Georgia Standards of Excellence Curriculum Frameworks

Mathematics

GSE Fourth Grade

Unit 7: Measurement

Georgia Department of Education

Richard Woods, Georgia's School Superintendent

"Educating Georgia's Future"

Unit 7: MEASUREMENT

TABLE OF CONTENTS

IF YOU HAVE NOT READ THE FOURTH GRADE CURRICULUM OVERVIEW IN ITS ENTIRETY PRIOR TO USE OF THIS UNIT, PLEASE **STOP** AND CLICK HERE: https://www.georgiastandards.org/Georgia-Standards/Frameworks/4th-Math-Grade-Level-Overview.pdf
Return to the use of this unit once you have completed reading the Curriculum Overview. Thank you!

OVERVIEW

In this unit students will:

- investigate what it means to measure length, weight, liquid volume, time, and angles
- understand how to use standardized tools to measure length, weight, liquid volume, time, and angles
- understand how different units within a system (customary and metric) are related to each other
- know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz; L, ml; hr, min, sec.
- solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals.
- make a line plot to display a data set of measurements in fractions of a unit ($\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$)
- solve problems involving addition and subtraction of fractions by using information presented in line plots
- apply the area and perimeter formulas for rectangles in real world and mathematical problems.
- decompose rectilinear figures into non-overlapping squares and rectangles to find the total area of the rectilinear figure
- recognize angles as geometric shapes that are formed when two rays share a common endpoint, and understand concepts of angle measurement
- measure angles in whole number degrees using a protractor
- recognize angle measurement as additive and 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.

Although the units in this instructional framework emphasize key standards and big ideas at specific times of the year, routine topics such as estimation, mental computation, and basic computation facts should be addressed on an ongoing basis. Ideas related to the eight STANDARDS FOR MATHEMATICAL PRACTICE: make sense of problems and persevere in solving them, reason abstractly and quantitatively, construct viable arguments and critique the reasoning of others, model with mathematics, use appropriate tools strategically, attend to precision, look for and make use of structure, and look for and express regularity in repeated reasoning, should be addressed constantly as well. The first unit should establish these routines, allowing students to gradually enhance their understanding of the concept of number and to develop computational proficiency.

These tasks are not intended to be the sole source of instruction. They are representative of the kinds of experiences students will need in order to master the content, as well as mathematical practices that lead to conceptual understanding. Teachers should NOT do every task in the unit; they should choose the tasks that fit their students' needs. The tasks in these units illustrate the types of learning activities that should be utilized from a variety of sources. For more detailed information about unpacking the content standards, unpacking a task, math routines and rituals, maintenance activities and more, please refer to the Grade Level Overview for Grade 4.

STANDARDS FOR MATHEMATICAL PRACTICE

This section provides examples of learning experiences for this unit that support the development of the proficiencies described in the Standards for Mathematical Practice. These proficiencies correspond to those developed through the Literacy Standards. The statements provided offer a few examples of connections between the Standards for Mathematical Practice and the Content Standards of this unit. The list is not exhaustive and will hopefully prompt further reflection and discussion.

1. **Make sense of problems and persevere in solving them.** Students will solve problems involving measurement and the conversion of measurements from a larger unit to a smaller unit.
2. **Reason abstractly and quantitatively.** Students will recognize angle measure as additive in relation to the reference of a circle.
3. **Construct viable arguments and critique the reasoning of others.** Students construct and critique arguments regarding the relative size of measurement units and relating them to everyday objects.
4. **Model with mathematics.** Students use line plots to display data of measurements in fractions of a unit.
5. **Use appropriate tools strategically.** Students select and use tools such as a ruler, balance, graduated cylinders, angle rulers and protractors to measure.
6. **Attend to precision.** Students will specify units of measure and state the meaning of the symbols they choose.
7. **Look for and make use of structure.** Students use the structure of a two-column table to generate a conversion table for measurement equivalents.
8. **Look for and express regularity in repeated reasoning.** Students notice repetitive actions in computations to make generalizations about conversion of measurements from a larger unit to a smaller unit.

*****Mathematical Practices 1 and 6 should be evident in EVERY lesson*****

STANDARDS FOR MATHEMATICAL CONTENT

Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit.

MGSE4.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.

a. Understand the relationship between gallons, cups, quarts, and pints.
b. Express larger units in terms of smaller units within the same measurement system.
c. Record measurement equivalents in a two-column table.

MGSE4.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.

MGSE4.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.

MGSE4.MD.8 Recognize area as additive. Find areas of rectilinear figures by decomposing them into non-overlapping rectangles and adding the areas of the non-overlapping parts, applying this technique to solve real world problems.

Represent and interpret data.

MGSE4.MD.4 Make a line plot to display a data set of measurements in fractions of a unit ($\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$). Solve problems involving addition and subtraction of fractions with common denominators by using information presented in line plots. *For example, from a line plot, find and interpret the difference in length between the longest and shortest specimens in an insect collection.*

Geometric Measurement - understand concepts of angle and measure angles.
MGSE4.MD.5. Recognize angles as geometric shapes that are formed wherever two rays share a common endpoint, and understand concepts of angle measurement:
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.
b. An angle that turns through *n* one-degree angles is said to have an angle measure of n degrees.

MGSE4.MD.6. Measure angles in whole-number degrees using a protractor. Sketch angles of specified measure.

MGSE4.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 or letter for the unknown angle measure.

BIG IDEAS

- To measure something according to a particular attribute means you compare the object to a unit and determine how many units are needed to have the same amount as the object.
- Measurements are estimates.
- When reporting a measurement, you must always indicate the unit you are using.
- The larger the unit, the smaller the number you obtain as you measure.
- Measurement units within a system of measurement have relative sizes. (km, m, cm; kg, g; lb, oz; L, mL; hr, min, and sec.)
- Finding the area of a rectangle or square can be found using the formula l x w. The area should be expressed using square units.
- Finding the perimeter of a rectangle or square can be found using the formula $2l + 2w$ or $2(l + w)$. The perimeter should be expressed using linear units.
- Rectilinear figures can be decomposed into smaller rectangles and squares. The area of the smaller rectangles and squares can be determined using the formula $a = l \times w$. The areas of the smaller rectangles and squares can be added together to find the total area of the rectilinear figure.
- The measure of an angle does not depend on the lengths of its sides.
- Angle measurement can be thought of as a measure of rotation.
- Data can be measured and represented on line plots in units of whole numbers or fractions.
- Data can be collected and used to solve problems involving addition or subtraction of fractions.
- Appropriate units should be used to measure weight or mass of an object. (ounce, pound, gram, kilogram)
- Finding the exact measure of an angle involves using a protractor.
- It is helpful to think about benchmark references for various weight, mass, length and angle units.
- The sum of the angles in any triangle is 180°.
- Half rotations are equivalent to 180° or a straight angle. Full rotations are 360° or a full circle.
- Measurement data can be displayed using a line plot to display a data set of measurements in fractions of a unit to the nearest $\frac{1}{8}$ of an inch.

ESSENTIAL QUESTIONS *Choose a few questions based on the needs of your students.*

- About how heavy is a kilogram?
- Does liquid volume change when you change the measurement material? Why or why not?
- How are a circle and an angle related?
- How are area and perimeter related?
- How is data collected?
- How are fluid ounces, cups, pints, quarts, and gallons related?
- How are grams and kilograms related?
- How are the angles of a triangle related?
- How are the units used to measure perimeter different from the units used to measure area?
- How are the units used to measure perimeter like the units used to measure area?
- How can I decompose a rectilinear figure to find its area?
- How are units in the same system of measurement related?
- How can angles be combined to create other angles?
- How can we estimate and measure capacity?
- How can we measure angles using wedges of a circle?
- How can we use the relationship of angle measures of a triangle to solve problems?
- How do graphs help explain real-world situations?
- How do we compare customary measures of fluid ounces, cups, pints, quarts, and gallons?
- How do we compare metric measures of milliliters and liters?
- How do we determine the most appropriate graph to use to display the data?
- How do we make a line plot to display a data set?
- How do we measure an angle using a protractor?
- How do we use mass/weight measurement?
- How does a circle help with angle measurement?
- How does a turn relate to an angle?
- How does the area change as the rectangle's dimensions change (with a fixed perimeter)?
- How heavy does one pound feel?
- What are benchmark angles and how can they be useful in estimating angle measures?
- What around us has a mass of about a gram?
- What around us has a mass of about a kilogram?
- What do we actually measure when we measure an angle?
- What does half rotation and full rotation mean?
- What is an angle?
- What unit is the best to use when measuring capacity?
- What unit is the best to use when measuring volume?
- What units are appropriate to measure weight?
- When do we use conversion of units?
- Why are units important in measurement?
- Why do we need a standard unit with which to measure angles?
- Why do we need to be able to convert between capacity units of measurement?

CONCEPTS/SKILLS TO MAINTAIN

It is expected that students will have prior knowledge/experience related to the concepts and skills identified below. It may be necessary to pre-assess in order to determine if time needs to be spent on conceptual activities that help students develop a deeper understanding of these ideas.

- To measure an object with respect to a particular attribute (For example: length, area, capacity, elapsed time, etc.), we may select another object with the same attribute as a unit and determine how many units are needed to 'cover' the object.
- The use of standard units will make it easier for us to communicate with each other.
- When we use larger units, we do not need as many as when we use smaller units. Therefore, the larger unit will result in a smaller number as the measurement.
- Measure and solve problems using hour, minute, second, pounds, ounces, grams, kilograms, milliliters, liters, centimeters, meters, inches (to halves and fourths), feet, ounces, cups, pints, quarts, and gallons.
- Solve problems involving perimeters of polygons and perimeter and area of rectangles.
- Draw a scaled picture graph and bar graph.
- Generate measurement data using length and display data by making a line plot.
- Relate area to multiplication and addition and find the area of a rectangle using whole number side length.

Fluency: Procedural fluency is defined as skill in carrying out procedures flexibly, accurately, efficiently, and appropriately. Fluent problem solving does not necessarily mean solving problems within a certain time limit, though there are reasonable limits on how long computation should take. Fluency is based on a deep understanding of quantity and number.

Deep Understanding: Teachers teach more than simply "how to get the answer" and instead support students' ability to access concepts from a number of perspectives. Therefore, students are able to see math as more than a set of mnemonics or discrete procedures. Students demonstrate deep conceptual understanding of foundational mathematics concepts by applying them to new situations, as well as writing and speaking about their understanding.

Memorization: The rapid recall of arithmetic facts or mathematical procedures. Memorization is often confused with fluency and automaticity. Fluency implies a much richer kind of mathematical knowledge and experience.

Number Sense: Students consider the context of a problem, look at the numbers in a problem, make a decision about which strategy would be most efficient in each particular problem. Number sense is not a deep understanding of a single strategy, but rather the ability to think flexibly between a variety of strategies in context.

Fluent students:

- flexibly use a combination of deep understanding, number sense, and memorization.
- are fluent in the necessary baseline functions in mathematics so that they are able to spend their thinking and processing time unpacking problems and making meaning from them.
- are able to articulate their reasoning.
- find solutions through a number of different paths.

For more about fluency, see: http://www.youcubed.org/wp-content/uploads/2015/03/FluencyWithoutFear-2015.pdf and: https://bhi61nm2cr3mkdgk1dtaov18-wpengine.netdna-ssl.com/wp-content/uploads/nctm-timed-tests.pdf

COMMON MISCONCEPTIONS

4.MD.1 & 2 - Student believe that larger units will give larger measures. Students should be given multiple opportunities to measure the same object with different measuring units. For example, have the students measure the length of a room with one-inch tiles, with one-foot rulers, and with yardsticks. Students should notice that it takes fewer yardsticks to measure the room than the number of rulers of tiles needed.

4.MD.4 - Students use whole-number names when counting fractional parts on a number line. The fraction name should be used instead. For example, if two-fourths is represented on the line plot three times, then there would be six-fourths.

Specific strategies may include:

Create number lines with the same denominator without using the equivalent form of a fraction. For example, on a number line using eighths, use 48 instead of 12. This will help students later when they are adding or subtracting fractions with unlike denominators. When representations have unlike denominators, students ignore the denominators and add the numerators only.

Have students create stories to solve addition or subtraction problems with fractions to use with student created fraction bars/strips.

4.MD.5 - Students are confused as to which number to use when determining the measure of an angle using a protractor because most protractors have a double set of numbers. Students should decide first if the angle appears to be an angle that is less than the measure of a right angle (90°) or greater than the measure of a right angle (90°). If the angle appears to be less than 90°, it is an acute angle and its measure ranges from 0° to 89°. If the angle appears to be an angle that is greater than 90°, it is an obtuse angle and its measures range from 91° to 179°. Ask questions about the appearance of the angle to help students in deciding which number to use.

STRATEGIES FOR TEACHING AND LEARNING

Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit.

In order for students to have a better understanding of the relationships between units, they need to use measuring devices in class. The number of units needs to relate to the size of the unit. They need to discover that there are 12 inches in 1 foot and 3 feet in 1 yard. Allow students to use rulers and yardsticks to discover these relationships among these units of measurements. Using 12-inch rulers and a yardstick, students can see that the set of three of the 12-inch rulers is the same as 3 feet since each ruler is 1 foot in length and is equivalent to one yardstick. Have students record the relationships in a two-column table or t-charts. A similar strategy can be used with centimeter rulers and a meter stick to discover the relationships between centimeters and meters.

Present word problems as a source for developing students' understanding of the relationships among inches, feet, and yards. Students are also 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.

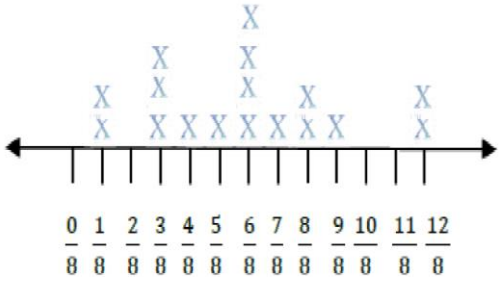
Present problems that involve multiplication of a fraction by a whole number (denominators are 2, 3, 4, 5 6, 8, 10, 12 and 100). Problems involving addition and subtraction of fractions should have the same denominators. Allow students to use strategies learned with these concepts.

Students used models to find area and perimeter in Grade 3. They need to relate discoveries from the use of models to develop an understanding of the area and perimeter formulas to solve real-world and mathematical problems. Students should also use their knowledge of squares and rectangles to decompose rectilinear figures into smaller rectangles and squares. Then, using the formula developed through their work in fourth grade with area, students can find the area of each smaller rectangle or square and find the area of the rectilinear figure by finding the sum of the areas calculated in the smaller rectangles or squares.

Represent and interpret data

Data has been measured and represented on line plots in units of whole numbers, halves, or quarters. Students have also represented fractions on number lines. Now students are using line plots to display measurement data in fraction units and using the data to solve problems involving addition or subtraction of fractions.

Have students create line plots with fractions of a unit ($\frac{1}{2}, \frac{1}{4}, \frac{1}{8}$) and plot data showing multiple data points for each fraction.



Length of insects (in inches)

Pose questions that students may answer, such as:

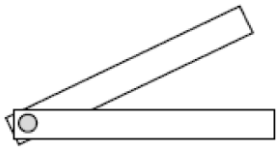
- "How many one-eighths are shown on the line plot?" Expect "two one-eighths" as the answer. Then ask, "What is the total of these two one-eighths?" Encourage students to count the fractional numbers as they would with whole number counting but using the fraction name.
- "What is the total number of inches for insects measuring $\frac{3}{8}$ inches?" Students can use skip counting with fraction names to find the total, such as, "three-eighths, six-eighths, nine-eighths. The last fraction names the total. Students should notice that the denominator did not change when they were saying the fraction name. Have them make a statement about the result of adding fractions with the same denominator.
- "What is the total number of insects measuring $\frac{1}{8}$ inch or $\frac{5}{8}$ inches?" Have students write number sentences to represent the problem and solution such as, $\frac{1}{8} + \frac{1}{8} + \frac{5}{8} = \frac{7}{8}$ inches.

Use visual fraction strips and fraction bars to represent problems to solve problems involving addition and subtraction of fractions.

Geometric measurement - understand concepts of angle and measure angles.

Angles are geometric shapes composed of two rays that are infinite in length. Students can understand this concept by using two rulers held together near the ends. The rulers can represent the rays of an angle. As one ruler is rotated, the size of the angle is seen to get larger. Ask questions about the types of angles created. Responses may be in terms of the relationship to right angles. Introduce angles as acute (less than the measure of a right angle) and obtuse (greater than the measure of a right angle). Have students draw representations of each type of angle. They also need to be able to identify angles in two-dimensional figures.

Students can also create an angle explorer (two strips of cardboard attached with a brass fastener) to learn about angles.



They can use the angle explorer to get a feel of the relative size of angles as they rotate the cardboard strips around.

Students can compare angles to determine whether an angle is acute or obtuse. This will allow them to have a benchmark reference for what an angle measure should be when using a tool such as a protractor or an angle ruler.

Provide students with four pieces of straw, two pieces of the same length to make one angle and another two pieces of the same length to make an angle with longer rays.

Another way to compare angles is to place one angle over the other angle. Provide students with a transparency to compare two angles to help them conceptualize the spread of the rays of an angle. Students can make this comparison by tracing one angle and placing it over another angle. The side lengths of the angles to be compared need to be different.

Students are ready to use a tool to measure angles once they understand the difference between an acute angle and an obtuse angle. Angles are measured in degrees. There is a relationship between the number of degrees in an angle and circle which has a measure of 360 degrees. Students are to use a protractor to measure angles in whole-number degrees. They can determine if the measure of the angle is reasonable based on the relationship of the angle to a right angle. They also make sketches of angles of specified measure.

- Students should be actively engaged by developing their own understanding.
- Mathematics should be represented in as many ways as possible by using graphs, tables, pictures, symbols, and words.
- Appropriate manipulatives and technology should be used to enhance student learning.
- Students should be given opportunities to revise their work based on teacher feedback, peer feedback, and metacognition, which include self-assessment and reflection.

SELECTED TERMS AND SYMBOLS

The following terms and symbols are often misunderstood. These concepts are not an inclusive list and should not be taught in isolation. However, due to evidence of frequent difficulty and misunderstanding associated with these concepts, instructors should pay particular attention to them and how their students are able to explain and apply them.

Teachers should present these concepts to students with models and real life examples. Students should understand the concepts involved and be able to recognize and/or demonstrate them with words, models, pictures, or numbers.

Note – At the elementary level, different sources use different definitions. Please preview any website for alignment to the definitions given in the frameworks. The Standards glossary of mathematical terms: http://www.corestandards.org/Math/Content/mathematics-glossary/glossary.

The terms below are for teacher reference only and are not to be memorized by the students.

- centimeter(cm)
- cup (c)
- customary
- foot (ft)
- gallon (gal)
- gram (g)
- kilogram (kg)
- kilometer (km)
- liquid volume
- liter (L)
- mass
- measure
- meter (m)
- metric
- mile (mi)
- milliliter (mL)
- ounce (oz)
- pint (pt)
- pound (lb)
- quart (qt)
- relative size
- ton (T)
- weight
- decompose
- yard (yd)
- data
- line plot
- intersect
- acute angle
- angle
- arc
- circle
- degree
- measure
- obtuse angle
- one-degree angle
- protractor
- rectilinear figure
- right angle
- straight angle

TASKS

The following tasks represent the level of depth, rigor, and complexity expected of all fourth-grade students. These tasks or tasks of similar depth and rigor should be used to demonstrate evidence of learning. It is important that all elements of a task be addressed throughout the learning process so that students understand what is expected of them. While some tasks are identified as performance tasks, they also may be used for teaching and learning.

Scaffolding Task	Tasks that build up to the learning task.
Constructing Task	Constructing understanding through deep/rich contextualized problem-solving tasks.
Practice Task	Tasks that provide students opportunities to practice skills and concepts.
Performance Task	Tasks, which may be a formative or summative assessment, that checks for student understanding/misunderstanding and or progress toward the standard/learning goals at different points during a unit of instruction.

Culminating Task	Designed to require students to use several concepts learned during the unit to answer a new or unique situation. Allows students to give evidence of their own understanding toward the mastery of the standard and requires them to extend their chain of mathematical reasoning.
Intervention Table	The Intervention Table provides links to interventions specific to this unit. The interventions support students and teachers in filling foundational gaps revealed as students work through the unit. All listed interventions are from New Zealand's Numeracy Project.
Formative Assessment Lesson (FAL)	Lessons that support teachers in formative assessment which both reveal and develop students' understanding of key mathematical ideas and applications. These lessons enable teachers and students to monitor in more detail their progress towards the targets of the standards.
CTE Classroom Tasks	Designed to demonstrate how the Career and Technical Education knowledge and skills can be integrated. The tasks provide teachers with realistic applications that combine mathematics and CTE content.
3-Act Task	A Three-Act Task is a whole-group mathematics task consisting of 3 distinct parts: an engaging and perplexing Act One, an information

	and solution seeking Act Two, and a solution discussion and solution revealing Act Three. More information along with guidelines for 3-Act Tasks may be found in the ***Guide to Three-Act Tasks*** on georgiastandards.org.

