SFUSD Math Core Curriculum
Grade 4

# Unit 4.7: Measurement

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## Big Idea

Measurement is a comparison of identified attributes, such as length to length or weight to weight, using predetermined units. Measurement units can be decomposed into smaller units and used interchangeably.

## Unit Objectives

- Students use conversion tables for measurement units in length, weight, liquid volume and time in both metric and U.S. customary units.
- Students write and apply conversion rules for various measurement systems.
- Students apply concepts and formulas for area and perimeter to solve problems.
- Students understand what an angle is and they measure angles with protractors.
- Students solve problems using angle measurements.
- Students use addition or subtraction to find unknown angle measures

## Unit Description

This unit is divided into three parts. The first part focuses on measurement units for length (metric and U.S. customary), weight (metric and U.S. customary), liquid volume (U.S. customary), and time. Students use conversion tables to express larger units in terms of smaller ones. They fill out conversion tables and determine the conversion rules. They apply these rules to word problems. Each day students are introduced to new measurement systems, but the unifying concept is that larger units of measure are made up of smaller units of measure.

> **NOTE:** While students are not expected to memorize the less common conversion rates, they are expected to familiarize themselves with various conversion rates for length and weight.

The second part of this unit focuses on applying an understanding of area and perimeter of rectangles to solving multi-step problems that include the measurement units learned in this unit.

The third part of this unit focuses on angle measurement. Angles are defined as rotations of one ray away from another along an axis.

Angle measures are additive. That means when two angles share a common ray and the angle measure of both angles is known, you can add the measures of each angle to find the measure of the combined

angle. Similarly, if two angles share a common ray and the combined angle measure and the measure of one angle are known, you can subtract to find the measure of the unknown angle. Students learn the definitions of *obtuse, acute,* and *right angles* as well as how to measure angles using a protractor. They will apply this knowledge in the analysis of polygons in the next unit of study.

## CCSS-M Content Standards

### Measurement and Data

**Solve problems involving measurement and conversion of measurements.**

4.MD.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. Record measurement equivalents in a two-column table. *For example, know that 1 ft is 12 times as long as 1 in. Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), (3, 36),*

4.MD.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.

4.MD.3 Apply the area and perimeter formulas for rectangles in real world and mathematical problems. *For example, find the width of a rectangular room given the area of the flooring and the length, by viewing the area formula as a multiplication equation with an unknown factor*.

**Geometric Measurement: understand concepts of angle and measure angles.**

4.MD.5 Recognize angles as geometric shapes that are formed wherever two rays share a common endpoint, and understand concepts of angle measurement:

4.MD.5a 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.

4.MD.5b An angle that turns through *n* one-degree angles is said to have an angle measure of *n* degrees.

4.MD.6 Measure angles in whole-number degrees using a protractor. Sketch angles of specified measure.

4.MD.7 Recognize angle measure as additive. When an angle is decomposed into non-overlapping parts, the angle measure of the whole is the sum of the angle measures of the parts. Solve addition and subtraction problems to find unknown angles on a diagram in real world and mathematical problems, e.g., by using an equation with a symbol for the unknown angle measure.

### Geometry

**Draw and identify lines and angles, and classify shapes as properties of their lines and angles.**

4.G.1 Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures.

**For additional resources to support students' fluency with measurement, see the folder 4.7 Additional Measurement Fluency Resources.**

| Note |
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| **Note:** CCSS-M Standard **4.MD.2** describes many different measurement systems for distance, time, liquid volume, mass, and money. It is a standard that is found in many of the previous units and as such, many of the problems students have worked on this year use measurement as the context. However, this unit focuses on how any system of measurement has a conversion factor, so that larger units may be expressed in terms of smaller ones, such as 1 foot = 12 inches or 1 hour = 60 minutes. Money is not one of the topics covered in this unit, but it has been the context for many problems in previous units. **customary US liquid volume** is taught in lesson series 1, but metric liquid volume is not. **Metric liquid volume** can be taught in fourth grade in the context of science units by providing students conversion rate tables. |

