.Content.5.MD.A.1
  Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems.
- CCSS.Math.Content.5.MD.B.2
  Make a line plot to display a data set of measurements in fractions of a unit (1/2, 1/4, 1/8). Use operations on fractions for this grade to solve problems involving information presented in line plots.
- CCSS.Math.Content.4.MD.C.5.a
  An angle is measured with reference to a circle with its center at the common endpoint of the rays, by considering the fraction of the circular arc between the points where the two rays intersect the circle. An angle that turns through 1/360 of a circle is called a "one-degree angle," and can be used to measure angles.
- CCSS.Math.Content.4.MD.C.6
  Measure angles in whole-number degrees using a protractor. Sketch angles of specified measure.
- CCSS.Math.Content.4.MD.A.2
  Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale.
- CCSS.Math.Content.4.MD.A.1
  Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit.

Enduring Understandings Generalizations of desired understanding via essential questions (Students will understand that …)	Essential Questions Inquiry used to explore generalizations
• There are systems of measure • Systems of measure provide standards of communication • Measurement can be taken directly or indirectly	• How do we measure? • Why do we measure? • How do we measure directly? • How do we measure indirectly?

Expected Performances
What students should know and be able to do

Students will know the following:
- Measurement is divided into systems and units
- Measurement can be direct or indirect

Students will be able to do the following:
- Measure length, width, time, area, surface area, volume, etc.
- Measure indirectly items like the height of the flagpole.

Character Attributes

- Respect
- Responsibility
- Honesty
- Compassion
- Perseverance
- Citizenship
- Integrity
- Loyalty
- Courage
- Cooperation

Technology Competencies

- Ability to use a ruler in both customary and metric units of measure
- Ability to use a protractor to measure angles
- Use a calculator, when appropriate

Develop Teaching and Learning Plan

Teaching Strategies:	Learning Activities:
• Teacher will guide students through a review of core concepts for this course	• Students will actively review concepts • Students will complete a practical final exam for this course.

Assessments	
Performance Task(s) 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: Demonstrate ability to measure both directly and indirectly Role: Student Audience: Teacher Situation: You must complete a portfolio of work which demonstrates ability as well as a lab practical for this course Product or Performance: Portfolio and a Practical Lab Standards for Success: Assessment specific rubric	• Check-in review of portfolio • Practical assessment of measurement skills

Suggested Resources
• https://www.usa.gov/federal-agencies/weights-and-measures-division • Supplemental Worksheets • Supplemental Activities from http://www.yummymath.com