Task Name	Task Type/Grouping Strategy	Content Addressed	Standard(s)	Task Description
Measuring Mania	Constructing Task *Individual/Small Group Task*	Measure $\frac{1}{2}$, $\frac{1}{4}$, and $\frac{1}{8}$ inch sections on ruler	MGSE4.MD.1	Students mark half, quarter and eighth of an inch increments on a ruler template.
What's the Story?	Performance Task *Individual/Partner Task*	Make a line plot to display data to 1/8 inch	MGSE4.MD.1 MGSE4.MD.2 MGSE4.MD.4	Students will create a line plot using a given set of data. Students will create and answer questions about the data. Students will create the context for the data given.
Chocolate Covered Candies	3 Act Task *Individual/Partner Task*	Finding approximate area	MGSE4.MD.3	Students will calculate the area of chocolate candies using centimeter grid paper.
Perimeter and Area	Constructing Task *Individual/Partner*	Determine area and perimeter	MGSE4.MD.2 MGSE4.MD.3	Students will create rectangles with different areas, but the same perimeter. Students will create formulas that help find the perimeters and areas of any given rectangle or square.
Parking Lot	3 Act Task *Individual/Partner*	Determine area	MGSE4.MD.2 MGSE4.MD.3	Students will create a question to investigate and answer about a vacant lot.

Indoor Playground	3 Act Task *Individual/Partner*	Determine area when given the perimeter	MGSE4.MD.2 MGSE4.MD.3	Students will determine the area and perimeter of a playground that is being moved indoors.
The Fence or the Yard?	Scaffolding Task *Individual/ Partner*	Comparing area and perimeter and finding the area of rectilinear figures	MGSE4.MD.3 MGSE4.MD.8	Students will find the area and perimeter of rectangles and rectilinear figures using concrete materials.
Piles of Tiles	3-Act Task *Whole Group*	Finding the area of a rectilinear figure	MGSE4.MD.3 MGSE4.MD.8	Students will determine the area of a rectilinear table using color tiles and determine if there are enough color tiles in the bag to cover the area of the table.
Setting the Standard	Scaffolding Task *Small Group Task*	Understand and use a standard unit of measure (gram)	MGSE4.MD.1	Students will measure the mass of fruit in grams and kilograms using a balance scale.
Measuring Mass	Scaffolding Task *Small Group Task*	Estimate and weigh items using grams and kilograms	MGSE4.MD.1	Students will estimate the mass of objects and then find the actual mass using referent items.
A Pound of What?	Constructing Task *Small Group Task*	Understand and use pound as a measure of weight	MGSE4.MD.1	Students will make a bag that weighs a pound and use it as a reference for estimating weight of other objects in the environment.

Exploring an Ounce	Constructing Task *Small Group Task*	Understand and use an ounce as a measure of weight	MGSE4.MD.1	Students use clay to make an ounce by breaking apart pieces of clay and measuring to check the mass of each piece.
Too Heavy? Too Light?	Constructing Task *Individual/Partner Task*	Problem solving that requires unit conversion within the same system	MGSE4.MD.1 MGSE4.MD.2	Students solve word problems involving units of weight and mass.
Capacity Line-Up	Scaffolding Task *Partner/Small group*	Estimate and measure metric capacity	MGSE4.MD.1 MGSE4.MD.2	Students will estimate the capacity of different containers and find the actual capacity in milliliters using graduated cylinders.
More Punch Please!	Constructing Task *Individual/Partner task*	Measure capacity using customary units; Convert	MGSE4.MD.1 MGSE4.MD.2	Students rewrite a punch recipe for a party. Students use

		liquid measures within the customary system		knowledge of customary capacity conversions, multiplication and division to solve the problem.
Water Balloon Fun!	Constructing Task *Individual/Partner Task*	Measure capacity using metric and customary units	MGSE4.MD.1 MGSE4.MD.2	Students solve word problems involving metric and customary capacity units.
Culminating Task: Dinner at the Zoo/Naptime at the Zoo	Performance Task *Individual/Partner Task*	Use weight measurement and weight conversion; apply area formula	MGSE4.MD.1 MGSE4.MD.2 MGSE4.MD.3	Students will determine how much food to order for zoo animals during the month of April given their eating habits and weights.

Angle Measurement

Task Name	Task Type/Grouping Strategy	Content Addressed	Standard(s)	Task Description
Which Wedge is Right?	Scaffolding Task *Partner task*	Use non-standard units to measure angles	MGSE4.MD.5	Students will measure given angles using part of a circle, also known as a wedge.

Angle Tangle	Scaffolding Task *Individual/Partner task*	Use a 360° circle; Identify and use benchmark angles	MGSE4.MD.5 MGSE4.MD.7	Students will discover how a circle is related to angle measurement using fraction circles.
Build an Angle Ruler	Scaffolding Task *Individual/Partner task*	Build and use an angle ruler	MGSE4.MD.5 MGSE4.MD.7	Students will measure angles in a design using a wedge from a circle.
Guess My Angle!	Constructing Task *Whole group/Partner task*	Measure angles using a protractor	MGSE4.MD.5 MGSE4.MD.6 MGSE4.MD.7	Students will learn how to use a protractor to measure angles.
Turn, Turn, Turn	Constructing Task *Whole group task*	Use rotation to find angles	MGSE4.MD.5 MGSE4.MD.6 MGSE4.MD.7	Students rotate paper plates to form a variety of angles and discuss half and full rotations.
Summing It Up	Constructing Task *Individual/Partner task*	Explore the angle measures of a triangle	MGSE4.MD.5 MGSE4.MD.6 MGSE4.MD.7	Students will add the measure of angle in a triangle to discover that the sum of all angles in a triangle should be 180°.
Culminating Task: Angles of Set Squares	Performance Task *Individual/Partner Task*	Combine shapes to make angles; Find measure of unknown angle of a triangle	MGSE4.MD.5 MGSE4.MD.6 MGSE4.MD.7	Students will combine squares and triangles and find the measure of unknown angles.

Should you need further support for this unit, please view the appropriate unit webinar at:
https://www.georgiastandards.org/Archives/Pages/default.aspx

For examples of student work for this unit, please visit the K-5 Mathematics Video Page.

INTERVENTION TABLE

The Intervention Table below provides links to interventions specific to this unit. The interventions support students and teachers in filling foundational gaps revealed as students work through the unit. All listed interventions are from New Zealand's Numeracy Project.

Cluster of Standards	Name of Intervention	Snapshot of summary or Student I can statement. . .	Materials Master
Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit. **MGSE4.MD.1 MGSE4.MD.2 MGSE4.MD.3 MGSE4.MD.8**	Weighing Stations	Create and use appropriate units and devices to measure length, area, volume and capacity, weight (mass), turn (angle), temperature, and time.	
	Making Benchmarks-Mass	Create and use appropriate units and devices to measure length, area, volume and capacity, weight (mass), turn (angle), temperature, and time.	
	Supermarket Shopping	Create and use appropriate units and devices to measure length, area, volume and capacity, weight (mass), turn (angle), temperature, and time.	
	How Much Room?	Use linear scales and whole numbers of metric units for length, area, volume and capacity, weight (mass), angle, temperature, and time.	
	Areas of Rectangles	Find areas of rectangles by applying multiplication.	
	What Goes Around	Use side or edge lengths to find the perimeters and areas of rectangles.	
	You Can Count on Squares!	Use side or edge lengths to find the perimeters and areas of rectangles.	
Geometric Measurement - understand concepts of angle and measure angles. **MGSE4.MD.5 MGSE4.MD.6 MGSE4.MD.7**	Angles, Parallel Lines, and Polygons	Deduce the angle properties of intersecting and parallel lines and the angle properties of polygons and apply these properties.	
	Turns	Give and follow instructions for movement that involve distances, directions, and half or quarter turns.	
	Angles	Create and use appropriate units and devices to measure length, area, volume and capacity, weight (mass), turn (angle), temperature, and time.	
	Measuring Angles	Use linear scales and whole numbers of metric units for length, area, volume and capacity, weight (mass), angle, temperature, and time.	
	Simple Angles	Use linear scales and whole numbers of metric units for length, area, volume and capacity, weight (mass), angle, temperature, and time.	

FORMATIVE ASSESSMENT LESSONS (FALS)

Formative Assessment Lessons are designed for teachers to use in order to target specific strengths and weaknesses in their students' mathematical thinking in different areas. A Formative Assessment Lesson (FAL) includes a short task that is designed to target mathematical areas specific to a range of tasks from the unit. Teachers should give the task in advance of the delineated tasks and the teacher should use the information from the assessment task to differentiate the material to fit the needs of the students. The initial task should not be graded. It is to be used to guide instruction.

Teachers may use the following Formative Assessment Lessons (FALS) Chart to help determine the areas of strengths and weaknesses of students in particular areas within the unit.

Formative Assessment Lessons aligned to this grade level can be found here:

https://education.ky.gov/curriculum/conpro/Math/Pages/ElemFormAssessLessons.aspx

http://www.debbiewaggoner.com/elementary-fals.html

CONSTRUCTING TASK: Measuring Mania Return to Task Table

TASK CONTENT: Students will measure $\frac{1}{2}$, $\frac{1}{4}$, and $\frac{1}{8}$ inch sections on a ruler.

STANDARDS FOR MATHEMATICAL CONTENT

MGSE4.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.

a. Understand the relationship between gallons, cups, quarts, and pints.
b. Express larger units in terms of smaller units within the same measurement system.
c. Record measurement equivalents in a two-column table.

STANDARDS FOR MATHEMATICAL PRACTICE TO BE EMPHASIZED

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.

BACKGROUND KNOWLEDGE

Students believe that larger units will give larger measures. Students should be given multiple opportunities to measure the same object with different measuring units. For example, have the students measure the length of a room with one-inch tiles, with one-foot rulers, and with yardsticks. Students should notice that it takes fewer yardsticks to measure the room than the number of rulers or tiles needed.

ESSENTIAL QUESTIONS

- What is a unit?
- How are the units of linear measurement within a standard system related?

MATERIALS

- ruler
- colored pencils, markers, or crayons

GROUPING

Individual

NUMBER TALKS

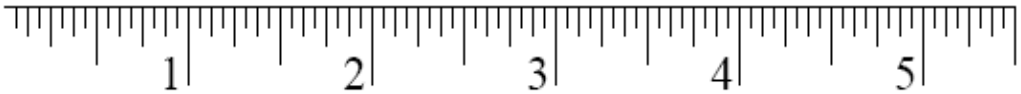
Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. Catherine Fosnot has developed problem "strings" which may be included in number talks to further develop mental math skills. See *Mini lessons for Operations with Fractions, Decimals, and Percents* by Kara Louise Imm, Catherine Twomey Fosnot and Willem Uittenbogaard. (*Mini lessons for Operation with Fractions, Decimals, and Percent*, 2007, Kara Louise Imm, Catherine Twomey Fosnot and Willem Uittenbogaard)

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

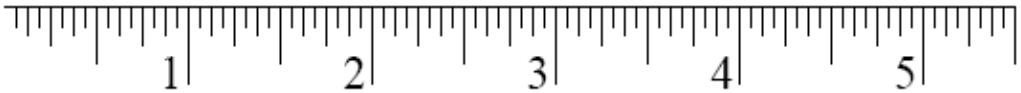
In this task, students will develop a deeper understanding of linear measurement. Students will measure lengths to the nearest one-half, one-fourth, and one-eighth of an inch and explore their relationships. Teachers should support good student dialogue and take advantage of comments and questions to help guide students into correct mathematical thinking.

Part I: Measuring

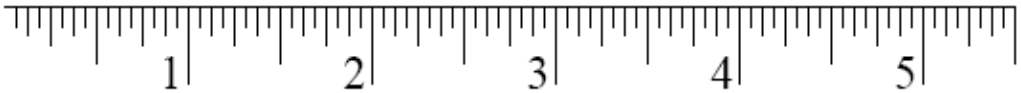
- Show all $\frac{1}{2}$ inch increments. Start at the beginning of the ruler.



- Show all $\frac{1}{4}$ inch increments. Start at the beginning of the ruler.



- Show all $\frac{1}{8}$ inch increments. Start at the beginning of the ruler.



Part II

a. How many $\frac{1}{2}$" segments can you get from 1" of string? From 2"? Show how you know.

b. How many $\frac{1}{4}$" segments can you get from 1" of string? From 2"? Show how you know.

c. How many $\frac{1}{8}$" segments can you get from 1" of string? From 2"? Show how you know.

d. How many $\frac{1}{8}$" segments can you get from $\frac{1}{4}$" of string? From 2"? Show how you know.

FORMATIVE ASSESSMENT QUESTIONS

- How does one measure to the nearest $\frac{1}{2}$ inch if starting from **any** of the hash marks on a ruler? What about $\frac{1}{4}$ inch or $\frac{1}{8}$ inch?

DIFFERENTIATION

Extension

- Students can be challenged to measure assorted objects provided in the classroom to the nearest $\frac{1}{8}$ inch. They can also calculate how many 1/8-inch sections would be in the total length of measured items. This can be repeated and the students can measure to the nearest $\frac{1}{4}$ inch and $\frac{1}{2}$ inch.

Intervention

- Have students create a paper ruler displaying the measurements with only $\frac{1}{8}$ inch increments. This may eliminate the confusion of the $\frac{1}{16}$ inch lines. Students can also create a paper ruler displaying only $\frac{1}{4}$ or $\frac{1}{2}$ inch increments.

Intervention Table

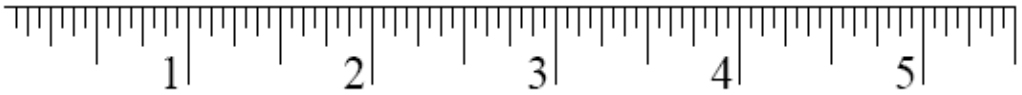
TECHNOLOGY

- http://www.ixl.com/math/grade-3/compare-and-convert-customary-units-of-length This activity involves converting measurements in the customary system. It can be used for additional practice.
- http://mathcentral.uregina.ca/RR/database/RR.09.99/sawatzky1/teachnotes-meas.html#estimate This lesson involves estimating lengths. It can be used for additional practice or remediation purposes.
- http://www.funbrain.com/measure/ This online activity involving the measurement in inches can be used for additional practice.

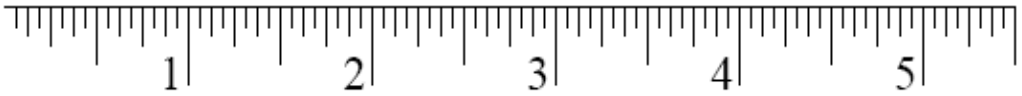
Name_____ Date_____

Measuring Mania Recording Sheet
Part One

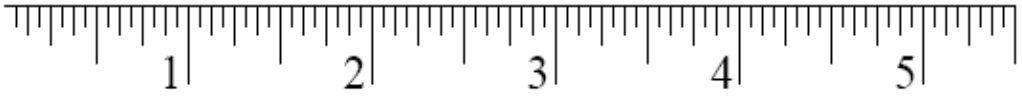
1. Show all $\frac{1}{2}$ inch increments. Start at the beginning of the ruler and highlight each increment with a contrasting color.



2. Show all $\frac{1}{4}$ inch increments. Start at the beginning of the ruler and highlight each increment with a contrasting color.



3. Show all $\frac{1}{8}$ inch increments. Start at the beginning of the ruler and highlight each increment with a contrasting color.



Measuring Mania Recording Sheet
Part Two

Use string and a ruler to answer the following questions. You may use a marker to draw the measurements on each piece of string.

1. How many $\frac{1}{2}$" segments can you get from 1" of string? From 2"? Show how you know.

2. How many $\frac{1}{4}$" segments can you get from 1" of string? From 2"? Show how you know.

3. How many $\frac{1}{8}$" segments can you get from 1" of string? From 2"? Show how you know.

4. How many $\frac{1}{8}$" segments can you get from $\frac{1}{4}$" of string? From 2"? Show how you know.

PERFORMANCE TASK: What's the Story? Return to Task Table

TASK CONTENT: Students will make a line plot to display data to the nearest $\frac{1}{8}$ inch.

STANDARDS FOR MATHEMATICAL CONTENT

MGSE4.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.

a. Understand the relationship between gallons, cups, quarts, and pints.
b. Express larger units in terms of smaller units within the same measurement system.
c. Record measurement equivalents in a two-column table.

MGSE4.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.

MGSE4.MD.4 Make a line plot to display a data set of measurements in fractions of a unit ($\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$). Solve problems involving addition and subtraction of fractions with common denominators by using information presented in line plots. *For example, from a line plot, find and interpret the difference in length between the longest and shortest specimens in an insect collection.*

STANDARDS FOR MATHEMATICAL PRACTICE TO BE EMPHASIZED

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.

BACKGROUND KNOWLEDGE

Students need a good understanding of the different ways to represent data in a graph in order to choose the most appropriate graph for the data presented. Data for a line graph would need to be given as an ordered pair or with two pieces of information (in a t-chart for example) for each data point. Line graphs are frequently used to display data over time.
Be sure students understand that the bars in bar graphs should not be attached to one another. A small space must be placed between each bar within the graph. Histograms are similar to bar graphs in that they use bars, but represent continuous data; therefore, they do not have spaces between each bar. (This will be discussed in sixth grade.)

Know how to create a bar graph.

Students use whole-number names when counting fractional parts on a number line. The fraction name should be used instead. For example, if two-fourths is represented on the line plot three times, then there would be six-fourths.

Specific strategies may include:
Create number lines with the same denominator without using the equivalent form of a fraction. For example, on a number line using eighths use 48 instead of 12. This will help students later when they are adding or subtracting fractions with unlike denominators. When representations have unlike denominators, students ignore the denominators and add the numerators only.
Have students create stories to solve addition or subtraction problems with fractions to use with student created fraction bars/strips.

ESSENTIAL QUESTIONS

- How is data collected?
- How do we determine the most appropriate graph to use to display the data?
- How is data interpreted?
- How do graphs help explain real-world situations?

MATERIALS

- Set of data that is teacher or student generated or "What's the Story" Recording Sheet (one per student)
- Markers, colored pencils, or crayons
- Graph paper or chart paper
- Ruler

GROUPING

Individual/Partner Task

NUMBER TALKS

Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. Catherine Fosnot has developed problem "strings" which may be included in number talks to further develop mental math skills. See *Mini lessons for Operations with Fractions, Decimals, and Percents* by Kara Louise Imm, Catherine Twomey Fosnot and Willem Uittenbogaard. (*Mini lessons for Operation with Fractions, Decimals, and Percent,* 2007, Kara Louise Imm, Catherine Twomey Fosnot and Willem Uittenbogaard)

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

In this task, students will be working with graphs and data sets. Given a set of data, students will create a graph, describe a context for the data, explain a possible collection method, and report what they learn from the data. The set of data used can be student or teacher created.

Comments

You may want to demonstrate this type of activity as a whole class before assigning this task. The students should have graph paper or chart paper available in case they choose to use it. Students should also have the opportunity to share their solutions. The set of data can be determined by the teacher so that the data set can apply to different learning levels, and degrees of difficulty. The teacher also has the option of allowing students to create their own data set.

A sample set of data could be as follows: $\frac{1}{8}, \frac{1}{8}, \frac{2}{8}, \frac{2}{8}, \frac{3}{8}, \frac{3}{8}, \frac{3}{8}, \frac{3}{8}, \frac{3}{8}, \frac{3}{8}, \frac{4}{8}, \frac{4}{8}, \frac{5}{8}, \frac{5}{8}, \frac{5}{8}, \frac{5}{8}, \frac{6}{8}, \frac{6}{8}, \frac{7}{8}, \frac{7}{8}, \frac{7}{8}, \frac{7}{8}, \frac{8}{8}, \frac{8}{8}, \frac{8}{8}$, and $\frac{8}{8}$,.

For the sample data given, there are many possible situations students may come up with. The following are some sample stories for the given data:

- We sampled sets of 8 M&Ms checking for the number of red in each set. The first sample we took had 7 reds out of 8 M&Ms or $\frac{7}{8}$, the second sample had only 3 out 8 M&M's red or 3/8 . . .
- I measured my sunflower plant every three days to check its growth. After the first 3 days (the first sample), I noticed it grew $\frac{7}{8}$ of an inch. After the second 3 days (the second sample), I noticed it grew $\frac{3}{8}$ of an inch . . .

Task Directions

Have students follow the directions below:

Use your set of data to:

- Display the data on a line plot.
- Label your line plot appropriately.
- Create a situation that would fit the set of data given.
- Explain how the set of data was/might have been collected.
- Give at least five real-world interpretations from the given set of data on your recording sheet.

FORMATIVE ASSESSMENT QUESTIONS

- How did you decide what kind of situation would be appropriate to describe the data in your line plot?
- What are ways in which these data could have been collected?
- Would the data be appropriate on another type of graph? If so which graph(s)?
- Is there another way that your data could have been collected?
- What other interpretations you can make from your line plot?
- What label did you place on the x axis of the line plot? L

DIFFERENTIATION

Extension

- Have students repeat the activity using data that they collect.
- Have students display their data in an appropriate graph.
- Have students research and describe situations in which data are collected and displayed routinely.

Intervention

- Have students work with a smaller data set for the task.
- Allow students to collect or create data for their project.

Intervention Table

TECHNOLOGY

- http://illuminations.nctm.org/LessonDetail.aspx?ID=L520 The Soup Spot: This lesson involves students conducting a survey based on food and creating line plots. It can be used for additional practice or remediation purposes.
- http://illuminations.nctm.org/LessonDetail.aspx?ID=L355 This lesson involves generating graphs. Please note, finding mean, mode, median and range are not a 4th grade standard. The lesson can be used for additional practice.