# Progression of Mathematical Ideas

| Prior Supporting Mathematics | Current Essential Mathematics | Future Mathematics |
| --- | --- | --- |
| In Kindergarten students described measurable attributes such as length and weight. They compared two objects with the same measurable attribute to determine which has more or less of that attribute.<br><br>In Grade 1 students compared three objects according to their length. They learned how to express the length of an object as an iteration of whole number shorter lengths laid end to end.<br><br>They learned to tell time to the hour and half-hour.<br><br>In Grade 2 students were introduced to standard length units. They used appropriate tools such as rulers to measure length. They estimated lengths in inches, feet, centimeters, and meters. They measured an object's length using two *different* unit lengths and described how | In Grade 4 students learn how to convert one larger measurement unit into a greater number of smaller units, for example, converting 1 pound to 16 ounces. When given a conversion rate, they create two-column conversion tables showing larger units of measures in terms of equivalent smaller units and use these tables to solve real-world problems involving intervals of time, liquid volume, weight, length, and area. They apply area and perimeter formulas to real world contexts.<br><br>Students recognize angles as geometric shapes that are formed when one ray rotates away from another about a shared vertex. They learn how to measure angles using protractors. They also learn that angles are additive, meaning that, for example, two angles measuring 15 degrees can be put together to create an angle measuring 30 degrees. | In Grade 5 students will convert one smaller measurement unit into a smaller number of larger units, e.g. converting 1 centimeter into 0.01 meters. They will focus on volume as an attribute of solid figures and use unit cubes to measure volume. They will find the volume of right rectangular prisms (boxes) both concretely and with formulas.<br><br>In Grade 6 students will learn about rates and unit rates, which are measurements of change with two or more things being compared. They will learn to find surface areas of polyhedrons.<br><br>In Grade 7 students will solve problems involving scale drawings based on lengths and areas. They will construct triangles based on specific angle measures. They will learn to find the area and circumference of |

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| the difference in numbers relates to the size of the unit.<br><br>They told time to the nearest 5 minutes.<br><br>In Grade 3 students measured liquid volumes and weight using standard units of grams, kilograms, and liters. They learned the concepts of area and perimeter of rectangles and shapes composed of rectangles.<br><br>They told time to the minute and measured time intervals. | | circles.<br><br>In Grade 8 students will learn about slope as rate of change in the growth of a pattern. They will learn and apply formulas for the volume of cones, cylinders, and spheres. |

## Unit Design


**Entry Task:** *What do you already know?*
**Apprentice Task:** *What sense are you making of what you are learning?*
**Expert Task:** *How can you apply what you have learned so far to a new situation?*
**Milestone Task:** *Did you learn what was expected of you from this unit?*

## Unit Overview (19 Days)

| | Days | Description | Core Math |
|---|---|---|---|
| Entry Task | 1 | **Community Center Yard:** Students apply knowledge of area, perimeter, and conversion of yards to feet to solve a problem about building a small park. | Area is measured in square units, while perimeter is measured in linear units. The area of a rectangle can be calculated by multiplying length by width. In order to find the area in smaller units (feet) you must either convert the original dimensions to feet (1 yard = 3 feet) or |

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| | | | determine how many square feet there are in one square yard (1 sq yd = 9 sq ft because 3 • 3 = 9). |
| **Lesson Series 1** | 5 | Students work with conversion tables for the metric and U.S. customary measurement systems for length and weight, the U.S. customary system for liquid measurement, and the international system for time. | Larger units of measurement can be expressed with smaller units within the same system. The U.S. customary system has many different rules governing the relationships between the smaller units and the larger ones. The metric system, on the other hand, uses magnitudes of 10, similar to our base-10 place value system, to convert larger units into smaller ones. |
| **Apprentice Task** | | **Caitlyn's Track and Field Experience:** Students solve a problem about a student on a track team and the various measurement situations she encounters. Measurement contexts with time, distance, and length are used. | To combine and/or compare measurement units within a system, it is useful to convert them to a common unit that makes the comparison easier. |
| **Lesson Series 2** | 3 | Students apply concepts of area and perimeter to solve problems in real-world and mathematical measurement contexts. They find the area of irregular polygons by decomposing them into smaller rectangles, finding the areas, and recomposing them. They also use a subtractive process, visualizing a rectangular prism around the irregular polygon and subtracting the "extra" part. | Area is the measure of space within a figure. It is expressed in square units. Perimeter is the measure around the edge of a shape. It is expressed in linear units. |
| **Expert Task** | 1 | **Tori's Rectangles:** Students investigate what happens to the area and perimeter of rectangles when the dimensions (length and width) are doubled and tripled. They explore other multiplicative increases toward a generalizable rule. | For a given rectangle, if the length and width are doubled, then the perimeter is also doubled, but the area is quadrupled. If the dimensions are tripled, the perimeter is tripled but the area grows by a factor of 9 (that is, 3 • 3). This occurs because perimeter is a linear measurement, while area is a square measure. |

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| **Lesson Series 3** | 7 | Students learn that an angle is defined as a rotation of one ray away from another and that angles can be measured by a protractor. Students learn that angles can be added and subtracted. | Angles are measured with reference to a circle that is pre-defined as 360°. The rotation of one ray away from another is considered a fraction of a circle. Hence, every degree is 1/360 of a circle. |
| **Milestone Task** | 1 | **Splitting Angles?** Students demonstrate their understanding of the additive nature of angles by constructing a 120° angle with a protractor and dividing it into smaller angles according to specific guidelines. They measure and label right, acute, and obtuse angles.<br><br>For the constructed response portion of the task, students solve problems involving measurement conversion and fill out a two-column conversion table. | Angles can be subdivided into smaller angles. These smaller angles can be chunked together to recreate the original angle. |

# Resources

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| | Student Pages | Blackline Masters | Materials |
|---|---|---|---|
| **Entry Task**<br><br>S = Spanish<br>C = Chinese | Unit 4.7 Family Letter S C<br>Entry Task Community Center Park S C<br>Entry Task From Parking Lot to Park Presentation S C | | |
| **Lesson Series 1** | Converting Linear Measures in Metric S C<br>Converting Yards to Feet to Inches S C<br>Converting Pounds to Ounces and Kilograms to Grams S C<br>Converting Liquid Volumes in US Customary S C<br>Converting Units of Time S C | Linear Metric Chart BLM S C<br>Linear US Customary Chart BLM S C<br>Weight Measurement Customary and Metric Chart BLM S C<br>Liquid Volume Measurement Customary Chart BLM S C<br>Time Measurement Chart BLM S C | Introduction to Measurement Conversion Presentation S C<br><br>Scholastic School Jams video: http://goo.gl/xTNn5m<br>Poster paper<br>Measuring Tape: Metric and Customary<br>Scissors<br>Rulers: Metric and Customary<br>Meter sticks and yard sticks<br>Optional: balance scale or bathroom scale<br>Optional: Collection of liquid measure containers<br>Analog and digital clocks<br>Old calendars and/or images of year-long calendars |
| **Apprentice Task** | | Caitlyn's Track and Field Experience Student S C | Poster Paper<br>Optional: Jump rope |
| **Lesson Series 2** | Comparing Porches S C<br>Calculating the Area of Irregular Polygons S C<br>Mr. Toledo's Chicken Pen S C | Calculating the Area of Irregular Polygons BLM | Poster paper<br>Grid Paper<br>Optional: Picture of a porch<br>Optional: Straightedges, calculators, scissors |