Name _____ Date _____

What's the Story?

Use your set of data to:

- Display the data on a line plot.
- Label your line plot appropriately.
- Create a situation that would fit the set of data given.
- Explain how the set of data was/might have been collected.
- Give at least five real-world interpretations from the given set of data on your recording sheet.

Data:

Sample	1	2	3	4	5	6	7	8	9	10	11	12
Length (in)	$\frac{7}{8}$	$\frac{3}{8}$	$\frac{6}{8}$	$\frac{5}{8}$	$\frac{8}{8}$	$\frac{2}{8}$	$\frac{5}{8}$	$\frac{3}{8}$	$\frac{7}{8}$	$\frac{1}{8}$	$\frac{4}{8}$	$\frac{8}{8}$

Sample	13	14	15	16	17	18	19	20	21	22	23	24	25
Length (in)	$\frac{1}{8}$	$\frac{7}{8}$	$\frac{3}{8}$	$\frac{4}{8}$	$\frac{8}{8}$	$\frac{2}{8}$	$\frac{5}{8}$	$\frac{3}{8}$	$\frac{8}{8}$	$\frac{7}{8}$	$\frac{5}{8}$	$\frac{3}{8}$	$\frac{6}{8}$

Line Plot:

What's your story for a real-life situation for this set of data?_____

_____

_____

_____

How might this set of data have been collected? _____

What does the data tell us? Explain at least 5 things that we can learn from this set of data.

1.

2.

3.

4.

5.

3-ACT TASK: Chocolate Covered Candies

Return to Task Table

Adapted from More Chocolate Candy task by Yummymath.com

TASK CONTENT: Students will find approximate area**.** Approximate time: 30 minutes.

STANDARDS FOR MATHEMATICAL CONTENT

MGSE4.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.

STANDARDS FOR MATHEMATICAL PRACTICE

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.

BACKGROUND KNOWLEDGE

This task follows the 3-Act Math Task format originally developed by Dan Meyer. More information on this type of task may be found at http://blog.mrmeyer.com/category/3acts/. A Three-Act Task is a whole-group mathematics task consisting of 3 distinct parts: an engaging and perplexing Act One, an information and solution seeking Act Two, and a solution discussion and solution revealing Act Three. More information along with guidelines for 3-Act Tasks may be found in the ***Guide to Three-Act Tasks*** on georgiastandards.org.

Students worked with area and perimeter in third grade and many can find the area and perimeter of given rectangles. Some students may even be able to state the formulas for finding the perimeter and area of a rectangle. However, many students get these formulas confused unless they have sufficient opportunity to use models as they construct their understanding.

ESSENTIAL QUESTIONS

- How do you determine the area of an object?
- How do you compare area?

MATERIALS

- Chocolate Covered Student Recording Sheet
- Chocolate on a Grid sheet

- Act 1 image

GROUPING

Individual/partner

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

In this task, students will watch the video, picture or scenario and then tell what they noticed. Next, they will be asked to discuss what they wonder about or are curious about. Their curiosities will be recorded as questions on a class chart or on the board. Students will then use mathematics to answer their own questions. Students will be given information to solve the problem based on need. When they realize they don't have the information they need, and ask for it, it will be given to them.

Task Directions

Act I – Whole Group - Pose the conflict and introduce students to the scenario by showing the Act I picture.

1. Show the Act I picture to students.

2. Ask students what they noticed in the picture. The teacher records this information.
3. Pass out the 3 Act Task recording sheet.
4. Ask students what they wonder about and what questions they have about what they saw. Students should share with each other first before sharing aloud and then record these questions on the recording sheet (think-pair-share). The teacher may need to guide students so that the questions generated are math related.

   Anticipated questions students may ask and wish to answer:
   Which piece of chocolate is bigger?
   Which candy has the most chocolate?

5. As the facilitator, you can select which question you would like every student to answer, have students vote on which question the class will answer or allow the students to pick which question they would like to answer. Once the question is selected ask students to estimate answers to their questions (think-pair-share). Students will write their best estimate.

Act II – **Student Exploration** - Provide additional information as students work toward solutions to their questions.

1. Ask students to determine what additional information they will need to solve their questions. The teacher provides that information only when students ask for it.
    - Chocolates on a Grid sheet

2. Ask students to work in small groups to answer the questions they created in Act I. The teacher provides guidance as needed during this phase by asking questions such as:
    - Can you explain what you have done so far?
    - What strategies are you using?
    - What assumptions are you making?
    - What tools or models may help you?
    - Why is that true?
    - Does that make sense?

Act III – Whole Group - Share student solutions and strategies as well as Act III solution.

1. Ask students to present their solutions and strategies.
2. Share solution in Act III reveal.
3. Lead discussion to compare these, asking questions such as:
    - How reasonable was your estimate?
    - Is your solution exact? Why or not?
    - Which strategy was most efficient?
    - Can you think of another method that might have worked?
    - What might you do differently next time?

FORMATIVE ASSESSMENT QUESTIONS

- What models did you create?
- What organizational strategies did you use?

DIFFERENTIATION

Extension

- If the chocolates were combined, how would it affect the area? How might it affect the perimeter?

Intervention

- Provide each student with their own copy of the chocolate on a grid sheet. Allow students to use centimeter cubes to determine the approximate area or use colored pencils to shade the approximate area of each candy piece.

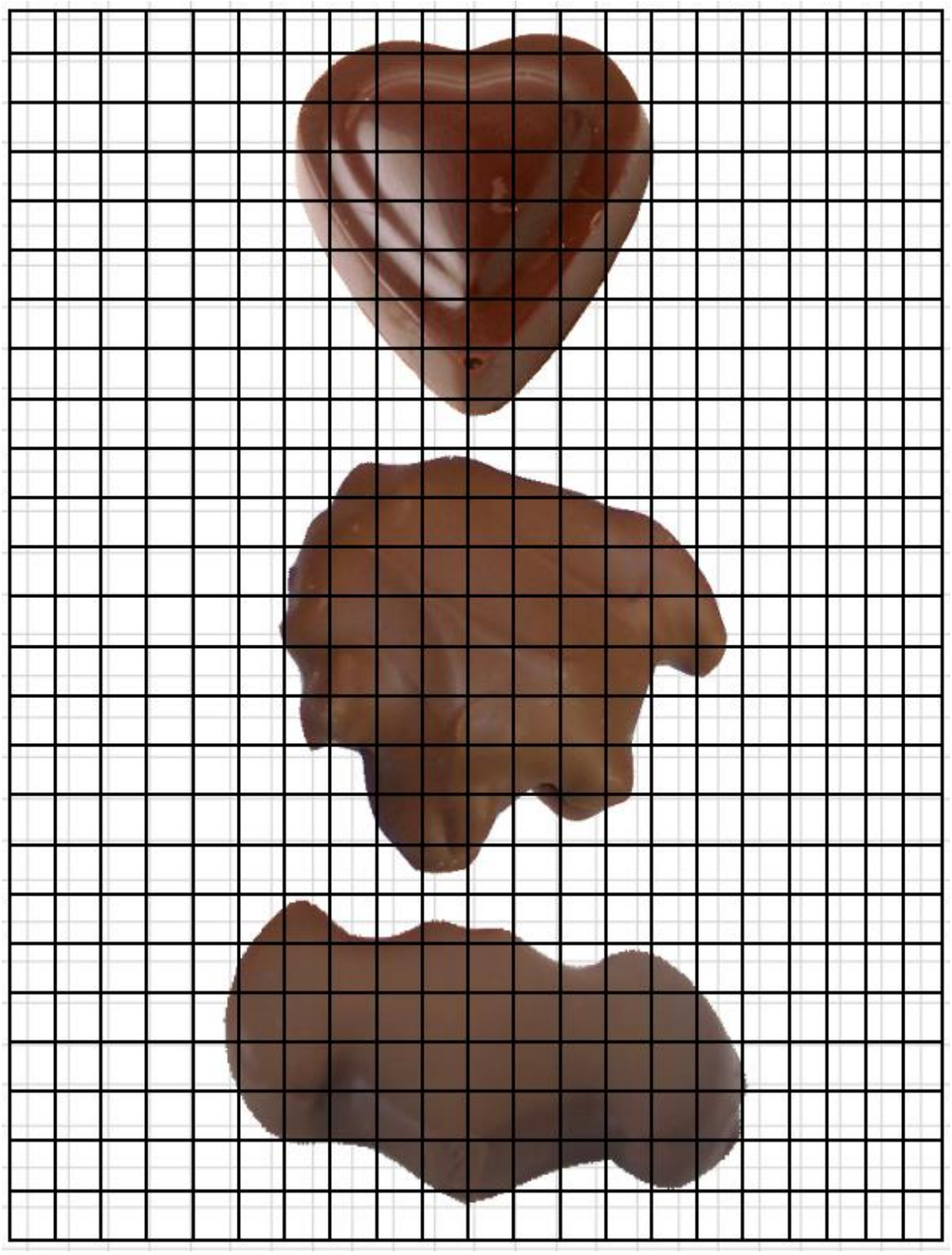
Intervention Table

TECHNOLOGY CONNECTIONS

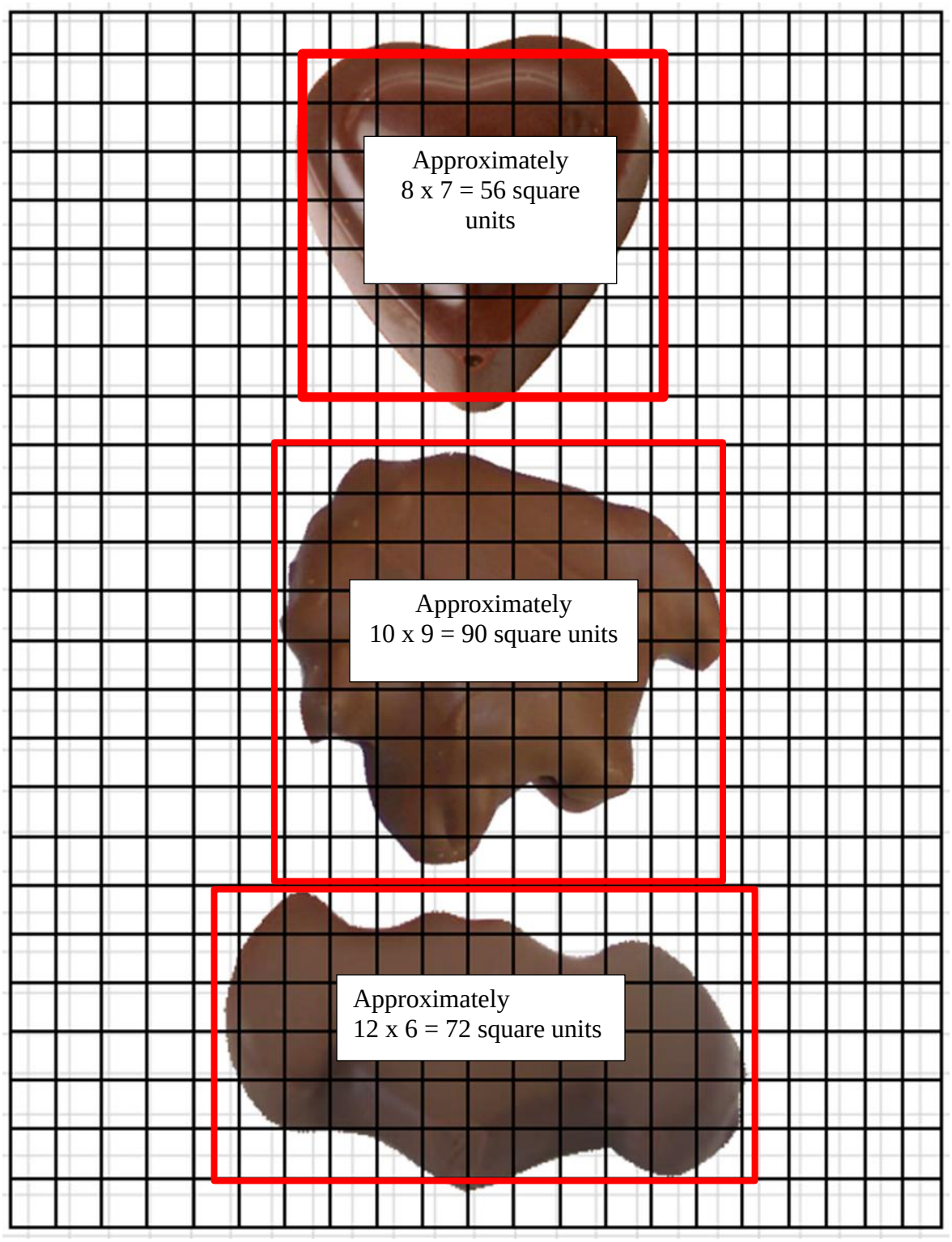
- http://illuminations.nctm.org/Lesson.aspx?id=2176 Finding Perimeter and Area: This lesson prompts students to determine the area and perimeter of several shapes that represent the clubhouse floor plans.
- http://illuminations.nctm.org/ActivityDetail.aspx?id=46 IGD Area of a Rectangle: This interactive activity allows students to see how to find the area of a rectangle by manipulating the length of two sides of a rectangle. It can be used for additional practice or remediation purposes.
- http://mathcentral.uregina.ca/RR/database/RR.09.99/sawatzky1/teachnotes-meas.html#perimeter Measurement Activity 3: Perimeter and Area: This lesson involves comparing area and perimeter. It can be used for additional practice or remediation purposes.

Act 2 image: Chocolates on a Grid (two per page)

Chocolates on a Grid Sheet



Act 3: Reveal



Name: _____

Adapted from Andrew Stadel

Task Title:

ACT 1

What questions come to your mind?
Main Question:

Estimate which candy piece is the largest. Explain your estimates.

_____

_____

_____

_____

_____

_____

_____

ACT 2

What information would you like to know or need to solve the MAIN question?

Use this area for your work, tables, calculations, sketches, and final solution.

ACT 3

What was the result?

ACT 4 (use this space when necessary)

CONSTRUCTING TASK: Perimeter and Area Return to Task Table

Adapted from "Fixed Perimeters" and "Fixed Areas" in Teaching Student-Centered Mathematics Grades 3-5 by John Van de Walle and LouAnn Lovin.

TASK CONTENT: Students will determine area and perimeter.

STANDARDS FOR MATHEMATICAL CONTENT

MGSE4.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.

MGSE4.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.

STANDARDS FOR MATHEMATICAL PRACTICE TO BE EMPHASIZED

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.

BACKGROUND KNOWLEDGE/COMMON MISCONCEPTIONS

Students worked with area and perimeter in third grade and many can find the area and perimeter of given rectangles. Some students may even be able to state the formulas for finding the perimeter and area of a rectangle. However, many students get these formulas confused unless they have sufficient opportunity to use models as they construct their understanding.

ESSENTIAL QUESTIONS

- How is perimeter different from area?
- What is the relationship between area and perimeter when the area is fixed?
- What is the relationship between area and perimeter when the perimeter is fixed?
- How does the area change as the rectangle's dimensions change (with a fixed perimeter)?
- How are the units used to measure perimeter like the units used to measure area?

- How are the units used to measure perimeter different from the units used to measure area?

MATERIALS

- 1-inch tiles (36 per student)
- 1 ruler or tape measure (per student)
- Student Recording sheet and 2 copies of $\frac{1}{4}$ inch grid paper (grid provided has 0.3-inch squares)

GROUPING

Individual or partner task

NUMBER TALKS

Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. Catherine Fosnot has developed problem "strings" which may be included in number talks to further develop mental math skills. See *Mini-lessons for Operations with Fractions, Decimals, and Percents* by Kara Louise Imm, Catherine Twomey Fosnot and Willem Uittenbogaard. (*Mini-lessons for Operation with Fractions, Decimals, and Percent*, 2007, Kara Louise Imm, Catherine Twomey Fosnot and Willem Uittenbogaard)

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

Task Directions
Part 1:

1. Instruct students to draw a rectangle with a perimeter measuring 12 units using the grid paper. Have a student volunteer share their rectangle for all to see (may adapt to whatever technology is available in your classroom.) Students' rectangles may be the following whole unit dimensions: 1 x 5, 2 x 4, or 3 x 3.
2. Ask students to find the area of their rectangle and to record in a table like the one used in Part 1.
3. Direct students to draw and find the area of all the rectangles they can that have a perimeter of 12 whole units. Have students continue to record findings in the chart. Discuss with students what they notice about the relationship between the area and perimeter.
4. Discuss with students how they are finding the area and perimeters of the rectangles made. Allow students to share the methods they are using. Students may say, " I am finding the perimeter of the rectangles by adding the length and the width and then multiplying the sum by two because the perimeter is the sum of the length and the width, but it needs to be doubled since there is another length and width in the rectangle." Show students how to write the formula (l x w) x 2 = p to represent the idea presented by the student. Another student might say, "To find the perimeter, I

am doubling the length and doubling the width and then adding them together." Again, show the students how to write the formula to represent this generalization using 2l x 2w = p.

5. Next, direct students to draw and find the area of all the rectangles they can that have a perimeter of 24 units. Rectangle dimensions will be: 1 x 11, 2 x 10, 3 x 9, 4 x 8, 5 x 7, and 6 x 6. Encourage students to use the formulas shown in the first part of the lesson to find perimeters and areas of the rectangles created.

Part 2:

You may choose to have your students complete the suggested problems using additional copies of the grid paper provided and tiles, if necessary, to support them as they construct their understanding of formula for area and perimeter.

FORMATIVE ASSESSMENT QUESTIONS

- What did you notice about the perimeter?
- How does the perimeter change as the shape of the rectangle changes?
- What did you notice about the area?
- How does the area change as the rectangle's dimensions change?

DIFFERENTIATION

Extension

- Give students more tiles and have them find the perimeter and area of all the possible rectangles they can create with the number given, possibly starting with 48 tiles.

Intervention

- Start with one tile. Have the student record the dimensions of the rectangle and determine the perimeter and area. Record and sketch on the centimeter grid paper. Add one tile at a time, constructing a rectangle that always has dimensions of 1 x number of tiles used. Allow for the students to determine the dimensions, perimeter, and area. As student grows more confident have them double the size of the rectangle, making it a 2 x number of tiles. Continue this pattern until student begins to make conjectures about the area and perimeter as the rectangle grows. Students should record their findings and sketch each rectangle on the centimeter grid paper.

Intervention Table

TECHNOLOGY

- http://illuminations.nctm.org/ActivityDetail.aspx?id=46 This interactive activity allows students to see how to find the area of a rectangle by manipulating the length of two sides of a rectangle. It can be used for additional practice or remediation purposes.
- http://mathcentral.uregina.ca/RR/database/RR.09.99/sawatzky1/teachnotes-meas.html#perimeter Activity 3 - Perimeter and Area: This lesson involves comparing area and perimeter. It can be used for additional practice or remediation purposes.

- http://illuminations.nctm.org/Lesson.aspx?id=2176 Finding Perimeter and Area: This lesson prompts students to determine the area and perimeter of several shapes that represent the clubhouse floor plans.

Name_____ Date _____

Perimeter and Area: Part 1

Directions:

1. On your grid paper, draw a rectangle with a perimeter of 12 units.
2. Measure the outside dimensions and record in the chart below.
3. Calculate and record the measurements for area and perimeter.
4. Repeat for all the rectangles possible having a perimeter of 24 units.

Rectangle Dimensions	Area	Perimeter

Name_____ Date _____

Perimeter and Area: Part 2

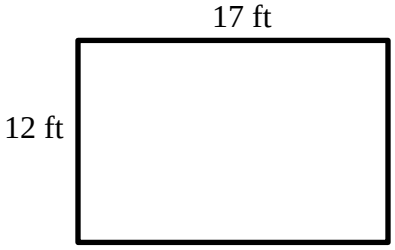
Solve the following problems.

1. The community center has decided to move the parking area to the back of the building and replace the front with a grass lawn. The lawn is rectangular shaped with a length of 10 yards and a width of 40 yards. A bag of grass seed covers 50 square yards at a cost of $4.99 per bag.

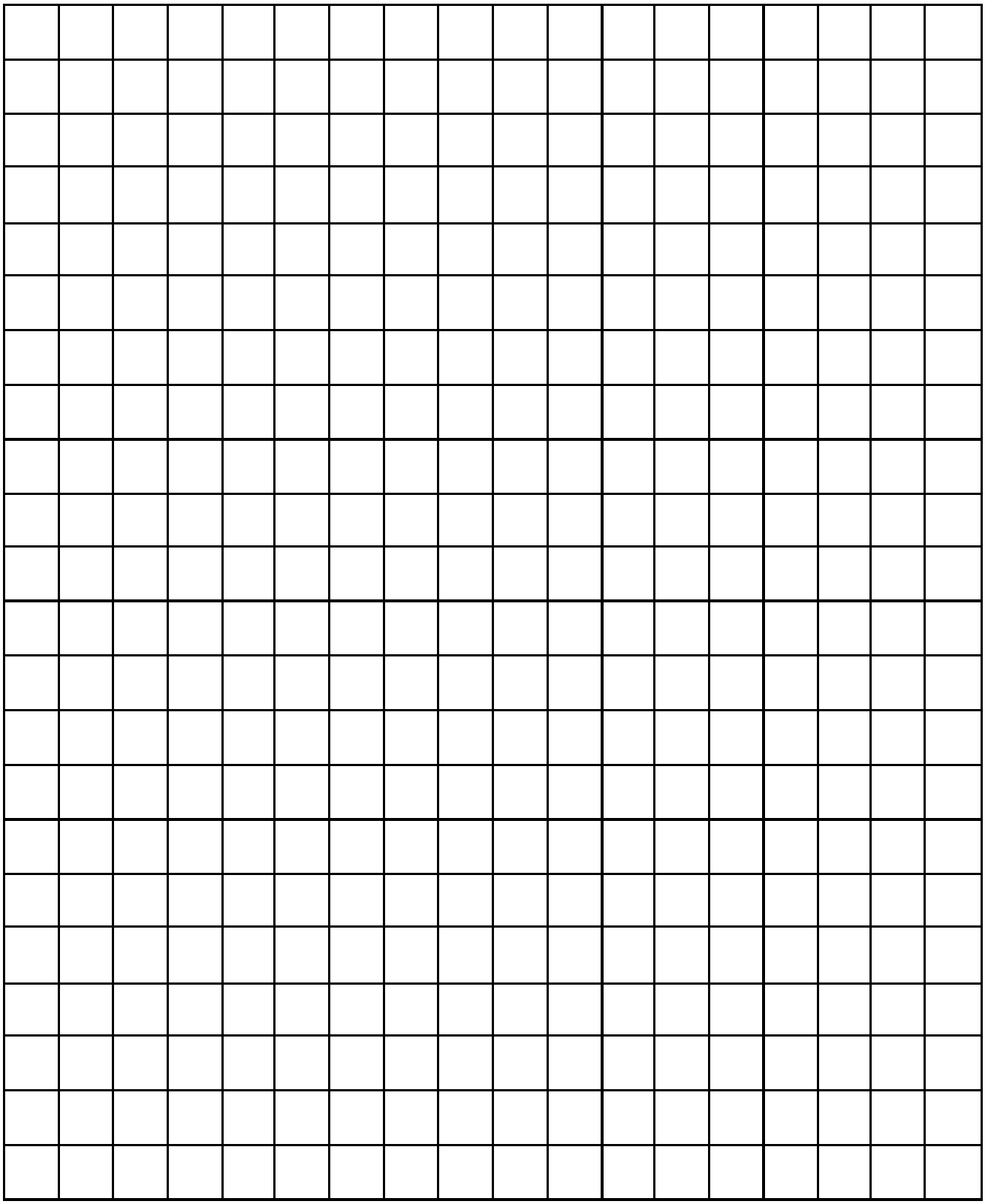
   A) What is the total area of the new lawn?
   B) How many bags of grass seed will they need to buy?
   C) What is the total cost to renovate the front lawn with the new grass?

2. Mr. Ely keeps his chickens in a square pen with an area of 100 square feet. What is the length of one side of the chicken pen?

3. Ethan's parents are re-carpeting his bedroom. The dimensions of the room are shown in the diagram.



   How many square feet of carpet do they need to buy for the entire room?



3-ACT TASK: Parking Lot Return to Task Table
Adapted from www.101qs.com

TASK CONTENT: Students will determine area and perimeter. Approximate time is 1 class period.

STANDARDS FOR MATHEMATICAL CONTENT

MGSE4.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.

MGSE4.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.

STANDARDS FOR MATHEMATICAL PRACTICE

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.

BACKGROUND KNOWLEDGE

This task follows the 3-Act Math Task format originally developed by Dan Meyer. More information on this type of task may be found at http://blog.mrmeyer.com/category/3acts/. A Three-Act Task is a whole-group mathematics task consisting of 3 distinct parts: an engaging and perplexing Act One, an information and solution seeking Act Two, and a solution discussion and solution revealing Act Three. More information along with guidelines for 3-Act Tasks may be found in the ***Guide to Three-Act Tasks*** on georgiastandards.org.

Students worked with area and perimeter in third grade and many can find the area and perimeter of given rectangles.

ESSENTIAL QUESTIONS

- How is perimeter different from area?
- How does the area change as the rectangle's dimensions change (with a fixed perimeter)?
- How are the units used to measure perimeter like the units used to measure area?
- How are the units used to measure perimeter different from the units used to measure area?

MATERIALS

- 1-inch tiles (36 per student)
- Parking Lot Recording sheet
- Act 1 image of vacant lot

GROUPING

Individual or partner task

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

In this task, students will watch the video, picture or scenario and then tell what they noticed. Next, they will be asked to discuss what they wonder about or are curious about. Their curiosities will be recorded as questions on a class chart or on the board. Students will then use mathematics to answer their own questions. Students will be given information to solve the problem based on need. When they realize they do not have the information they need, and ask for it, it will be given to them.

Task Directions

Act I – Whole Group - Pose the conflict and introduce students to the scenario by showing the Act I picture.

1. Show the Act I picture to students.

A company has decided to use this vacant block as a parking lot until a new building is constructed.

2. Ask students what they wonder about and what questions they have about what they saw. Students should share with each other first, and then the teacher records these questions (think-pair-share). The teacher may need to guide students so that the questions generated are math related.

   Anticipated questions students may ask and wish to answer:
   How big will the parking lot be?
   How many cars can fit in the parking lot?
   How long is the vacant lot?
   How wide is the vacant lot?
   What is the perimeter of the vacant lot?

3. As the facilitator, you can select which question you would like every student to answer, have students vote on which question the class will answer or allow the students to pick which question they would like to answer. Once the question is selected ask students to estimate answers to their questions (think-pair-share). Students will write their best estimate, then write two more estimates – one that is too low and one that is too high so that they establish a range in which the solution should occur. Instruct students to record their estimates on a number line.

Act II – **Student Exploration -** Provide additional information as students work toward solutions to their questions.

1. Ask students to determine what additional information they will need to solve their questions. The teacher provides that information only when students ask for it.:
   - Vacant block measures 90 feet x 150 feet
   - Area allowed for each car 9 feet x 18 feet

2. Ask students to work in small groups to answer the questions they created in Act I. The teacher provides guidance as needed during this phase by asking questions such as:
   - Can you explain what you have done so far?
   - What strategies are you using?
   - What assumptions are you making?
   - What tools or models may help you?
   - Why is that true?
   - Does that make sense?

Act III – Whole Group - Share student solutions and strategies as well as Act III solution.

1. Ask students to present their solutions and strategies.
2. Share solution http://www.101qs.com/2835-parking-lot.
3. Lead discussion to compare these, asking questions such as:
   a. How reasonable was your estimate?
   b. Which strategy was most efficient?

c. Can you think of another method that might have worked?
d. What might you do differently next time?

Comments
Act IV is an extension question or situation of the above problem. An Act IV can be implemented with students who demonstrate understanding of the concepts covered in Acts II and III. The following questions and/or situations can be used as an Act IV:

- For students who may have selected a basic question to answer, such as what is the perimeter of the lot, instruct them to pick one of the other questions to answer.
- Have you considered an entrance and exit? Have you considered cars entering and leaving parking spaces?

FORMATIVE ASSESSMENT QUESTIONS

- What models did you create?
- What organizational strategies did you use?

DIFFERENTIATION

Extension

- Provide students with various area sizes for the vehicles parking in the lot. Vehicle sizes could be 9 feet by 18 feet, 10 feet by 18 feet and 9 feet by 15 feet.

Intervention

- Have students sketch a model of the lot help determine the area and/or perimeter of the lot.
- Allow students to use color tiles to build a model of the lot, with each tile representing 10 feet.

Intervention Table

TECHNOLOGY CONNECTIONS

- http://illuminations.nctm.org/ActivityDetail.aspx?id=46 This interactive activity allows students to see how to find the area of a rectangle by manipulating the length of two sides of a rectangle. It can be used for additional practice or remediation purposes.
- http://mathcentral.uregina.ca/RR/database/RR.09.99/sawatzky1/teachnotes-meas.html#perimeter Activity 3 - Perimeter and Area: This lesson involves comparing area and perimeter. It can be used for additional practice or remediation purposes.
- http://illuminations.nctm.org/Lesson.aspx?id=2176 Finding Perimeter and Area: This lesson prompts students to determine the area and perimeter of several shapes that represent the clubhouse floor plans.

Act 1: Image and Scenario

A company has decided to use this vacant block as a parking lot until a new building is constructed.

Name: _____

Adapted from Andrew Stadel

Task Title:

ACT 1

What questions come to your mind?
On an empty number line, record an estimate that is too low, just right and an estimate that is too high. Explain your estimates.

ACT 2

What information would you like to know or need to solve the MAIN question?

Use this area for your work, tables, calculations, sketches, and final solution.

ACT 3

What was the result?

ACT 4 (use this space when necessary)

3-ACT TASK: Indoor Playground Return to Task Table

Adapted from Indoor Playground www.101qs.com

TASK CONTENT: Students will determine area and perimeter.

STANDARDS FOR MATHEMATICAL CONTENT

MGSE4.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.

STANDARDS FOR MATHEMATICAL PRACTICE

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.

BACKGROUND KNOWLEDGE

This task follows the 3-Act Math Task format originally developed by Dan Meyer. More information on this type of task may be found at http://blog.mrmeyer.com/category/3acts/. A Three-Act Task is a whole-group mathematics task consisting of 3 distinct parts: an engaging and perplexing Act One, an information and solution seeking Act Two, and a solution discussion and solution revealing Act Three. More information along with guidelines for 3-Act Tasks may be found in the ***Guide to Three-Act Tasks*** on www.georgiastandards.org.

Students worked with area and perimeter in third grade and many can find the area and perimeter of given rectangles. Some students may even be able to state the formulas for finding the perimeter and area of a rectangle. However, many students get these formulas confused unless they have sufficient opportunity to use models as they construct their understanding.

ESSENTIAL QUESTIONS

- How is perimeter different from area?
- How are the units used to measure perimeter like the units used to measure area?
- How are the units used to measure perimeter different from the units used to measure area?

MATERIALS

- 1-inch tiles (36 per student)
- 3 Act Student Recording sheet
- Act 1 image
- Act 3 reveal sheet

GROUPING

Individual or partner task

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

In this task, students will consider the scenario and then tell what they noticed. Next, they will be asked to discuss what they wonder about or are curious about. Their curiosities will be recorded as questions on a class chart or on the board. Students will then use mathematics to answer their own questions. Students will be given information to solve the problem based on need. When they realize they do not have the information they need, and ask for it, it will be given to them.

Task Directions

Act 1 – Whole Group - Pose the conflict and introduce students to the scenario by showing the Act 1 picture.

1. Show the Act I picture to students.
   The decision has been made to turn the small playground at your school into an indoor playground.

2. Pass out the 3 Act Recording Sheet.
3. Ask students what they wonder about and what questions they have about what they saw. Students should share with each other first before sharing aloud to the class and then record these questions on the recording sheet (think-pair-share). The teacher may need to guide students so that the questions generated are math related.

Anticipated questions students may ask and wish to answer:
What will be the area of the indoor playground?
How big will the indoor playground be?

4. As the facilitator, you can select which question you would like every student to answer, have students vote on which question the class will answer or allow the students to pick which question they would like to answer. Once the question is selected ask students to estimate answers to their questions (think-pair-share). Students will write their best estimate, then write two more estimates – one that is too low and one that is too high so that they establish a range in which the solution should occur. Instruct students to record their estimates on a number line.

Act II – **Student Exploration** - Provide additional information as students work toward solutions to their questions.

1. Ask students to determine what additional information they will need to solve their questions. The teacher provides that information only when students ask for it.:
    - The length of the playground is 15 feet.
    - The perimeter of the playground is 66 feet
    - The height of the swing set is 10 feet

2. Ask students to work in small groups to answer the questions they created in Act I. The teacher provides guidance as needed during this phase by asking questions such as:
    - Can you explain what you have done so far?
    - What strategies are you using?
    - What assumptions are you making?
    - What tools or models may help you?
    - Why is that true?
    - Does that make sense?

Act III – Whole Group - Share student solutions and strategies as well as Act III solution.

1. Ask students to present their solutions and strategies.
2. Share solution.
3. Lead discussion to compare these, asking questions such as:
    a. How reasonable was your estimate?
    b. Which strategy was most efficient?
    c. Can you think of another method that might have worked?
    d. What might you do differently next time?

Comments

Act IV is an extension question or situation of the above problem. An Act IV can be implemented with students who demonstrate understanding of the concepts covered in acts II and III. The following questions and/or situations can be used as an Act IV:

- What is the smallest volume of a building that would hold the playground?

FORMATIVE ASSESSMENT QUESTIONS

- What models did you create?
- What organizational strategies did you use?

DIFFERENTIATION

Extension

- Have students find all the possible areas they can create with the perimeter given.
- Students can complete Act IV of the task.

Intervention

- Start with one tile. Have the student record the dimensions of the rectangle and determine the perimeter and area. Record and sketch on the centimeter grid paper. Add one tile at a time, constructing a rectangle that always has dimensions of 1 x number of tiles used. Allow for the students to determine the dimensions, perimeter, and area. As student grows more confident have them double the size of the rectangle, making it a 2 x number of tiles. Continue this pattern until student begins to make conjectures about the area and perimeter as the rectangle grows. Students should record their findings and sketch each rectangle on the centimeter grid paper.

Intervention Table

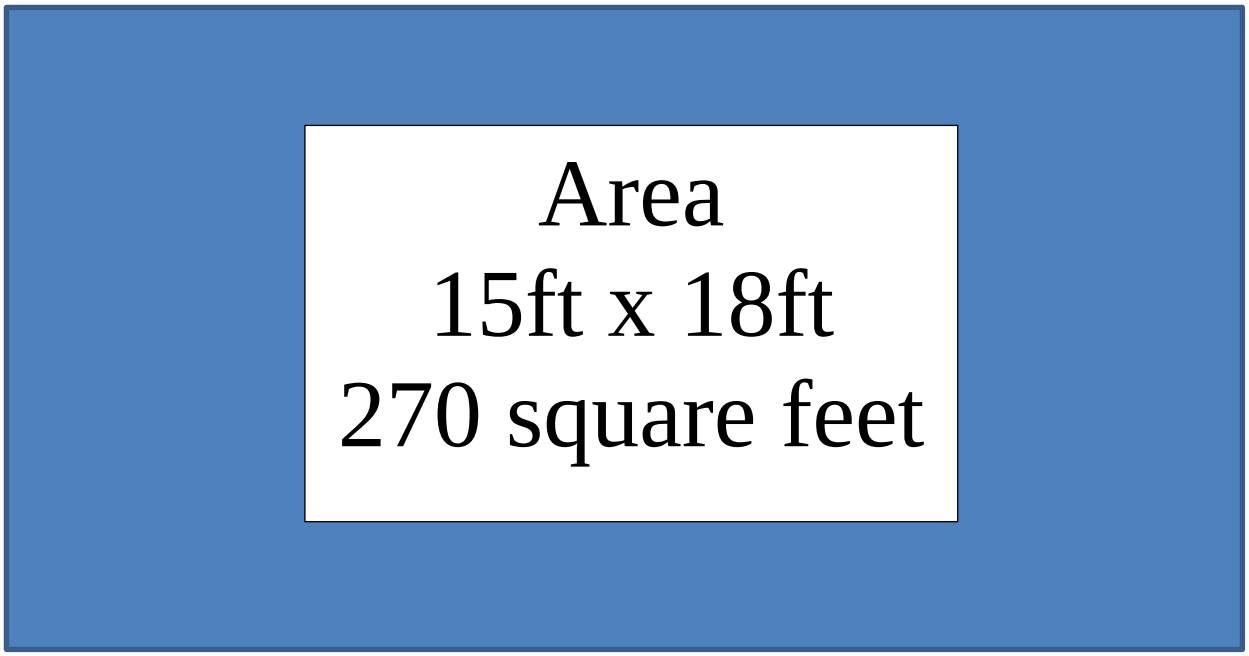
TECHNOLOGY CONNECTIONS

- http://illuminations.nctm.org/ActivityDetail.aspx?id=46 This interactive activity allows students to see how to find the area of a rectangle by manipulating the length of two sides of a rectangle. It can be used for additional practice or remediation purposes.
- http://mathcentral.uregina.ca/RR/database/RR.09.99/sawatzky1/teachnotes-meas.html#perimeter Activity 3 - Perimeter and Area: This lesson involves comparing area and perimeter. It can be used for additional practice or remediation purposes.
- http://illuminations.nctm.org/Lesson.aspx?id=2176 Finding Perimeter and Area: This lesson prompts students to determine the area and perimeter of several shapes that represent the clubhouse floor plans.

Act 1: Image and Scenario

The decision has been made to turn the small playground at your school into an indoor playground.

15 feet



18 feet

Name: _____

Adapted from Andrew Stadel

Task Title:

ACT 1

What questions come to your mind?
Main Question:

On an empty number line, record an estimate that is too low, just right and an estimate that is too high. Explain your estimates.

_____

_____

_____

_____

_____

ACT 2

What information would you like to know or need to solve the MAIN question?

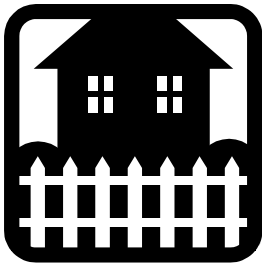
Use this area for your work, tables, calculations, sketches, and final solution.

ACT 3

What was the result?

Record the actual answer on the number line above containing the three previous estimates.

ACT 4 (use this space, when necessary)



SCAFFOLDING TASK: **The Fence or the Yard?** Return to Task Table

Adapted from North Carolina's Core Essentials Mathematics Program

TASK CONTENT: In this task, students will look for arrays around the school to practice calculating area and perimeter. The focus of this task is on the difference in area and perimeter.

APPROXIMATE TIME: 2-4 Days

STANDARDS FOR MATHEMATICAL CONTENT:

MGSE4.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.

MGSE4.MD.8 Recognize area as additive. Find areas of rectilinear figures by decomposing them into non-overlapping rectangles and adding the areas of the non-overlapping parts, applying this technique to solve real world problems.

STANDARDS FOR MATHEMATICAL PRACTICE

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

BACKGROUND KNOWLEDGE

Area can be found by tiling a rectangle and then counting the square units used to cover the rectangle or multiplying the side lengths to show it is the same. Students will also be using this knowledge to solve real world problems.

Students develop an understanding of the concept of perimeter by walking around the perimeter of a room or space, such as the playground or parking lot, using rubber bands to represent the perimeter of a plane figure on a geoboard, or tracing around a shape on an interactive whiteboard. They use addition to find perimeters and recognize the patterns that exist when finding the sum of the lengths and widths of rectangles.

COMMON MISCONCEPTIONS

Students may confuse perimeter and area when they measure the sides of a rectangle and then multiply. They think the attribute they find is length, which is perimeter. Pose problems situations that require students to explain whether they are to find the perimeter or area.

ESSENTIAL QUESTIONS

- How are the perimeter and area of a shape related?
- How can rectangles have the same perimeter but have different areas?
- What methods can I use to determine the area of an object?
- How can I demonstrate my understanding of the measurement of area and perimeter?

MATERIALS

- Math Journals (or paper)
- Manipulatives/cut outs (to help students create models for their problems)
- Tape
- Geoboards

GROUPING

Students may be grouped individually, in pairs, or in small groups at the teacher's discretion.

NUMBER TALK

By now number talks should be incorporated into the daily math routine. Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. In addition, Catherine Fosnot has developed "strings" of numbers that could be included in a number talk to further develop mental math skills. See *Minilessons for Early Multiplication and Division* by Willem Uittenbogaard and Catherine Twomey Fosnot (2007).

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

Part I (Whole Group) (SMP 1, 2, 6, and 7)

As a class, try these activities to build understanding of the concepts of area and perimeter. Discuss and clarify misunderstandings and misconceptions.

Array Scavenger Hunt

Where are rectangular arrays used? Go for a walk through the school. Look in your classroom, your home, or outside to find examples of arrays. List the examples you find and write a multiplication equation for each array.

Comparing Area and Perimeter

Find a place in your school where there are square tiles. (Many schools have square tiles on the floor. If there are none, this activity can be done using geoboards.) With a teacher's help, use tape to outline different rectilinear shapes. You can also create "Tetris-like" shapes as well.

- Find the perimeter of each shape.
- Find the area of each shape.
- Discuss the difference between the area and perimeter of your shapes.

Part II (Small Group) (SMP 1, 3, and 6)

"The Situation Station"

- In small groups, discuss these questions and topics. Use pictures, numbers, models, and words to prove your thinking. When you are finished, compare your findings with other groups.
- Situation #1: If someone says, "Perimeter is the fence, and area is the yard", what do they mean?
- Situation #2: You want to know the number of small squares on a checkerboard. Explain how a rectangular array could help you determine the number of squares quickly.

PART III (Partner Task) (SMP 1, 2, 3, 4, 5, 6, 7, and 8)

Complete this task with a partner. Use unit squares or tiles. The smallest size square you can make is from one square. Use the squares or tiles to make the next size square.

- How many squares did you use? What is the area of your new square? What is the perimeter?
- Build the next size square. What is the area of your new square? What is the perimeter?
- What do you notice?
- Can you figure out what the next square will be without using the tiles?
- How can you find "the next square?"

FORMATIVE ASSESSMENT QUESTIONS

- How did you find the area?
- How did you find the perimeter?
- What is the difference between area and perimeter?
- How do multiplication and arrays relate to area?