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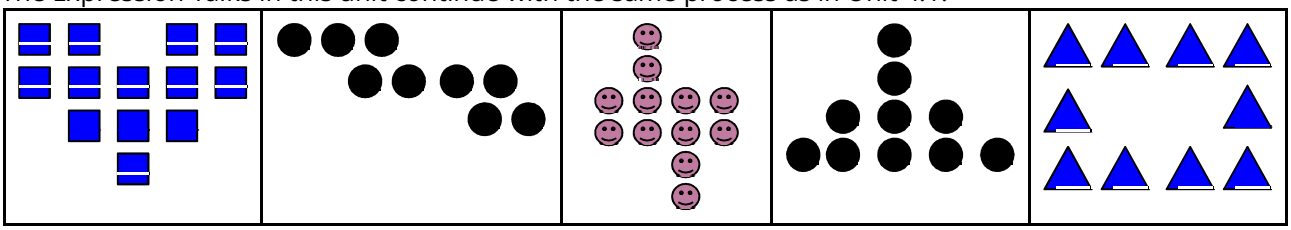
| **Expert Task** | | Expert Task Tori's Rectangles BLM S C | Grid Paper<br>Poster Paper<br>Optional: Scissors and straightedges |
| **Lesson Series 3** | Angle Hunter S C<br>Clock Angles S C<br>Angle Bullseye S C<br>How Many Degrees? S C<br>Angle Blackjack Rules S C | Making a Paper Protractor BLM<br>Clock Face BLM S C<br>Full-Circle Protractor BLM S C<br>Angle Blackjack Cards BLM<br>Re-engagement Day Measurement Teacher<br>Re-engagement Day Angle Bullseye Game BLM S C<br>Re-engagement Day Measuring Spider Web Angles BLM S C<br>Re-engagement Day Fruits and Vegetables BLM S C<br>Re-engagement Day Who Is the Shortest? BLM S C | Strips of paper<br>Paper brads or paperclips<br>Toothpicks<br>Glue<br>Scissors<br>Protractors<br>Rulers<br>Paper Bags<br>Thin straw or dry spaghetti |
| **Milestone Task** | | Milestone Dividing Angles BLM S C<br>Constructed Response BLM S C | Milestone Dividing Angles Suggested Answer Guide<br>Milestone Dividing Angles Rubric<br>Constructed Response Answer Guide<br>Constructed Response Rubric |

# Math Talks Bank

**How could I use this strategy during this unit?** Below are the Math Talks suggested for this unit. These Math Talks are also listed with each lesson. See the Math Teaching Toolkit section on Math Talks for more information. Math Talk Visuals are here. The lessons in this unit include four types of Math Talks:

## Expression Talk

The Expression Talks in this unit continue with the same process as in Unit 4.1.



## Number Talk with Division

The Number Talks with Division in this unit continue with the same process as in Unit 4.2, but with division instead of multiplication.

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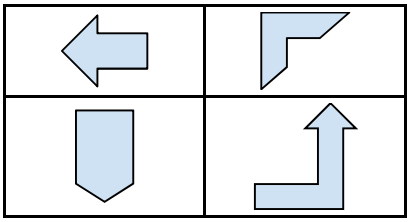
| ***300 ÷ 10*** | ***124 ÷ 4*** | ***140 ÷ 8*** |

## Which One Does Not Belong?

The *Which One Does Not Belong?* Math Talks in this unit continue with the same process as in Unit 4.2.



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| 36 | 54 |
| 4 | 121 |

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| 7 | 2 |
| 5 | 0 |

## Comparison

Comparison Math Talks in this unit continue with the same process as in Unit 4.5

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| *Which is greater?* ***82 ÷ 4*** ***3 × 8*** | *Which is greater?* ***12 × 25*** ***15 × 22*** | *Which is greater?* ***14 × 5*** ***16 × 4*** |
| *Which is greater?* ***90 ÷ 8*** ***120 ÷ 10*** | *Which is less?* ***16 × 5*** ***820 ÷ 10*** | |