DIFFERENTIATION

Extension

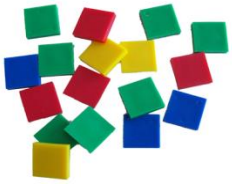
- Draw or cut out all possible rectangles with a perimeter of 16 inches and label them. How many different rectangles can you find? Find and record the area of each rectangle. Which rectangle has the greatest area? If you were building a dog pen, which rectangle shape would be best? Why?

Intervention

- With a partner, make a t-chart. Label one side "perimeter." Label the other side "area."
    - Discuss times when someone would need to know the perimeter of something. Add them to the list.
    - Discuss times when someone would need to know the area of something. Add them to the list.
    - Share your list with other groups.

Intervention Table

3-ACT TASK: Piles of Tiles Return to Task Table



Task Adapted From www.gfletchy.wordpress.com

TASK CONTENT: Students will find the area of a rectilinear figure by decomposing the figure into smaller rectangles or squares.

APPROXIMATE TIME: 1 class period

STANDARDS FOR MATHEMATICAL CONTENT

MGSE4.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.

MGSE4.MD.8 Recognize area as additive. Find areas of rectilinear figures by decomposing them into non-overlapping rectangles and adding the areas of the non-overlapping parts, applying this technique to solve real world problems.

STANDARDS FOR MATHEMATICAL PRACTICE

1. **Make sense of problems and persevere in solving them.** Students must make sense of the problem by identifying what information they need to solve it.
2. **Reason abstractly and quantitatively.** Students are asked to make an estimate (high and low) to determine a reasonable range that the possible solution might fall within.
3. **Construct viable arguments and critique the reasoning of others.** After writing down their own questions, students discuss their question with partners, creating the opportunity to construct the argument of why they chose their question, as well as critiquing the questions that others came up with.
4. **Model with mathematics.** Once given the information, the students use that information to develop a mathematical model to solve their question.
5. **Use appropriate tools strategically.** Students write their best estimate and two more estimates – one that is too low and one that is too high to establish a range in which the solution would occur.
6. **Attend to precision.** Students use clear and precise language when discussing their strategies and sharing their own reasoning with others.
8. **Look for and express regularity in repeated reasoning.** Students should begin to notice that a rectilinear figure can be decomposed into smaller rectangles and squares. Students repeatedly use the formula for finding the area of rectangles and squares to find the area of the rectilinear figure.

ESSENTIAL QUESTIONS

In order to maintain a student-inquiry-based approach to this task, it may be beneficial to wait until Act 2 to share the EQ's with your students. By doing this, students will be allowed the opportunity to be very creative with their thinking in Act 1. By sharing the EQ's in Act 2, you will be able to narrow the focus of inquiry so that the outcome results in student learning directly related to the content standards aligned with this task.

- How can area be determined without counting each square?
- How does knowing the dimensions of a rectangle relate to area?
- What is the relationship between dimensions and factors?

MATERIALS

- Act 1 video- https://vimeo.com/87987100
- Act 1 picture (attached)
- Act 2- Table Dimension Picture (attached)
- Act 2- Number of Tiles in the Bag Picture (attached)
- Act 3 pictures (attached)
- Student recording sheet

GROUPING

Individual/Partner and or Small Group

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

In this task, students will view the video (https://vimeo.com/87987100) and tell what they noticed. Next, they will be asked to discuss what they wonder about or are curious about. These questions will be recorded on a class chart or on the board and on the student recording sheet. Students will then use mathematics to answer their own questions. Students will be given information to solve the problem based on **need**. When they realize they don't have the information they need, and ask for it, it will be given to them.

Background Knowledge:

This task follows the 3-Act Math Task format originally developed by Dan Meyer. More information on this type of task may be found at http://blog.mrmeyer.com/category/3acts/. A Three-Act Task is a whole-group mathematics task consisting of 3 distinct parts: an engaging and perplexing Act One, an information and solution seeking Act Two, and a solution discussion and solution revealing Act Three. More information along with guidelines for 3-Act Tasks may be found in the ***Guide to Three-Act Tasks*** on georgiastandards.org.

"Area is an amount of two-dimensional surface that is contained within a plane figure. Area measurement assumes that congruent figures enclose equal areas, and that area is additive, i.e., the area of the union of two regions that overlap only at their boundaries is the sum of their areas.

Area is measured by tiling a region with a two-dimensional unit (such as a square) and parts of the unit, without gaps or overlaps. Understanding how to spatially structure a two-dimensional region is an important aspect of the progression in learning about area" (from *Progressions for Common Core State Standards*, 2012, p. 4).

Van de Walle states that area is a measure of the space inside a region or how much it takes to cover a region. As with other attributes, students must first understand the attribute of area before measuring. "One purpose of comparison activities with areas is to help students distinguish between size (or area) and shape, length, and other dimensions. Activities in which one area is rearranged (conservation of area) are suggested. Cutting a shape into two parts and reassembling it in a different shape can show that the before and after shapes have the same area, even though they are different shapes" (Teaching Student Centered Mathematics, Volume II, Van de Walle, p. 324).

Common Misconceptions:

Students may think that different shapes made with the same units have different areas as well. This is due to lack of experience in developing conservation on area. (Math Misconceptions: From Misunderstanding to Deep Understanding (2010), Bamberger, Oberdorf, and Shultz-Ferrel. Using activities such as the one presented in the lesson with tangrams and arrays will provide the needed spatial experience for students to develop this understanding.

Task Directions:

Act 1 – Whole Group - Pose the conflict and introduce students to the scenario by showing Act I video and picture. **(Dan Meyer** http://blog.mrmeyer.com/2011/the-three-acts-of-a-mathematical-story/**)**
"Introduce the central conflict of your story/task clearly, visually, viscerally, using as few words as possible."

- Show the Act 1 video (https://vimeo.com/87987100) **and** picture to your students.
- Ask students what they noticed in the video and picture, what they wonder about, and what questions they have about what they saw in the video and picture. Do a think-pair-share so that students have an opportunity to talk with each other before sharing questions with the whole group. Students may need to watch the video several times.
- Share and record students' questions. The teacher may need to guide students so that the questions generated are math related.

Act 1 Picture:

Anticipated questions students may ask and wish to answer: (*Main question(s) to be investigated)

- * Are there enough tiles to cover the table?
- How many tiles are in the bag?
- *How many tiles will it take to cover the table?
- What is the area of the table?
- What is the perimeter of the table?

- Once students have their question, ask the students to estimate answers to their questions (think-pair-share). Students will write their best estimate, then write two more estimates – one that is too low and one that is too high so that they establish a range in which the solution should occur. Students should plot their three estimates on an empty number line. Note: As the facilitator, you may choose to allow the students to answer their own posed questions, one question that a fellow student posed, or a related question listed above. For students to be completely engaged in the inquiry-based problem-solving process, it is important for them to experience ownership of the questions posed.

Important note: Although students will only investigate the main question(s) for this task, it is important for the teacher to not ignore student generated questions. Additional questions may be answered after they've found a solution to the main question, or as homework or extra projects.

Act 2 – **Student Exploration** - Provide additional information as students work toward solutions to their questions. **(Dan Meyer** http://blog.mrmeyer.com/2011/the-three-acts-of-a-mathematical-story/**)**
"The protagonist/student overcomes obstacles, looks for resources, and develops new tools."

- During Act 2, students decide on the facts, tools, and other information needed to answer the question(s) (from Act 1). When students decide what they need to solve the problem, they should ask for those things. It is pivotal to the problem-solving process that students decide what is needed without being given the information up front.

- Required Information:
  1. Table Dimensions Picture

  2. Number of Tiles in the Bag

- Some groups might need scaffolds to guide them. The teacher should question groups who seem to be moving in the wrong direction or might not know where to begin. Questioning is an effective strategy that can be used, with questions such as:
  - What is the problem you are trying to solve?
  - What do you think affects the situation?
  - Can you explain what you have done so far?
  - What strategies are you using?
  - What assumptions are you making?
  - What tools or models may help you?

- Why is that true?
- Does that make sense?

Act 3 – Whole Group – Share solutions and strategies.

- Students to present their solutions and strategies and compare them.
- Reveal the solution in Act 3 pictures (see attached). If students choose to answer the question about how many tiles it takes to cover the table, reveal that the answer is about 2,000.
- Lead discussion to compare these, asking questions such as:
  - How reasonable was your estimate?
  - Which strategy was most efficient?
  - Can you think of another method that might have worked?
  - What might you do differently next time?

Act 4 - The Sequel - "The goals of the sequel task are to a) challenge students who finished quickly so b) I can help students who need my help. It can't feel like punishment for good work. It can't seem like drudgery. It has to entice and activate the imagination." Dan Meyer http://blog.mrmeyer.com/2013/teaching-with-three-act-tasks-act-three-sequel/

For Act 4, reference other student-generated questions that could be used for additional classwork, projects or homework.

FORMATIVE ASSESSMENT QUESTIONS

- What organizational strategies did you use?
- What can be used to measure area?
- How is area used in real-world situations?

DIFFERENTIATION

Extension

- If you were to add sections to the table where currently there isn't any, how many more tiles would you need?

Intervention

- Have students solve the area for half of the table or a fifth of the table.

Intervention Table

Act 1: Picture

Act 2: Table Dimensions

Act 2: Number of tiles in the bag

Act 3: Pictures

Name: _____

Adapted from Andrew Stadel

Task Title:

ACT 1

What questions come to your mind?
Main Question:

On an empty number line, record an estimate that is too low, just right and an estimate that is too high. Explain your estimates.

_____
_____
_____
_____
_____
_____
_____

ACT 2

What information would you like to know or need to solve the MAIN question?

Use this area for your work, tables, calculations, sketches, and final solution.

ACT 3

What was the result?

ACT 4 (use this space when necessary)

SCAFFOLDING TASK: Setting the Standard Return to Task Table

TASK CONTENT: Students will understand and use a standard unit of measure (gram).

STANDARDS FOR MATHEMATICAL CONTENT

MGSE4.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.

a. Understand the relationship between gallons, cups, quarts, and pints.
b. Express larger units in terms of smaller units within the same measurement system.
c. Record measurement equivalents in a two-column table.

STANDARDS FOR MATHEMATICAL PRACTICE TO BE EMPHASIZED

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.

BACKGROUND KNOWLEDGE

Students should know how to measure mass using a balance.

Students should have experience measuring and comparing weight using a balance scale and understand the difference between standard and non-standard units of measurement.

The Metric prefixes are as follows:

Kilo	Hecto	Deka	Gram	Deci	Centi	Milli
1,000	100	10	1	1/10	1/100	1/1,000

Based on the chart above, 10 grams is 1 dekagram, 100 grams is 1 hectogram, and 1,000 grams is a kilogram. Also, one tenth of a gram is a decigram, one hundredth of a gram is a centigram, and one thousandth of a gram is a milligram. **Remember, in fourth grade students are only responsible to know and understand the relationship between kilogram and gram**. However, it is appropriate to use the correct label when creating 10-gram bags and 100-gram bags.

ESSENTIAL QUESTIONS

- What is weight (mass when using a balance)?
- Why do we measure weight and mass?
- What units are appropriate to measure weight and mass?
- What objects around us weighs about a gram?
- What happens to a measurement when we change units?

MATERIALS

For each group
- Balance scale
- Set of small items
- Set of gram weights (1g, 5g, 10g, and 20g)

For each student
- "Setting the Standard" student recording sheet
- Snack-size zippered plastic bag

For the class
- 5 lbs. aquarium gravel
- Several pieces of fruit (apple, orange, banana)
- One 2-gallon zippered plastic bag (to create a 1-kilogram bag)

GROUPING

Small Group Task

NUMBER TALKS

Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. Catherine Fosnot has developed problem "strings" which may be included in number talks to further develop mental math skills. See *Mini lessons for Operations with Fractions, Decimals, and Percents* by Kara Louise Imm, Catherine Twomey Fosnot and Willem Uittenbogaard. (*Mini lessons for Operation with Fractions, Decimals, and Percents*, 2007, Kara Louise Imm, Catherine Twomey Fosnot and Willem Uittenbogaard)

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

In this task, students transition from non-standard to a standard unit of measure (grams). Then students use grams to measure the mass of fruit.

The distinction between mass and weight is not made until middle school, when students begin their study of gravity. Therefore, the emphasis of this unit should be placed on measurement. In the classroom, teachers should use the correct name (mass or weight) depending of the instrument used to make the measurement. ("Mass" is used when measuring with a balance scale; "weight" is used when measuring with a spring scale, which includes scales like a bathroom scale.)

Comments

To introduce this task, show a gram weight. Introduce its name and symbol and describe it as a standard unit of mass. Ask students to use the balance scale to compare 1 gram (1g) to the paper clips. Show the other gram weights (5g, 10g, and 20g) and have students estimate and then measure how many paper clips would equal each weight. Ask students to share their findings.

When discussing the mass of the fruit, guide students to suggest making new units (100 g weights). These can be created using a zippered plastic bag and aquarium gravel. Let students show how these can be created. Students should determine that they will have to combine their weight sets to get a total of 100 grams on one side of the balance scale and then measure an equivalent amount of gravel to balance the scale. Provide the fruit and have students measure the fruit using the new and old weights. (A medium apple weighs about 200g.)

Some students may try to name this new unit 100 grams (100g). If so, encourage the use of metric roots and prefixes from prior knowledge to do so (see "Background Knowledge" above.) Finally, collect 10 of the 100g bags and place them in a large zippered plastic bag. Ask students to figure out the mass of this new unit (1000 g). Guide students to the term kilogram meaning 1000 grams.

Task Directions

Students will follow the directions below from the "Setting the Standard" student recording sheet.

1. Find the mass of each object using 1-gram (1 g) weights.
2. Record the masses in the chart below.
3. Place a piece of fruit in your balance scale. Talk with your group about how you would measure the fruit using metric units. Record your thoughts below.
4. Create a three-column chart similar to the one above. Label the first column **Fruit Name**, the second column **Measurement in Grams (g)**, and the third column **Measurement in Kilograms (kg)**. Find the mass of each piece of fruit and record it in your chart. Students may find the mass of more than one piece of fruit to have at least one kilogram.

FORMATIVE ASSESSMENT QUESTIONS

- What is the difference between a standard and non-standard unit of measurement?
- How can you use gram weights and a balance scale to measure the mass of an object?
- What is the difference between units in the same system of measurement?

DIFFERENTIATION

Extension

- Ask students to find the mass of the objects using different units, such as hectograms and dekagrams.
- Ask students to estimate how many apples would be needed to make one kilogram? How many bananas? How many oranges?

Intervention

- Make the relationship between kilogram and gram (1kg = 1,000g) explicit.
- Add the second chart to the student recording sheet, allowing the student to focus on measurement, not creating a chart.

Intervention Table

TECHNOLOGY

- http://www.bbc.co.uk/bitesize/ks1/maths/length_and_weight/play/ Harbour Measurements: This online activity allows students to learn about length and weight. It can be used for additional practice.
- http://www.bgfl.org/bgfl/custom/resources_ftp/client_ftp/ks2/maths/weigh/index.htm Weigh It Up: This activity is a problem-solving activity which uses a set of scales and a variety of shapes. It can be used for additional practice or remediation purposes.
- http://www.youtube.com/watch?v=vbglZ9qw0hU This Ten Marks tutorial video about comparing weight measurements can be used for remediation purposes.

Setting the Standard

1. Measure each item using gram weights in the balance scale. Record the measures in the chart below.

Item Name	Measurement in Grams (g)	Measurement in Kilograms (kg)

2. Place a piece of fruit in your balance scale. Talk with your group about how you would measure the fruit using metric units. Record your thoughts below.

_____

_____

_____

_____

3. Create a three-column chart similar to the one above. Label the first column **Fruit Name**, the second column **Measurement in Grams (g)**, and the third column **Measurement in Kilograms (kg)**. Find the weight of each piece of fruit and record it in your chart. You may weigh more than one piece of fruit at a time.

SCAFFOLDING TASK: Measuring Mass Return to Task Table

TASK CONTENT: Estimate and find the mass items using grams and kilograms.

STANDARDS FOR MATHEMATICAL CONTENT

MGSE4.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.

a. Understand the relationship between gallons, cups, quarts, and pints.
b. Express larger units in terms of smaller units within the same measurement system.
c. Record measurement equivalents in a two-column table.

STANDARDS FOR MATHEMATICAL PRACTICE TO BE EMPHASIZED

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.

BACKGROUND KNOWLEDGE

In third grade, students became familiar with the terms gram and kilogram, the metric units used to measure the mass of an object. One kilogram is equal to 1,000 grams. One-gram weighs about as much as a large paper clip or a packet of sweetener and one kilogram is the weight of a textbook a baseball bat and is equal to about 2.2 pounds.

ESSENTIAL QUESTIONS

- How are grams and kilograms related?
- What objects around us has a mass of about a gram? About a kilogram?
- When should we measure with grams? Kilograms?
- What happens to a measurement when we change units?

MATERIALS

- "Measuring Mass, Part 1 – Grams" student recording sheet
- "Measuring Mass, Part 2 – Kilograms" student recording sheet
- Large paper clip
- Gram weight
- Balance scale
- 1 kg reference weights

GROUPING

Small Group Task

NUMBER TALKS

Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. Catherine Fosnot has developed problem "strings" which may be included in number talks to further develop mental math skills. See *Mini lessons for Operations with Fractions, Decimals, and Percents* by Kara Louise Imm, Catherine Twomey Fosnot and Willem Uittenbogaard. (*Mini lessons for Operation with Fractions, Decimals, and Percents*, 2007, Kara Louise Imm, Catherine Twomey Fosnot and Willem Uittenbogaard)

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

In this task, students will experiment with gram and kilogram weights. They will select objects to weigh, estimate their mass, and then use a balance scale to determine the actual mass.

Comments

Before beginning this task, you may want to review the previous task in which students made kilogram weights from bags and material such as aquarium gravel.

This task can be broken into two parts or the class can be broken into groups and the students can rotate through each part of the task.

One-liter bottles filled with water have a mass of about one kilogram. Alternatively, fill bags with sand, aquarium gravel, or dried beans. Students can use these "reference weights" to compare masses when looking for items that have a mass of one kilogram.

Part 1

To introduce this part of the task, hold up a large paper clip and explain that it has a mass of about one gram. Pass some large paper clips around to the students so that they can get an idea of how much a gram is. Involve the class in a discussion about what might be appropriate to measure in grams. After asking the class for a few suggestions, students will list things in the classroom they think they could find the mass of using grams. Ask students to record their items in the table on their student recording sheet, "Measuring Mass, Part 1 – Grams."

For each item on their chart, students should hold the item to estimate its mass first, measure its mass using a spring scale, and write down the actual mass of each item.

When students are finished, hold a class discussion about what objects are appropriate to find the mass of in grams and what students learned from this part of the task.

Part 2

To introduce this part of the task, pass the kilogram referents around to the students. Ask the class for a few suggestions of classroom items for which kilograms would be an appropriate unit of measure.

For each item on their chart, students should first hold the item to estimate its mass (more than, less than, or about 1 kilogram), measure its mass using a spring scale, and write down the actual weight of each item.

When students are finished, hold a class discussion about what objects are appropriate to find the mass of in grams and what students learned from this part of the task.

Task Directions
Part 1 - Grams
Students will follow the directions below from the "Measuring Mass, Part 1 - Grams" student recording sheet.

"Think about how heavy a paper clip is. Now find five objects that you think should be measured using grams. Do not use a scale to check yet! After you have found five objects:"

- Write the name of the objects in the chart below.
- Make an estimate for each item and record it in the chart below.
- Find the mass of each item using the scale provided and record it in the chart below.

1. How did you make your estimates?
2. Why are the items you chose appropriate to measure in grams?
   Be ready to share your thinking with the class.

Part 2
Students will follow the directions below from the "Measuring Mass, Part 2 - Kilograms" student recording sheet.

"You and your partner are going on a kilogram scavenger hunt! Use one of the reference weights to get an idea of what one kilogram feels like. Then find items around the room that have a mass of less than, about, and more than one kilogram."

1. List the items in the table below.
2. Predict whether each item is more than, less than, or about 1 kilogram.
3. Find the mass of each item using a balance scale.
4. Record the mass in the last column.

"Remember: 1 kg = 1,000 grams"

"Look at the table. Write about what you found about your understanding of a kilogram? Be prepared to discuss your findings with the class.

On the back of this sheet, list at least five items for which kilograms would be appropriate as the unit of measure."

FORMATIVE ASSESSMENT QUESTIONS

- Why is it important to associate items with a given mass?
- When would you use grams and kilograms in your everyday life?
- What are your predictions for which objects will have a mass of about a gram? Why?
- What are your predictions for which objects will have a mass of about a kilogram? Why?

DIFFERENTIATION

Extension

- Have students find ten items around their house that they would measure using grams or kilograms. Encourage them to find five items for grams, and five items for kilograms. Have them estimate the mass of each item.
- Have students estimate the mass of five different people in kilograms. (family members, neighbors, friends, babysitters, etc.).

Intervention

- Each week have a ten-minute discussion about units of mass. Ask students to choose an item from the classroom, discuss the appropriate unit to use to measure the mass, and then estimate the weight of the object. In math journals, have students keep a reference list of the different masses of items using grams and kilograms. This can be used as a reference throughout the year.

Intervention Table

TECHNOLOGY

- http://www.bbc.co.uk/bitesize/ks1/maths/length_and_weight/play/ Harbour Measurements: This online activity allows students to learn about length and weight. It can be used for additional practice.

- http://www.bgfl.org/bgfl/custom/resources_ftp/client_ftp/ks2/maths/weigh/index.htm Weigh It Up: This activity is a problem-solving activity which uses a set of scales and a variety of shapes. It can be used for additional practice or remediation purposes.

- http://www.youtube.com/watch?v=vbglZ9qw0hU Compare and Convert Weight in Customary Units: This Ten Marks tutorial video about comparing weight measurements can be used for remediation purposes.

Name _____ Date _____

Measuring Mass

Part 1 – Grams

Think about how heavy a paper clip is. Now find five objects that you think should be measured using grams. Do not use a scale to check yet! After you have found five objects:

- Write the name of the objects in the chart below.
- Make an estimate for each item and record it in the chart below.
- Find the mass of each item using the scale provided and record it in the chart below.

Object	Estimated Mass (g)	Actual Mass (g)
1.		
2.		
3.		
4.		
5.		
6.		

1. How did you make your estimates?

_____

_____

2. Why are the items you chose appropriate to measure in grams?

_____

_____

3. Be ready to share your thinking with the class.

Name _____ Date _____

Measuring Mass

Part 2 - Kilograms

You and your partner are going on a kilogram scavenger hunt! Use one of the reference weights to get an idea of what one kilogram feels like. Then find items around the room that have a mass of less than, about, and more than one kilogram.

1. List the items in the table below.
2. Predict whether each item is more than, less than, or about 1 kilogram.
3. Find the mass of each item using a balance scale.
4. Record the mass in the last column.

Remember: 1 kg = 1,000 grams

Object	**Prediction** (check the correct box below)			**Actual Mass (g)**
	Less Than 1 Kilogram	More Than 1 Kilogram	About 1 Kilogram	
1.				
2.				
3.				
4.				
5.				
6.				

Look at the table. Write what you found about your understanding of a kilogram? Be prepared to discuss your findings with the class.

On the back of this sheet, list at least five items for which kilograms would be appropriate as the unit of measure.

CONSTRUCTING TASK: A Pound of What?

Return to Task Table

TASK CONTENT: Students will understand and use pound as a measure of weight.

STANDARDS FOR MATHEMATICAL CONTENT

MGSE4.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.

a. Understand the relationship between gallons, cups, quarts, and pints.
b. Express larger units in terms of smaller units within the same measurement system.
c. Record measurement equivalents in a two-column table.

STANDARDS FOR MATHEMATICAL PRACTICE TO BE EMPHASIZED

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.

BACKGROUND KNOWLEDGE

Students should know how to use a scale and have heard the term pound as a unit of weight measurement. You may want to begin with a brainstorming session of when they have heard the term "pound" used in real life.

ESSENTIAL QUESTIONS

- Why are units important in measurement?
- What units are appropriate to measure weight?
- How heavy does one-pound feel?

MATERIALS

- "A Pound of What?, Part 1 – How Much Is a Pound?" student recording sheet
- "A Pound of What?, Part 2 – What Weighs a Pound?" student recording sheet
- One-pound (1 lb) weight
- 1 cloth or paper bag for each student
- Sand, aquarium gravel, blocks, cubes, beans, etc. for students to fill bags
- Items in the classroom that weigh about one pound
- Spring scale

GROUPING

Partner Task

NUMBER TALKS

Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. Catherine Fosnot has developed problem "strings" which may be included in number talks to further develop mental math skills. See *Mini lessons for Operations with Fractions, Decimals, and Percents* by Kara Louise Imm, Catherine Twomey Fosnot and Willem Uittenbogaard. (*Mini lessons for Operations with Fractions, Decimals, and Percents*, 2007, Kara Louise Imm, Catherine Twomey Fosnot and Willem Uittenbogaard)

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

In this task, students will be involved in a kinesthetic activity that helps them experience how heavy a pound is and develop a conceptual understanding of a pound. Students will then use that experience to estimate the weight of everyday items.

Comments

This task can be broken into two parts or the class can be broken into groups and the students can rotate through each part of the task.

You will need a lot of material (sand, aquarium gravel, blocks, cubes, and/or beans) if every student is going to create their own pound. You will need at least 25 pounds of material for 20 students. In order to allow students to experiment when creating one pound, there should be more than one pound of material per student. If you do not have enough material, students may work in pairs to create a pound.

Part 1 – How Much is a Pound?

To introduce this task, pass a one-pound weight around to the students. Ask each student to hold the one pound and to try to remember how heavy it feels. Bags of materials can be made ahead of time and be used as referents for this task. (Bags may contain sand, aquarium gravel, blocks, cubes, beans, etc.)

Students should empty and refill their bags at least three times, even if they were very close to one pound on their first or second attempt. Also, using mathematical words to describe whether the bag weighs more than, less than, or equal to a pound is an important part of this activity. Make sure the students don't skip this step.

Part 2 – What Weighs a Pound?

To introduce this part of the task, while the pound referents are being passed around to the students, ask the class for a few suggestions of classroom items for which pounds would be an appropriate unit of measure.

For each item on their chart, students should first hold the item to estimate its weight (more than, less than, or about 1 pound), measure its weight using a spring scale, and write down the actual weight of each item.

When students are finished, hold a class discussion about what objects weigh approximately one pound and what students learned from this part of the task. Use the results from the students' work to generate a list of items in the classroom that weigh approximately one pound. One of the most important goals in teaching and learning measurement skills is for students to have some familiar referents for common units; therefore, a poster with items that weigh about one pound would be a good reference list to post for use throughout the year.

Task Directions

Part 1 – How Much is a Pound?

Students will follow the directions below from the "A Pound of What? Part 1 – How Much is a Pound?" student recording sheet.

> Think about how heavy the pound your teacher gave you felt. Now create a bag that you think will weigh about 1 pound. Do not use a scale to create your bag! After you have made your 1-pound bag, weigh your bag using the scale provided.
>
> - Does your bag weigh less than a pound?
> - More than a pound?
> - Exactly one pound?
>
> 1. Determine if your bag weighs more than, less than, or equal to one pound. Record your results in the chart below.
> 2. List common items from school or home that could be measured using pounds.
> 3. Think, could the same items be measured using kilograms? Record your thinking below.

Part 2 – What Weighs a Pound?

Students will follow the directions below from the "A Pound of What? Part 2 – What Weighs a Pound?" student recording sheet.

> You and your partner are going on a pound scavenger hunt! Use one of the reference weights to get an idea of how heavy one pound is. Then find items around the room that weigh less than, about, and more than one pound.
>
> 1. List the items in the table below.
> 2. Predict whether each item is more than, less than, or about 1 pound.
> 3. Weigh each item with a spring scale.
> 4. Record the weight in the last column.
>
> Look at the table. Write what you found about your understanding of a pound? Be prepared to discuss your findings with the class.

FORMATIVE ASSESSMENT QUESTIONS

- When could you use a pound in your everyday routines?
- How could you estimate and/or measure an item without using a scale?

DIFFERENTIATION

Extension

- Sometimes it is helpful to have some referents for weights. For example, a bag of sugar or flour is about 5 pounds; a bag of potatoes may weigh 10 pounds, etc. Ask students to create a poster of common everyday objects that weigh a specific amount. (Be careful about weights indicated on a product package as that will *not* include the weight of the container, which may be significant in some situations. This would be a good discussion to have with students.)

Intervention

- Create picture cards of items and separate cards with corresponding weights in pounds. Have students match the items with their weights and use a self-checking system on the back of the cards. Understanding how much items in their own world weigh will assist in the overall understanding of the unit.

Intervention Table

TECHNOLOGY

- http://www.youtube.com/watch?v=vbglZ9qw0hU Compare and Convert Weights in Customary Units: This tutorial video about converting measures of weight can be used for remediation purposes.
- http://www.mathsisfun.com/measure/index.html Measurement Index: This is a tutorial resource which discusses converting customary units of weight. It can be used for remediation purposes.

A Pound of What?

Part 1 – How Much is a Pound?

Think about how heavy the pound your teacher gave you felt. Now create a bag that you think will weigh about 1 pound. Do not use a scale to create your bag! After you have made your 1-pound bag, weigh your bag using the scale provided.

1. Determine if your bag weighs more than, less than, or equal to one pound. Record your results in the chart below.

	Actual Weight of My Bag	**More Than**, **Less Than**, or **Equal to** One Pound
Attempt #1		My bag weighs _____ a pound.
Attempt #2		My bag weighs _____ a pound.
Attempt #3		My bag weighs _____ a pound.

2. List common items from school or home that could be measured using pounds.

_____ _____ _____

_____ _____ _____

_____ _____ _____

_____ _____ _____

3. Think, could the same items be measured using kilograms? Record your thinking below.

_____

_____

A Pound of What?

Part 2 – What Weighs a Pound?

You and your partner are going on a pound scavenger hunt! Use one of the reference weights to get an idea of how heavy one pound is. Then find items around the room that weigh less than, about, and more than one pound.

1. List the items in the table below.
2. Predict whether each item is more than, less than, or about 1 pound.
3. Weigh each item with a spring scale.
4. Record the weight in the last column.

Remember: 1 lb = 16 ounces

Object	**Prediction** (check the correct box below)			**Actual Weight (oz or lbs)**
	Less Than 1 Pound	More Than 1 Pound	About 1 Pound	
1.				
2.				
3.				
4.				
5.				
6.				

Look at the table. Write what you found about your understanding of a pound. Be prepared to discuss your findings with the class.

CONSTRUCTING TASK: Exploring an Ounce Return to Task Table

TASK CONTENT: Students will understand and use an ounce as a measure of weight.

STANDARDS FOR MATHEMATICAL CONTENT

MGSE4.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.

a. Understand the relationship between gallons, cups, quarts, and pints.
b. Express larger units in terms of smaller units within the same measurement system.
c. Record measurement equivalents in a two-column table.

STANDARDS FOR MATHEMATICAL PRACTICE TO BE EMPHASIZED

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.

BACKGROUND KNOWLEDGE

Students should have worked with the gram and kilogram prior to this task. They should also understand simple fractions and the use of a balance scale and spring scale.

ESSENTIAL QUESTIONS

- What units are appropriate to measure weight?

MATERIALS

- "Exploring an Ounce, Part 1 – Creating an Ounce" student recording sheet (2 pages)
- "Exploring an Ounce, Part 2 – Estimating an Ounce" student recording sheet
- One pound of clay, play-dough, or sand per group
- Balance scales (for part 1)
- Spring scales (for part 2)

GROUPING

Small Group Task

NUMBER TALKS

Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. Catherine Fosnot has developed problem "strings" which may be included in

number talks to further develop mental math skills. See *Mini lessons for Operations with Fractions, Decimals, and Percents* by Kara Louise Imm, Catherine Twomey Fosnot and Willem Uittenbogaard. (*Mini lessons for Operations with Fractions, Decimals, and Percents*, 2007, Kara Louise Imm, Catherine Twomey Fosnot and Willem Uittenbogaard)

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

In this task, students will construct an ounce and investigate its uses in weight measurement.

Comments
An important concept for students in weight measurement is to develop referents for different units of measurement. The ounce can seem very arbitrary to students, especially since it is a sixteenth of a pound, not a commonly used fraction. Physically constructing an ounce (in Part 1) allows students to gain an understanding of the relationship between an ounce and a pound.

Students should search for items in this activity the same way in which they found items for the pound, gram, and kilogram. (See Part 2)

Make sure students do not confuse the weight measure ounce with the liquid measure ounce, also known as a fluid ounce. This is a common mistake. Many students may be familiar with a 16-ounce or 20-ounce drink, and they can easily confuse the two different units. It would be beneficial to discuss the fact that the ounces used in customary capacity measurement are known as fluid ounces and are abbreviated fl.oz. Show students a bottle of water, a soda bottle, or a bottle of lotion to show the abbreviation for fluid ounces.

Task Directions
Part 1 – Creating an Ounce

Students will follow the directions below from the "Exploring an Ounce – Part 1; Creating an Ounce" student recording sheet.

1. Would pounds be a good way to measure the weight of a nickel? Why or why not?
2. Would pounds be a good way to measure the weight of a pencil? Why or why not?
3. Would pounds be a good way to measure the weight of a textbook? Why or why not?
4. Some things are too small to weigh accurately in terms of a whole pound. Therefore, we need some way to divide the pound into smaller units. You're going to use one pound (1 lb) of clay (or other materials) to do that.
    a. Using the scale at your desk, divide your clay into two equal parts. How did you use your scale to determine if it has been divided equally?
    b. What fraction of a whole pound have you created?
    c. Take one of the pieces you just created and divide it into two equal pieces. Again, make sure the pieces are equal using your balance scale. What fraction of the whole pound is one of these pieces of clay?

d. Continue doing this until you have two pieces of clay that are each $\frac{1}{16}$ of the pound. How many times did you have to divide to do this? Explain how you know.
e. The smallest unit you have created is called an ounce. How many ounces are there in a pound?

5. Using your ounce of clay, find three items in your classroom that weigh approximately one ounce. List them below.
6. When you think about an ounce, it helps to have something you can easily think of that weighs about one ounce. How can you use the three items above to help you estimate an ounce?
7. Find three things that weigh about 8 ounces. List them.
(*Hint: What fraction of a pound is 8 ounces? Do you have a piece of clay you can use to make this easier?*)
8. How can you use this knowledge to estimate the weight of objects?

Part 2 – Estimating an Ounce

Students will follow the directions below from the "Exploring an Ounce – Part 2; Estimating an Ounce" student recording sheet.

Think about how heavy one ounce (1 oz) is. Now find five objects that you think should be weighed using ounces. Do not use a scale to check yet! After you have found five objects:

- Write the name of the objects in the chart below.
- Make an estimate for each item's weight and record it in the chart below.
- Weigh each item using the scale provided and record it in the chart below.
    1. How did you make your estimates?
    2. Why are the items you chose appropriate to measure in ounces?
    3. Be ready to share your thinking with the class.

FORMATIVE ASSESSMENT QUESTIONS

- What unit(s) is the most appropriate to measure the weight of items that would fit in your pocket? Why?
- What method would you choose to use when measuring a pencil? Why? Describe how that method is used.

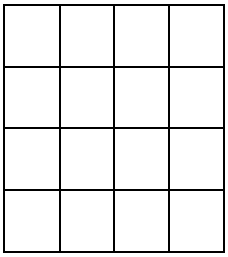
DIFFERENTIATION

Extension

- Have students create algebraic expressions and/or balance scale problems for ounces and pounds.

Intervention

- Use a square divided into 16 small squares (see below) to help develop the understanding of the concept of 16ths and relate it to 1 pound. Move those sixteenths into eights, then fourths, then halves and use the terminology quarter-pound, half-pound, etc. which may be familiar to students (such as when describing hamburgers).



Intervention Table

TECHNOLOGY

- http://www.youtube.com/watch?v=vbglZ9qw0hU Compare and Convert Weights in Customary Units: This Ten Marks tutorial video about converting measures of weight can be used for remediation purposes.
- http://www.mathsisfun.com/measure/index.html Measurement Index: This is a tutorial resource which discusses converting customary units of weight. It can be used for remediation purposes.

Name _____ Date _____

Exploring an Ounce

Part 1 – Creating an Ounce

1. Would pounds be a good way to measure the weight of a nickel? Why or why not?

   _____

   _____

2. Would pounds be a good way to measure the weight of a pencil? Why or why not?

   _____

   _____

3. Would pounds be a good way to measure the weight of a textbook? Why or why not?

   _____

   _____

4. Some things are too small to weigh accurately in terms of a whole pound. Therefore, we need some way to divide the pound into smaller units. You're going to use one pound (1 lb) of clay (or other materials) to do that.

   a. Using the scale at your desk, divide your clay into two equal parts. How did you use your scale to determine if it has been divided equally?

      _____

      _____

   b. What fraction of a whole pound have you created? _____

   c. Take one of the pieces you just created and divide it into two equal pieces. Again, make sure the pieces are equal using your balance scale. What fraction of the whole pound is one of these pieces of clay? _____

d. Continue doing this until you have two pieces of clay that are each 1/16 of the pound. How many times did you have to divide to do this? Explain how you know.

_____

_____

e. The smallest unit you have created is called an ounce. How many ounces are there in a pound? _____

5. Using your ounce of clay, find three items in your classroom that weigh approximately one ounce. List them below.

_____ _____ _____

6. When you think about an ounce, it helps to have something you can easily think of that weighs about one ounce. How can you use the three items above to help you estimate an ounce?

_____

_____

7. Find three things that weigh about 8 ounces. List them.
(*Hint: What fraction of a pound is 8 ounces? Do you have a piece of clay you can use to make this easier?*)

_____ _____ _____

8. How can you use this knowledge to estimate the weight of objects?

_____

_____

_____

_____

_____

Name _____ Date _____

Exploring an Ounce

Part 2 – Estimating an Ounce

Think about how heavy one ounce (1 oz) is. Now find five objects that you think should be weighed using ounces. Do not use a scale to check yet! After you have found five objects:

- Write the name of the objects in the chart below.
- Make an estimate for each item and record it in the chart below.
- Weigh each item using the scale provided and record it in the chart below.

Object	Estimated Weight (oz)	Actual Weight (oz)
1.		
2.		
3.		
4.		
5.		
6.		

1. How did you make your estimates?

_____

_____

2. Why are the items you chose appropriate to measure in ounces?

_____

_____

_____

3. Be ready to share your thinking with the class.

CONSTRUCTING TASK: Too Heavy? Too Light? Return to Task Table

TASK CONTENT: Students will solve problems that require unit conversion within the same system.

STANDARDS FOR MATHEMATICAL CONTENT

MGSE4.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.

a. Understand the relationship between gallons, cups, quarts, and pints.
b. Express larger units in terms of smaller units within the same measurement system.
c. Record measurement equivalents in a two-column table.

MGSE4.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.

STANDARDS FOR MATHEMATICAL PRACTICE TO BE EMPHASIZED

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.

BACKGROUND KNOWLEDGE

Students need to know which units are within the same system of measurement and how they are related. They will also need to have multi-digit addition and subtraction skills.

ESSENTIAL QUESTIONS

- When do we use conversion of units?
- Why are units important in measurement?
- What happens to a measurement when we change units?

MATERIALS

"Too Heavy? Too Light?" student recording sheet

GROUPING

Individual/Partner Task

NUMBER TALKS

Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. Catherine Fosnot has developed problem "strings" which may be included in number talks to further develop mental math skills. See *Mini lessons for Operations with Fractions, Decimals, and Percents* by Kara Louise Imm, Catherine Twomey Fosnot and Willem Uittenbogaard. (*Mini lessons for Operations with Fractions, Decimals, and Percents*, 2007, Kara Louise Imm, Catherine Twomey Fosnot and Willem Uittenbogaard)

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

In this task, students will add weights of different units within the same system. Conversion of units will need to be used.

Comments

In this task, students are asked to combine several weights to find the total weight. Since all weights are given using two different units (kg and g, or lb and oz), students must think about how the units are related to each other. For example, students will need to use the following relationships: 1 kg = 1,000 g and 1 lb = 16 oz.
Students may use different strategies to answer the questions on the "Too Heavy? Too Light?" student recording sheet. Some may choose to convert everything to the smaller unit (grams or ounces) before adding the given weights. Others will try to add the two units separately and then convert, if necessary. It is important to provide the time required for students to share and discuss their different strategies.

Task Directions

Students will follow the directions below from the "Too Heavy? Too Light?" student recording sheet.

"Answer each of the following problems. Share and discuss how you solved the problems."

Problem 1

Marvin has 3 cousins in Michigan whose birthdays are all in February. He wants to send birthday presents to all three of them. Because the delivery company cannot send a box heavier than 10 kg, he had to find the mass of the three presents he bought. Their masses were 4 kg 700 g, 2 kg 800 g, and 3 kg 200 g. Can he put all three presents in one box? Why or why not?

Problem 2
Kim is participating in a bass fishing tournament. In order to advance to the final round, the total weight of the fish she catches must be more than 5 pounds. Kim caught 4 fish that weighed as follows: 1 lb 6 oz, 13 oz, 1 lb 7 oz, and 1 lb 4 oz. Will Kim advance to the final round of the competition? Explain why or why not.

Problem 3
Stevie's Bakery received 15 kg 700 g of sugar. The production manager noticed that they needed 23 kg 100 g of sugar to make the order of cookies she just received. How much more sugar does she need to complete this order of cookies?

FORMATIVE ASSESSMENT QUESTIONS

- What steps did you take to solve the problem?
- Did you convert to smaller units first? Why or why not?
- How could you solve the problem in a different way?
- Why is it important to understand measurement in real life?

DIFFERENTIATION

Extension
- Have students solve the problem in at least two different ways and write about the different strategies, describing the differences. Then have students tell why one is better than the other.
- Ask students to create their own problems using a common situation they may encounter.

Intervention
- Provide the following steps to help solve these problems.
  Step 1: Use a drawing with labels to record information about the problem.
  Step 2: Convert the measurements to like pieces.
  Step 3: Solve.
- Before giving students who struggle this task, provide similar problems that have been amended. By eliminating information that is not important for the problem, students are able to focus on the mathematics.

Intervention Table

TECHNOLOGY

- http://www.bbc.co.uk/bitesize/ks1/maths/length_and_weight/play/ Harbour Measurements: This online activity allows students to learn about length and weight. It can be used for additional practice.
- http://www.bgfl.org/bgfl/custom/resources_ftp/client_ftp/ks2/maths/weigh/index.htm Weigh It Up: This activity is a problem-solving activity which uses a set of scales and a variety of shapes. It can be used for additional practice or remediation purposes.