# Entry Task

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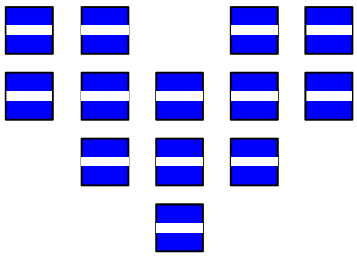
| **Core Math** | Area is measured in square units, while perimeter is measured in linear units. The area of a rectangle can be calculated by multiplying length by width. In order to find the area in smaller units (feet) you must either convert the original dimensions to feet (1 yard = 3 feet) or determine how many square feet there are in one square yard (1 sq yd = 9 sq ft because 3 • 3 = 9). |
| **Description** | Students apply knowledge of area, perimeter, and conversion of yards to feet to solve a problem about building a small park. |
| **CCSS-M Standard(s)** | **Measurement and Data**<br>**Solve problems involving measurement and conversion of measurements.**<br>4.MD.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. Record measurement equivalents in a two-column table. *For example, know that 1 ft is 12 times as long as 1 in. Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), (3, 36).*<br>4.MD.3 Apply the area and perimeter formulas for rectangles in real world and mathematical problems. *For example, find the width of a rectangular room given the area of the flooring and the length, by viewing the area formula as a multiplication equation with an unknown factor*. |
| **Resources and Setup** | Entry Task Community Center Park S C<br>Entry Task From Parking Lot to Park Presentation S C<br>Entry Task Community Center Park Teacher<br>Brief History of Measurement Systems Teacher<br>Math notebooks<br>Optional: Image of a small, rectangular park to explain the context<br>Yard stick and inches ruler |
| **Homework** | Entry Task HW S C |

**Math Talk**

**Expression Talk**



| Lesson Plan | |
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| **LAUNCH**<br><br>**1**<br><br>(5 min) | Project Entry Task From Parking Lot to Park Presentation S C for the students to explain the context of the problem (converting a parking lot into a small park. Subsequent slides explain conversion of yards to feet and linear vs square measurements (to be used as needed)<br><br>Have students work in pairs and remind them to explain their thinking with words, calculations, and diagrams. |
| **EXPLORE**<br><br>**2**<br><br>(40 min) | Circulate as students work on the task. Notice if students understand when yards are being used and when feet are being used. Look for examples of students solving the problem without converting the units (they kept the numbers the same and just calculate from them) and for examples where students used correct conversions. This will be the information for the summary.<br><br>**→Key Math to Observe**<br>● Can students draw and label a model of the park that is described?<br>● Given the conversion rate of 3 feet per yard, do students make accurate conversions?<br>● Do students understand how to calculate area and how to calculate perimeter?<br>● Can students use previous information about how many feet in one yard to determine how many square feet are in one square yard?<br>● Do students make the mistake of assuming that since there are 3 feet in 1 yard, there must be 3 square feet in 1 square yard?<br>● Do students divide to find how many bags of grass seed are needed? |
| **SUMMARIZE**<br><br>**3**<br><br>(15 min) | **→ Core Math to Emphasize**<br>● One yard is equal to three feet.<br>● Measurements in yards can be expressed in terms of feet<br>● Area is the measure of space within a 2D figure. Area is expressed in square units.<br>● Perimeter is the measure around a figure. It is expressed in linear units.<br><br>Decide what type of student work you want to use for a whole class discussion. Questions 3 and 4 deal with area. Question 4 could be solved by multiplying 400 by 9. It is more likely that students will convert the yard measurements to feet and multiply 120 by 30. These two strategies could form an interesting class discussion in comparing and contrasting the strategies.<br><br>Question 7 asks students to compare 8 square feet with one square yard. In order to do this, students need to understand that a square yard has dimensions of 3 ft. by 3 ft., hence an area of 9 square feet. Using student work to discuss this would allow for a discussion of the meaning of area and the effects of converting measurements expressed in larger units (yards) in terms of smaller units (feet). |

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| |  **Notebook Prompt (5 minutes)**<br>One thing I remembered about area and perimeter today was _____. |

| Notes | Universal Support |
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| ● Students may confuse area with perimeter.<br>● Students may not know how to calculate area or perimeter.<br>● Students may not apply the conversion rate of 3 ft/yd to the problem.<br>● Students may not notice or understand the difference between yards in the initial problem and feet for the rest of it. | **Considerations for students with learning differences:**<br>● Read the task out loud and discuss what is being asked.<br><br>**Considerations for EL students:**<br>● The Entry Task From Parking Lot to Park Presentation S C will help students understand the context.<br>● Have students repeat back the instructions to check for understanding.<br>● For students still struggling with precise calculations, allow for the use of calculators.<br>● Practice what is meant by perimeter by having students walk around a small space. |