Too Heavy? Too Light?

Answer each of the following problems. Share and discuss how you solved the problems.

Problem 1
Marvin has 3 cousins in Michigan whose birthdays are all in February. He wants to send birthday presents to all three of them. Because the delivery company cannot send a box heavier than 10 kg, he had to find the mass of the three presents he bought. Their masses were 4 kg 700 g, 2 kg 800 g, and 3 kg 200 g. Can he put all three presents in one box? Why or why not?

Problem 2
Kim is participating in a bass fishing tournament. In order to advance to the final round, the total weight of the fish she catches must be more than 5 pounds. Kim caught 4 fish that weighed as follow: 1 lb 6 oz, 13 oz, 1 lb 7 oz, and 1 lb 4 oz. Will Kim advance to the final round of the competition? Explain why or why not.

Problem 3
Stevie's Bakery received 15 kg 700 g of sugar. The production manager noticed that they needed 23 kg 100 g of sugar to make the order of cookies she just received. How much more sugar does she need to complete this order of cookies?

CONSTRUCTING TASK: Capacity Line-Up Return to Task Table

TASK CONTENT: Students will estimate and measure metric capacity.

STANDARDS FOR MATHEMATICAL CONTENT

MGSE4.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.

a. Understand the relationship between gallons, cups, quarts, and pints.
b. Express larger units in terms of smaller units within the same measurement system.
c. Record measurement equivalents in a two-column table.

MGSE4.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.

STANDARDS FOR MATHEMATICAL PRACTICE TO BE EMPHASIZED

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.

BACKGROUND KNOWLEDGE/COMMON MISCONCEPTIONS

Students should have experience with basic capacity and conservation. Students will also need to be familiar with using liquid measuring tools (e.g. graduated cylinders). Milliliter can be abbreviated as mL or ml. In this unit, mL is used to highlight the liter, but students should be aware that both are acceptable and should be able to recognize the use of ml.
Students believe that larger units will give larger measures. Students should be given multiple opportunities to measure the same object with different measuring units. For example, have the students measure the length of a room with one-inch tiles, with one-foot rulers, and with yardsticks. Students should notice that it takes fewer yardsticks to measure the room than the number of rulers or tiles needed.

ESSENTIAL QUESTIONS

- Can different size containers have the same capacity?
- How can we estimate and measure capacity?

MATERIALS

For class

- *A House for Birdie* by Stuart J. Murphy, or similar text

For each student

- "Capacity Line-up, Measuring with Graduated Cylinders" student recording sheet

For each group

- 6 containers of different size and shape, labeled A-F (i.e. small jars, cans, plastic containers, and bottles); one should hold at least one liter
- Large bottle of water
- Pan or tray for spillage
- Set of graduated cylinders – be sure graduated cylinders are large enough to measure the capacity of the containers used for this task and that the graduated cylinders measure in milliliters (mL)
- 2 sheets of construction paper

GROUPING

Partner/Small Group Task

NUMBER TALKS

Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. Catherine Fosnot has developed problem "strings" which may be included in number talks to further develop mental math skills. See *Mini lessons for Operations with Fractions, Decimals, and Percents* by Kara Louise Imm, Catherine Twomey Fosnot and Willem Uittenbogaard. (*Mini lessons for Operations with Fractions, Decimals, and Percents*, 2007, Kara Louise Imm, Catherine Twomey Fosnot and Willem Uittenbogaard)

TASK DESCRIPTION, DEVELOPMENT, AND DISCUSSION

In this task, students will explore estimation and measurement of capacity and volume with real-world tools. Students will participate in exploratory activities to compare the capacity of different containers.

Comments

This task can be introduced by reading *A House for Birdie* by Stuart J. Murphy, or a similar text. The humorous story relates real-life objects to liquid volume and capacity.

Give each group a set of 6 containers labeled A-F and ask the group to come to a consensus in ordering them from least to greatest capacity. Ask for explanations from the group. Even adults have difficulty judging how much different size containers hold in relation to each other, so don't be surprised when groups provide a variety of answers. To illustrate this concept further, have

each group take 2 pieces of construction paper. Make 2 tube shapes – one by taping the two long edges together and the other by taping the two short edges together. Ask students which holds more. Most groups roughly split in thirds for the answer – short and fat, tall and skinny, same. Have students place the skinny cylinder inside the fat one and fill the skinny one with filler to the top edge. Then lift it up allowing the filler to empty into the fat cylinder. Students will see that the capacity is the same because they hold the same amount. Challenge groups to revisit their original line-up and give explanations for changing the order and/or keeping the order the same. Students will use graduated cylinders for this task. To introduce the graduated cylinders, share how to use and read this tool. Encourage students to make sure they keep the graduated cylinder straight and still, read it at eye level, and look at the uppermost number to determine which graduated cylinder to use.

To give students a first experience with graduated cylinders, pour 225 mL of water into a 500-mL cylinder. Ask for volunteers to state the measure. Point out that the measure cannot be accurately determined because the water level is between the lines. Ask if there is another cylinder that is more appropriate to use. This guides students to use the correct measurement tools to get the most accurate measurements. Each student then selects a container, fills it with water, estimates its capacity in mL, and records the estimate. Students use the estimate to select a cylinder and record its name. Pour the contents into the cylinder to check to see if the right tool was used. When the right tool is selected (the water level is readable at a line on the cylinder), students record the measure and cylinder used. Remind students that this task involves estimating and measuring capacity in metric units (mL). Challenge students to locate at home items that are measured in this same unit.

Task Directions
Students will follow the directions below from the "Capacity Line-up, Measuring with Graduated Cylinders" student recording sheet.

"*Record your estimate of the capacity of each container in the* "Estimate" *column below. Next, find the best graduated cylinder to use to measure the capacity and record its capacity in the* "Cylinder Used" *column. Finally, record the capacity of each container in the* "Actual Measure" *column."*

FORMATIVE ASSESSMENT QUESTIONS

- Does size and shape always affect capacity? Why or why not?
- How did you decide which graduated cylinder to use?
- What must you do to get the most accurate measure?

DIFFERENTIATION

Extension
- Have groups fill the largest container with water and then pour it into the second largest and then the third largest, etc. to see if their progression was correct.

Intervention

- Ask students to complete each row of their table before moving on to another container. This will allow them to develop some experience with capacity before making their next estimate.

Intervention Table

TECHNOLOGY

- http://www.linkslearning.k12.wa.us/Kids/1_Math/2_Illustrated_Lessons/6_Weight_and_Capacity/index.html Weight and Capacity: This tutorial video introduces students to different kinds of measurements. It can be used for remediation purposes.
- http://www.iboard.co.uk/activity/Measure-Capacity-114 Measure Capacity: This resource is an introductory activity for estimating and checking the capacity of different containers. It can be used as a mini lesson for this task, additional practice or remediation purposes.
- http://www.iboard.co.uk/activity/Measuring-Jugs-Make-1-Litre-115 Measuring Jugs – Make One Liter: This online resource involves metric units of capacity. It can be used for additional practice or remediation purposes.

Name_____ Date _____

Capacity Line-up

Measuring with Graduated Cylinders

Record your estimate for the capacity of each container in the "Estimate" column below. Next, find the best cylinder to use to measure the capacity and record its capacity in the "Cylinder Used" column. Finally, record the capacity of each container in the "Actual Measure" Column.

Container	Estimate	Cylinder Used	Actual Measure
A	**_____mL**	**_____mL**	**_____mL**
B	**_____mL**	**_____mL**	**_____mL**
C	**_____mL**	**_____mL**	**_____mL**
D	**_____mL**	**_____mL**	**_____mL**
E	**_____mL**	**_____mL**	**_____mL**
F	**_____mL**	**_____mL**	**_____mL**

CONSTRUCTING TASK: More Punch, Please! Return to Task Table

TASK CONTENT: Students will measure capacity using customary units and convert liquid measures within the customary system.

STANDARDS FOR MATHEMATICAL CONTENT

MGSE4.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.

a. Understand the relationship between gallons, cups, quarts, and pints.
b. Express larger units in terms of smaller units within the same measurement system.
c. Record measurement equivalents in a two-column table.

MGSE4.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.

STANDARDS FOR MATHEMATICAL PRACTICES

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.

BACKGROUND KNOWLEDGE/COMMON MISCONCEPTIONS

Before students are given this task, they will need to be familiar with customary units of capacity and their relationship to each other (e.g. ounce, cup, pint, quart, and gallon).
According to Van de Walle (2006) "*volume* typically refers to the amount of space that an object takes up" whereas "*capacity* is generally used to refer to the amount that container will hold" (p. 265). To distinguish further between the two terms, consider how the two are measured. Volume is measured using linear measures (ft, cm, in, m, etc.) while capacity is measured using liquid measures (L, mL, qt, pt, g, etc). However, Van de Walle reminds educators, "having made these distinctions [between volume and capacity], they are not ones to worry about. The term *volume* can also be used to refer to the capacity of a container" (p. 266). For clarity, the term "liquid volume" can be used when referring to volume as capacity.

Van de Walle, J. A. & Lovin, L. H. (2006). *Teaching students-centered mathematics: Grades 3-5*. Boston: Pearson Education, Inc.

ESSENTIAL QUESTIONS

- How are fluid ounces, cups, pints, quarts, and gallons related?
- How can fluid ounces, cups, pints, quarts, and gallons be used to measure capacity?
- Why do we need to be able to convert between capacity units of measurement?

MATERIALS

"More Punch, Please!" student recording sheet

GROUPING

Individual/Partner Task

NUMBER TALKS

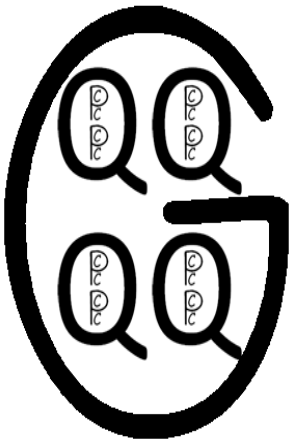
Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. Catherine Fosnot has developed problem "strings" which may be included in number talks to further develop mental math skills. See *Mini lessons for Operations with Fractions, Decimals, and Percents* by Kara Louise Imm, Catherine Twomey Fosnot and Willem Uittenbogaard. (*Mini lessons for Operations with Fractions, Decimals, and Percents*, 2007, Kara Louise Imm, Catherine Twomey Fosnot and Willem Uittenbogaard)

TASK DESCRIPTION, DEVELOPMENT, AND DISCUSSION

In this task students work with liquid measures to determine the amount of punch needed for a class party.

Comments

Before this task is introduced (or as an opening to this task), students could be asked to create a graphic representing the relationship between customary measurements of capacity. Using water, they can find the relationships between the different units of measure (ounce, cups, pints, quarts, and gallons). Once students know how the different units of measure are related, they can create a graphic representation of these relationships. Allow students to create a graphic representation that makes sense to them. Then allow students to share their graphic representations with students in their small group or choose two or three students who created different representations to share their graphic representation with the class. One possible representation is shown to the right.



In the graphic representation shown, each "C" represents a cup, each "P" represents a pint, each "Q" represents a quart, and the "G" represents a gallon. This model shows there are 16 cups in a gallon, 8 pints in a gallon, and 4 quarts in a gallon. Students can then be asked to convert between different customary measurements using their model as a reference. For example, ask students questions such as:

- If I have 2 quarts of punch, how many cups do I have?
- How many quarts would 12 cups fill?
- How many pints would be needed to fill 3 quarts?
- How many cups are in 6 pints?
- If one cup is 8 fluid ounces, how many fluid ounces are in a pint? Quart? Gallon?

The quantities used in the recipe in this task can be adjusted for the number of students in fourth grade at your school. Also, the context of the task can be adapted to better suit a particular school's traditions (e.g. fourth grade dance rather than a fourth-grade party).

Task Directions
Students will follow the directions below from the "More Punch, Please!" student recording sheet.

We are making punch for a fourth-grade party. A little more than 100 students will attend the party. The recipe below will serve 16 students.

Party Punch
Serves 16 (serving size: 8 fluid ounces)
Ingredients:
2 Pints Strawberry Sherbet
2 Quarts Fruit Punch, chilled
32 Fluid Ounces Lemon-Lime flavored carbonated beverage, chilled
Directions:
Place sherbet in punch bowl. Pour in fruit punch and lemon-lime soda.

Answer the following questions about the punch for the party. Show all work and explain how you know your answers are accurate.

1. *How much of each ingredient needs to be purchased to serve punch at the party? Rewrite the recipe to serve over 100 students.*
2. *How many total gallons of punch can be made with the ingredients purchased?*
3. *If each serving is 12 fluid ounces, how many servings can be made with the ingredients purchased?*

The answers to the questions presented in this task are given below.

1. **How much of each ingredient needs to be purchased to serve punch at the party? Rewrite the recipe to serve over 100 students.**

   $16 \times 7 = 112$. Therefore, multiplying the recipe by 7 will allow for more than 100 students.

The following ingredients will be needed:

Strawberry Sherbet
2 pints of Strawberry Sherbet × 7 = 14 pints of Strawberry Sherbet
There are 8 pints in one gallon, 14 pints ÷ 8 pints per gallon = 1 gallon and 6 pints.
There are 2 pints in one quart, 6 pints ÷ 2 pints per quart = 3 quarts.
Therefore, 1 gallon and 3 quarts of Strawberry Sherbet will be needed.
Fruit Punch
2 quarts of Fruit Punch × 7 = 14 quarts of Fruit Punch
There are 4 quarts in one gallon, 14 quarts ÷ 4 quarts per gallon = 3 gallons and 2 quarts.
So, 3 gallons and 2 quarts of Fruit Punch will be needed.
Lemon-Lime Soda
32 fluid ounces of Lemon-Lime Soda × 7 = 224 fluid ounces
There are 8 fluid ounces in one cup, 224 fluid ounces ÷ 8 fluid ounces per cup = 28 cups.
There are 16 cups in one gallon, 28 cups ÷ 16 cups per gallon = 1 gallon and 12 cups.
There are 4 cups in one quart, 12 cups ÷ 4 cups per quart = 3 quarts.
Therefore, 1 gallon and 3 quarts of Lemon-Lime Soda will be needed.

2. **How many total gallons of punch can be made with the ingredients purchased?**

   Add 1 gallon and 3 quarts, 3 gallons and 2 quarts, and 1 gallon and 3 quarts. There is a total of 5 gallons and 8 quarts. But there are 4 quarts in a gallon, so 8 quarts ÷ 4 quarts per gallon = 2 gallons. Adding the 2 gallons + 5 gallons, means there will be a total of 7 gallons of punch.

3. **If each serving is 12 fluid ounces, how many servings can be made with the ingredients purchased?**

   There is a total of 128 fluid ounces in one gallon (8 fluid ounces per cup × 16 cups per gallon = 128 fluid ounces per gallon). 7 gallons × 128 fluid ounces per gallon = 896 fluid ounces total.
   Divide the total number of fluid ounces by the number of fluid ounces per serving, 896 ÷ 12 = 74 twelve fluid-ounce servings and 8 fluid ounces left over.

FORMATIVE ASSESSMENT QUESTIONS

- How many batches of the recipe will you need? How do you know?
- How much sherbet will you need to buy? How many pints do you need? How many pints in a gallon? How many gallons is that? How do you know?
- How many quarts of Fruit Punch do you need? How many quarts in a gallon? How many gallons of Fruit Punch do you need? How do you know?
- How much Lemon-Lime soda do you need? How many fluid ounces in a gallon? How many gallons of Lemon-lime soda do you need? How do you know?
- How many fluid ounces in a gallon? How many fluid ounces of punch will you make? How many 8 fluid ounce servings is that? How do you know?

DIFFERENTIATION

Extension

- Encourage students to find a different punch recipe and to rewrite the recipe to serve over 100 students.
- Ask students to determine what size drink is typical (they can consider the type of cup being used, whether ice will be available, and other factors that may influence the amount of punch served to each student). Once students have collected data, they can display the data, choosing the most effective data display.

Intervention

- Some students may need opportunities to develop an understanding of how different measures are related by filling cup, pint, quart, and gallon containers with water to determine the relationships between these liquid measures.
- Some students may benefit from using a chart to help them organize their thinking and their work. See sample below, "More Punch, Please!, Version 2" student recording sheet.

Intervention Table

TECHNOLOGY

- http://www.linkslearning.k12.wa.us/Kids/1_Math/2_Illustrated_Lessons/6_Weight_and_Capacity/index.html Weight and Capacity: This tutorial video introduces students to different kinds of measurements. It can be used for remediation purposes.
- http://www.iboard.co.uk/activity/Measure-Capacity-114 Measure Capacity: This resource is an introductory activity for estimating and checking the capacity of different containers. It can be used as a mini lesson for this task, additional practice or remediation purposes.
- http://www.iboard.co.uk/activity/Measuring-Jugs-Make-1-Litre-115 Measuring Jugs – Make One Liter: This online resource involves metric units of capacity. It can be used for additional practice or remediation purposes.

Name_____ Date _____

More Punch, Please!

We are making punch for a fourth-grade party. A little more than 100 students will attend the party. The recipe below will serve 16 students.

Party Punch
Serves 16 (serving size: 8 fluid ounces)

Ingredients:
2 Pints Strawberry Sherbet
2 Quarts Fruit Punch, chilled
32 Fluid Ounces Lemon-Lime flavored carbonated beverage, chilled

Directions:
Place sherbet in punch bowl. Pour in fruit punch and lemon-lime soda.

Answer the following questions about the punch for the party. Show all work and explain how you know your answers are accurate.

1. How much of each ingredient needs to be purchased to serve punch at the party? Rewrite the recipe to serve over 100 students.
2. How many total gallons of punch can be made with the ingredients purchased?
3. If each serving is 12 fluid ounces, how many servings can be made with the ingredients purchased?

Name_____ Date _____

More Punch, Please!

Version 2

We are making punch for a fourth-grade party. A little more than 100 students will attend the party. The recipe below will serve 16 students.

Party Punch
Serves 16 (serving size: 8 fluid ounces)

Directions:
Place sherbet in punch bowl. Pour in fruit punch and lemon-lime soda.

Ingredients:
2 Pints Strawberry Sherbet
2 Quarts Fruit Punch, chilled
32 Fluid Ounces Lemon-Lime flavored carbonated beverage, chilled

Answer the following questions about the punch for the party. Show all of your work and explain how you know your answers are accurate.

1. How much of each ingredient needs to be purchased to serve punch at the party? Rewrite the recipe to serve over 100 students.

Party Punch	
Serves 16 (serving size: 8 fluid ounces)	Serves _____ (serving size: 8 fluid ounces)
2 Pints Sherbet 2 Quarts Punch 32 Fluid Ounces Lemon-Lime	_____ Pints Sherbet _____ Quarts Punch _____ Fluid Ounces Lemon-Lime

Show your work here.

2. How many total gallons of punch can be made with the ingredients purchased?

Party Punch
1 gallon = 4 quarts 1 gallon = 8 pints 1 gallon = 16 cups 1 gallon = 128 fluid ounces 1 quart = 2 pints 1 pint = 2 cups 1 cup = 8 fluid ounces

3. If each serving is 12 fluid ounces, how many servings can be made with the ingredients purchased?

Party Punch	
_____ Total gallons of punch	1 gallon = 128 fl. oz.
_____ Total fluid ounces of punch	
_____ Total 12-ounce servings	

CONSTRUCTING TASK: Water Balloon Fun! Return to Task Table

TASK CONTENT: Students measure capacity using metric and customary units.

STANDARDS FOR MATHEMATICAL CONTENT

MGSE4.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.

a. Understand the relationship between gallons, cups, quarts, and pints.
b. Express larger units in terms of smaller units within the same measurement system.
c. Record measurement equivalents in a two-column table.

MGSE4.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.

STANDARDS FOR MATHEMATICAL PRACTICE TO BE EMPHASIZED

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.

BACKGROUND KNOWLEDGE

Before students are given this task, they will need to be familiar with customary and metric units of capacity measure. Encourage students to refer to the graphic they created during the "More Punch, Please!" task (see previous tasks in this unit).
Also, in "Capacity Line-Up" students should have had experiences that demonstrated the relationship between milliliters and liters (e.g. how the relationship between a millimeter and a meter are like the relationship between milliliters and liters – it takes 1,000 millimeters to make a meter and it takes 1,000 milliliters to make a liter; how a graduated cylinder that holds 100 mL would need to be filled 10 times in order to fill a 1 liter bottle).

ESSENTIAL QUESTIONS

- How do we compare metric measures of milliliters and liters?
- How do we compare customary measures of fluid ounces, cups, pints, quarts, and gallons?

MATERIALS

- "Water Balloon Fun!" student recording sheet
- *Pastry School in Paris: An Adventure in Capacity* by Cindy Neuschwander or similar book about liquid measure
- Graduated cylinders and measuring cups to simulate balloons

GROUPING

Individual/Partner Task

NUMBER TALKS

Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. Catherine Fosnot has developed problem "strings" which may be included in number talks to further develop mental math skills. See *Mini lessons for Operations with Fractions, Decimals, and Percents* by Kara Louise Imm, Catherine Twomey Fosnot and Willem Uittenbogaard. (*Mini lessons for Operations with Fractions, Decimals, and Percents*, 2007, Kara Louise Imm, Catherine Twomey Fosnot and Willem Uittenbogaard)

TASK DESCRIPTION, DEVELOPMENT, AND DISCUSSION

In this task students compare liquid measures using milliliters, liters, fluid ounces, cups, pints, quarts, and gallons.