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| **Extensions** | If the fencing material cost $4.25 per foot, how much would it cost to enclose the whole park? |
| **Additional Note** | In third grade, students recognize area as an attribute of two dimensional shapes. In fourth grade, students are expected to apply the formula for the area of rectangles. This unit does not explicitly teach the concept of area, but rather, applies it to real world and mathematical contexts. Use these problems and student thinking to further develop the concept of area. |

# Lesson Series 1 **Overview**

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## Description

Students work with conversion tables for the metric and U.S. customary measurement systems for length and weight, the U.S. customary system for liquid measurement, and the international system for time. While students are not expected to memorize the less common conversion rates, they are expected to familiarize themselves with various conversion rates for length and weight.

## Standards

### Measurement and Data

**Solve problems involving measurement and conversion of measurements.**

4.MD.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. Record measurement equivalents in a two-column table. *For example, know that 1 ft is 12 times as long as 1 in. Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), (3, 36).*

4.MD.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.

4.MD.3 Apply the area and perimeter formulas for rectangles in real world and mathematical problems. *For example, find the width of a rectangular room given the area of the flooring and the length, by viewing the area formula as a multiplication equation with an unknown factor*.

| | Day 1 | Day 2 |
|---|---|---|
| **Core Math** | Larger units of measurement can be expressed with smaller units within the same system. The U.S. customary system has many different rules governing the relationships between the smaller units and the larger ones. The metric system, on the other hand, uses magnitudes of 10, similar to our base-10 place value system, to convert larger units into smaller ones. | |
| **Description** | Students learn to create two-column conversion tables with length measurements within the metric system. They find rules to convert measurements and apply converted measurements solving real-world problems. | Students learn how to create two-column conversion tables with length measurements in the U.S. customary system. They find rules to convert measurements and apply these to solving real-world problems. |
| **Resources and Setup** | Introduction to Measurement Conversion Presentation S C<br>Scholastic School Jams video<br>http://goo.gl/xTNn5m<br>Converting Linear Measures in Metric S C | Converting Yards to Feet to Inches S C<br>Linear US Customary Chart BLM S C<br>U.S. customary rulers and yardsticks |

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| | Linear Metric Chart BLM S C<br>Metric rulers and meter sticks | |
| **Homework** | Day 1 HW S C | Day 2 HW S C |

| | Day 3 | Day 4 | Day 5 |
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| **Core Math** | Larger units of measurement can be expressed with smaller units within the same system. The U.S. customary system has many different rules governing the relationship between the smaller units and the larger ones. The metric system, on the other hand, uses magnitudes of 10, similar to our base-10 place value system, to convert larger units into smaller ones.<br><br>While units of time can also be converted, it is important to note the conversion rates and the quirkiness of calendar leap years. | | |
| **Description** | Students learn to create two-column conversion tables with weight measurements within the metric and U.S. customary systems. They find rules to convert measurements and apply converted measurements to solving real-world problems. | Students learn how to create two-column conversion tables with liquid volume measurements within the U.S. customary system. They find rules to convert the measurements. They apply these converted measurements to real-world contexts. | Students learn how to create two-column conversion tables with measurements of time from seconds to centuries. They find rules to convert the measurements. They apply these converted measurements to real-world contexts. |
| **Resources and Setup** | Converting Pounds to Ounces and Kilograms to Grams S C<br>Weight Measurement Customary and Metric Chart BLM S C<br>Balance scale or bathroom scale | Converting Liquid Volumes in US Customary S C<br>Liquid Volume Measurement Customary Chart BLM S C<br>Optional: Containers for gallons, quarts, pint, measuring cup. This realia will help students understand the volumes being taught from a hands-on, visual perspective. | |

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