Comments

This task can be introduced by reading *Pastry School in Paris: An Adventure in Capacity* by Cindy Neuschwander or a similar book about liquid measure. While reading the story, discuss the concepts and relationships that are used during the story.
As students are working, observe the strategies they use to solve the given problems. Consider strategies that would be helpful for other members of the class to see and understand. While students are working, ask selected students if they would be willing to share their work with the class. During the lesson summary, have students share the strategies they used with their classmates.
Students may need to use graduated cylinders, measuring cups, and water to complete this task.

Task Directions

Students will follow the directions below from the "Water Balloon Fun!" student recording sheet.

Use what you know about the relationship between metric measures of capacity (milliliters, liters) or customary measures of capacity (fluid ounces, cups, pints, quarts, gallons) to solve the following problems. Show all of your work and explain your thinking.

1. The package for Matt's water balloons says that each balloon holds 300 mL of water. How

many balloons can he fill if he has 2 liters of water?

2. Beverly has two liters of water to fill six water balloons. Each balloon holds 350 milliliters of water. Does she have enough water to fill all six balloons? If not, how many balloons can she fill?
3. Camille has 6 water balloons. Each is filled with 4 fluid ounces of water. Bibi has 5 balloons. Each is filled with 1 cup of water. Whose balloons contain the most water?
4. Charlie used a total of 2 quarts of water to fill all of his balloons. Warren filled each of his 6 balloons with $1\frac{1}{2}$ cups of water. Who used the greater amount of water when filling all their balloons?

The answers to the questions presented in this task are given below.

1. The package for Matt's water balloons says that each balloon holds 300 mL of water. How many balloons can he fill if he has 2 liters of water?

Students could make a table to help them solve this problem.

Number of Balloons	Amount of Water (in mL)
1	300
2	600
3	900
4	1,200
5	1,500
6	1,800
7	2,100

1,000 mL = 1 L

Using the relationship above and the chart to the left, we know that Matt could fill 6 balloons with 2 liters of water (with 200 mL left over). In order to fill 7 balloons, he would need 2,100 mL or 2 liters 100 mL. So, he would need an additional 100 mL to fill 7 balloons.

So, Matt can fill 6 balloons with 2 liters of water.

2. Beverly has two liters of water to fill six water balloons. Each balloon holds 350 milliliters of water. Does she have enough water to fill all six balloons? If not, how many balloons can she fill?

Students can first calculate that there are 1,000 mL in one liter, so if Beverly has two liters of water, then 2 x 1,000 equals 2,000 mL. Since Beverly has two liters, or 2,000 mL of water, students could use a t-chart to find the answer to the problem.

Number of Balloons	Amount of Water (in mL)
1	350
2	700
3	1,050
4	1,400
5	1,750
6	2,100

She would need a total of 2,100 liters to fill all six balloons. She only has two liters or 2,000 mL of water. She only has enough to fill five balloons. She will have 250 mL of water left over. Students could also mention that Beverly needs 100 mL more water to be able to fill all six balloons.

So, Beverly can only fill 5 balloons with two liters of water.

3. **Camille has 6 water balloons. Each is filled with 4 fluid ounces of water. Bibi has 5 balloons. Each is filled with 1 cup of water. Whose balloons contain the most water?**

   Students would need to use the following relationships to solve this problem.
   8 fluid ounces = 1 cup

   Camille has 4 fluid ounces × 6 water balloons = 24 fluid ounces. Knowing that 8 ounces equals 1 cup, we know that Camille has 24 fluid ounces ÷ 8 fluid ounces = 3 cups of water.

   Bibi has 1 cup × 5 balloons = 5 cups of water. 5 cups is more than 3 cups. So, Bibi's balloons contain 2 cups more water.

4. **Charlie used a total of 2 quarts of water to fill all of his balloons. Warren filled each of his 6 balloons with $1\frac{1}{2}$ cups of water. Who used the greater amount of water when filling all their balloons?**

   Students could make a table to help them solve this problem.

Warren's Balloons	
Number of Balloons	Amount of Water (in Cups)
1	$1\frac{1}{2}$
2	3
3	$4\frac{1}{2}$
4	6
5	$7\frac{1}{2}$
6	9

2 cups = 1 pint
2 pints = 1 quart
So, 4 cups = 1 quart

Using the relationship above and the chart to the left, we know that Warren would need 9 cups of water to fill 6 balloons. If 4 cups = 1 quart, then 8 cups = 2 quarts. Therefore Warren used 2 quarts + 1 cup of water. That is 1 cup more than the amount of water Charlie used. So, Warren's balloons contain more water.

FORMATIVE ASSESSMENT QUESTIONS

- How can you compare those amounts of water?
- What are the relationships you need to know in order to solve this problem? How do you know?
- How will you use those relationships to solve this problem?
- How much water will he (or she) need? How do you know?
- Who has more water in their balloons? How do you know?
- How can you model this problem?
- Why did you choose to model the problem this way?

DIFFERENTIATION

Extension

- Encourage students to create story problems that require the comparison of liquid measures and to solve the problems. Ask a partner to solve the problems.

Intervention

- Some students may need opportunities to solve the problems using measuring cups and water.
- Provide students with a table that displays the relationships between different units of measure. This will allow students to focus on what the problem is asking.
- Similarly, some students may benefit by using a calculator to solve these problems. That would allow them to concentrate on the problem, not the operations required using decimal numbers.

Intervention Table

TECHNOLOGY

- http://www.linkslearning.k12.wa.us/Kids/1_Math/2_Illustrated_Lessons/6_Weight_and_Capacity/index.html Weight and Capacity: This tutorial video introduces students to different kinds of measurements. It can be used for remediation purposes.
- http://www.iboard.co.uk/activity/Measure-Capacity-114 Measure Capacity: This resource is an introductory activity for estimating and checking the capacity of different containers. It can be used as a mini-lesson for this task, additional practice or remediation purposes.
- http://www.iboard.co.uk/activity/Measuring-Jugs-Make-1-Litre-115 Measuring Jugs – Make One Liter: This online resource involves metric units of capacity. It can be used for additional practice or remediation purposes.

Name_____ Date _____

Water Balloon Fun!

Use what you know about the relationship between metric measures of capacity (milliliters, liters) or customary measures (fluid ounces, cups, pints, quarts, gallons) of capacity to solve the following problems. Show all of your work and explain your thinking.

1. The package for Matt's water balloons says that each balloon holds 300 mL of water. How many balloons can he fill if he has 2 liters of water?	
2. Beverly has two liters of water to fill six water balloons. Each balloon holds 350 milliliters of water. Does she have enough water to fill all six balloons? If not, how many balloons can she fill?	
3. Camille has 6 water balloons. Each is filled with 4 fluid ounces of water. Bibi has 5 balloons. Each is filled with 1 cup of water. Whose balloons contain the most water?	
4. Charlie used a total of 2 quarts of water to fill all of his balloons. Warren filled each of his 6 balloons with $1\frac{1}{2}$ cups of water. Who used the greater amount of water when filling all their balloons?	

Unit 7 Culminating Task – Part 1

PERFORMANCE TASK: Dinner at the Zoo Return to Task Table

TASK CONTENT: Students use weight measurement and weight conversion; apply area formula.

STANDARDS FOR MATHEMATICAL CONTENT

MGSE4.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.

a. Understand the relationship between gallons, cups, quarts, and pints.
b. Express larger units in terms of smaller units within the same measurement system.
c. Record measurement equivalents in a two-column table.

MGSE4.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.

MGSE4.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.

STANDARDS FOR MATHEMATICAL PRACTICE TO BE EMPHASIZED

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.

BACKGROUND KNOWLEDGE

Students should understand basic units of length and weight measurement and their relationships. Also, students should be able to solve problems in multiple ways and justify their thinking.

ESSENTIAL QUESTIONS

- What happens to a measurement when we change units?
- How do we use weight measurement?
- Why is it important to be able to measure weight?
- How do we compute area and perimeter?

MATERIALS

- "Dinner at the Zoo" and "Naptime at the Zoo" student recording sheets
- Extra paper

GROUPING

Individual/Partner Task

NUMBER TALKS

Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. Catherine Fosnot has developed problem "strings" which may be included in number talks to further develop mental math skills. See *Mini lessons for Operations with Fractions, Decimals, and Percents* by Kara Louise Imm, Catherine Twomey Fosnot and Willem Uittenbogaard. (*Mini lessons for Operations with Fractions, Decimals, and Percents*, 2007, Kara Louise Imm, Catherine Twomey Fosnot and Willem Uittenbogaard)

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

In this task, students will use developed thinking and problem-solving skills to plan meals and shelter space at a zoo. Students must use length and weight measurements and conversions to plan the meals and space.

Comments
This task is appropriate for individual or partner work. Students will need to be able to distinguish between fruits and vegetables. This task could foster a good class discussion as students are beginning their work. Also, you may need to discuss what is meant by herbivore pellets, yams, browse, alfalfa hay, Timothy hay and other terms with which they may not be familiar. Students will need to use their knowledge of kilograms and grams (1 kilogram = 1,000 grams) and pounds, ounces, and tons (1 pound = 16 ounces and 1 ton = 2,000 pounds) to complete this task.

While this task may serve as a summative assessment, it also may be used for teaching and learning. It is important that all elements of the task be addressed throughout the learning process so that students understand what is expected of them.
Because the focus of this task is on measurement and equivalent measures, it would be appropriate to allow students to use calculators for this task.

Possible Solutions
NOTE: Keep in mind that students will not have to write everything out in detail as shown here. However, they should give enough information to justify their answer.

You need to place an order for enough grain, hay, and chimpanzee food to last the month of April.

1. **How many days are in April?**
   There are 30 days in April.

2. **How much grain, hay, and chimpanzee food will you need to order? How do you know you will have enough?**

   We will need 2,400 lbs. of grain, 4,800 lbs. of hay for the zebras and 383 kg of food for the chimpanzees. We will need to order 48 bags of grain, 5 bales of hay, and 600 kg of chimpanzee food.

   a. Quantity of grain for zebras
      A zebra needs 10 pounds of grain per day and we have 8 zebras. That means we need 80 pounds of grain per day.
      Eighty pounds of grain for 30 days is a total of 2,400 pounds of grain. If each bag holds 50 lbs. of grain that would be 2,400 ÷ 50 = 48 bags of grain.
      We would need 48 bags of grain for 8 zebras for the month of April.

   b. Quantity of hay for the zebras:
      A zebra needs 20 lbs. of hay per day. Our 8 zebras need 160 pounds per day for 30 days for a total of 4,800 pounds of hay. A hay bale weighs $\frac{1}{2}$ ton, which is 1,000 pounds. Therefore, we will need 4 bales of hay for 4,000 lbs. and 1 more bale of hay for the 800 lbs. we will still need. We will need a total of 5 bales of hay.

   c. Quantity of feed for the chimpanzees:
      Each day a chimpanzee requires 2 kilograms of food. If one chimpanzee needs 2 kilograms of food for each of the 30 days in April, then 2 x 30 = 60 kilograms of food needed for one chimpanzee for the month of April.

      We have 10 chimpanzees each needing 60 kilograms of food for the month. Therefore, we will need 10 x 60 or 600 kilograms of food.

3. **What would be the least amount of money you would need to spend?**

   The least amount of money for grain, hay, and chimpanzee food would be $364 + $250 + $1,200 = $1,814.
   If students bought the grain for the zebras by the bag only the total would be $384 + $250 + $1,200 = $1,834.

   a. Cost of grain for zebras – Best price is $364 (by the ton + 8 bags)
      i. Grain bought by the bag - $192
         48 bags x $8 = $384
      ii. Grain bought by the ton
         If we buy it by the ton, we will need 1 ton plus 400 pounds (400 ÷ 50 = 8 bags).
         One ton = $300. Eight bags of feed are 400 pounds, so we would need 8 bags x $8 per bag = $64
         That gives a total of $300 + $64 = $364.
         Therefore, the better buy is one ton + 8 bags for a total of $364.

   b. Cost of hay for the zebras - $250
      We will need 5 bales of hay; 5 bales x $50 per bale = $250

   c. Cost of Chimpanzee Food – $1,200
      We will need 600 kilograms of food for the chimpanzees. If food costs $2 per kilogram, it will cost $2 x 600 = $1,200.

Task Directions: Part 1

Students will follow the directions below from the "Dinner at the Zoo" student recording sheet.

You are working at a small zoo. The director has put you in charge of ordering food for the 8 zebras and 10 chimpanzees. He has given you the following information:

Zebra Data
Average weight of a zebra: 600 pounds
Average amount of food eaten by a zebra each day: 10 lbs. of grain and 20 lbs. of hay
A hay bale weighs $\frac{1}{2}$ ton and costs $50
A 50-pound bag of grain costs $8
A ton of grain costs $300

Chimpanzee Data
Chimpanzees require 2 kilograms of food per day.
Chimpanzee food costs $2 per kilogram.

You need to place an order for enough grain, hay, and chimpanzee food to last the month of April.

1. How many days are in April?
2. How much grain, hay, and chimpanzee food will you need to order? Show how you know you will have enough food for the animals.
3. What would be the least amount of money you would need to spend?

Task Directions: Part 2

Students will follow the directions on the "Naptime at the Zoo" student recording sheet. Make sure students compute the total area of the zebra shelter and that of the chimpanzee shelter. You may have the students find the combined total shelter area for both zebras and chimpanzees.

FORMATIVE ASSESSMENT QUESTIONS

- What strategies are you using to organize your thinking about this task?
- Why is it important to know the relationship of ounces and pounds, grams, and kilograms?

DIFFERENTIATION

Extension

- Divide into groups and assign each group a different animal at the zoo. Research what the animal eats in a day. Plan out the meal for that day and then for a month. Bring together the research of the group and write a "grocery list" for the zoo for each month.
- Ask students to complete the problems on the "Dinner at the Zoo – Extension Task" student recording sheet which asks questions about giraffes. The questions and sample solutions are shown below.
    1. **How many total kilograms of food does a giraffe eat on any given day? (A giraffe eats 10 kg and 440 g of food each day or almost 10½ kg per day.)**
        a. Vegetables - Per day per giraffe – 320 g
            Onions: 120 g
            Yams: 100 g
            Carrots: 60 g
            Red Beets: 40 g
        b. Fruit – Per day per giraffe – 120 g
            Apples: 90 g
            Bananas: 30 g
        c. Hay – Per day per giraffe – 5 kg
            Alfalfa Hay: 2.5 kg
            Timothy Hay: 2.5 kg
        d. Other – Per day per giraffe – 5 kg
            Herbivore pellets 4 kg
            Browse (tree leaves) 1 kg
        e. Total kilograms of food for a giraffe in one day – 10 kg and 440 grams or nearly 10½ kg

Vegetables: 320 g
Fruit: 120 g
Hay: 5 kg
Other: 5 kg per giraffe per day

2. **How many kilograms of vegetables will the giraffes eat during the months of April and May?** (The giraffes will eat 97 kg 600 grams of vegetables during April and May or a little more than 97 $\frac{1}{2}$ kg of vegetables.)

   320 g per giraffe per day x 5 giraffes = 1600g for all giraffes per day
   1600 g of vegetables per day x 61 days = 97,600 g or 97 kg 600 grams

3. **How many kilograms of fruit will the giraffes eat during the months of April and May?** (The giraffes will eat 36 kg 600 grams of fruit during April and May or a little more than 36 $\frac{1}{2}$ kg of fruit.)

   120 g per giraffe per day x 5 giraffes = 600 g for all giraffes per day
   600 g of fruit per day x 61 days = 36,600 g or 36 kg 600 grams

Intervention

- Divide the task up amongst a group of students and let an individual student or pair of students work with one problem. Then have students combine their answers to solve the task.

Intervention Table

TECHNOLOGY

Please refer to the sources listed with the previous tasks in this unit.

Name _____ Date _____

Dinner at the Zoo

You are working at a small zoo. The director has put you in charge of ordering food for the 8 zebras and 10 chimpanzees. He has given you the following information:

Zebra Data
Average weight of a zebra: 600 pounds
Average amount of food eaten by a zebra each day: 10 lbs. of grain and 20 lbs. of hay
A hay bale weighs ½ ton and costs $50
A 50-pound bag of grain costs $8
A ton of grain costs $300

Chimpanzee Data
Chimpanzees require 2 kilograms of food per day.
Chimpanzee food costs $2 per kilogram.

You need to place an order for enough grain, hay, and chimpanzee food to last the month of April.

1. How many days are in April?

2. How much grain, hay, and chimpanzee food will you need to order? Show how you know you will have enough food for the animals.

3. What would be the least amount of money you would need to spend?

Name _____ Date _____

April: Zebra Food						
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

April: Chimpanzee Food						
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

Name _____ Date _____

Naptime at the Zoo

You are working at a small zoo. The director has put you in charge of arranging temporary sleeping quarters for the 8 zebras and 10 chimpanzees while their regular habitat is being renovated. She has given you the following information:

Zebra space requirements
Each zebra needs at least 48 square feet of stall space for sleeping/shelter.
The zebras need to be able to easily turn around in the space provided.

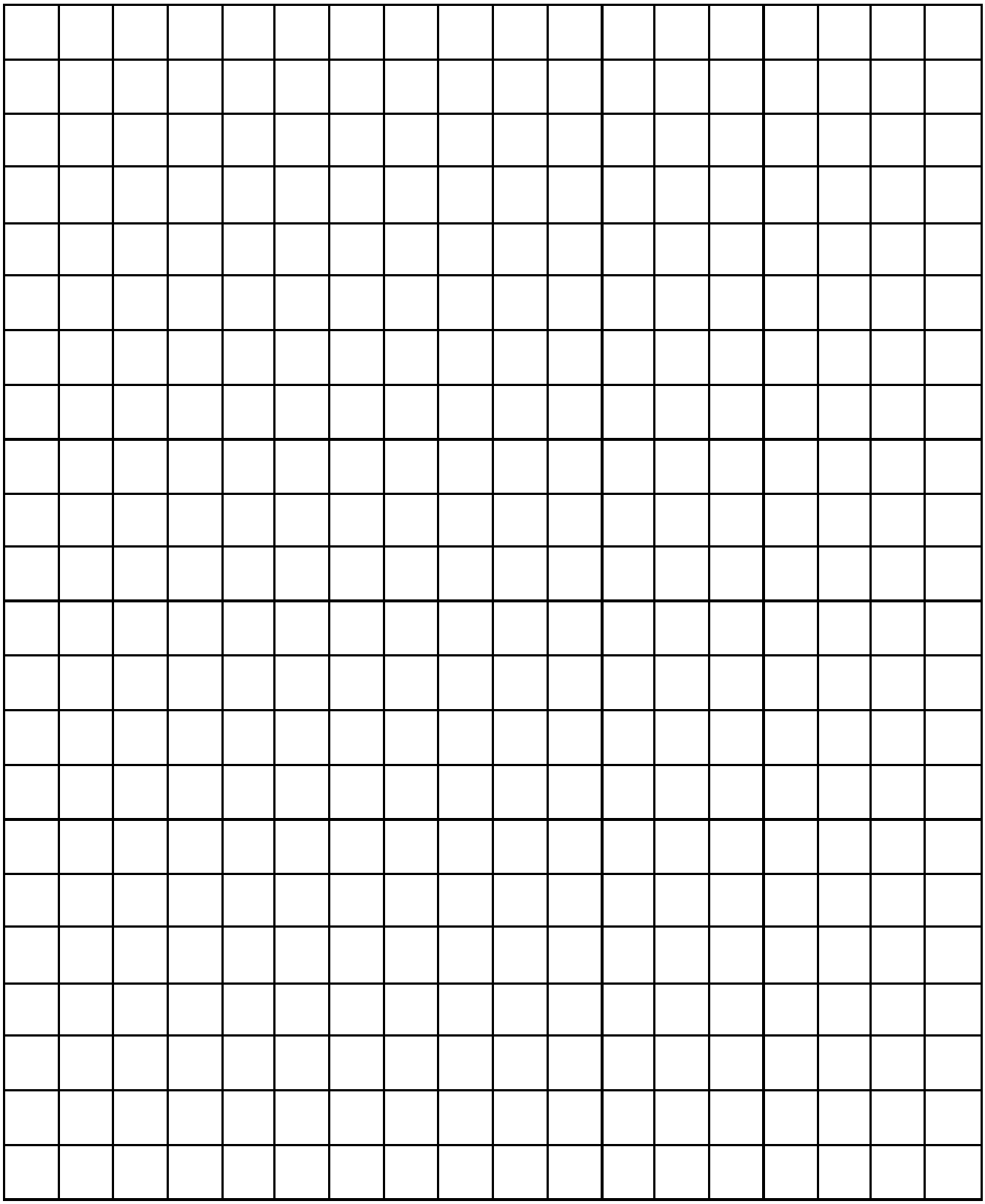
Chimpanzee requirements
Each chimpanzee needs a space at least 6 ft by 6 ft for sleeping/shelter.

Design a barn with a stall for each zebra. Include space for a walkway and food storage. Sketch your design on the grid paper provided and record your measurements in the chart.

Zebra Stall dimensions	Area	Perimeter
Totals:		

Design quarters for each chimpanzee. Include space for a walkway and food storage. Sketch your design on the grid paper provided and record your measurements in the chart.

Chimpanzee room dimensions	**Area**	**Perimeter**
Totals:		



Name _____ Date _____

Dinner at the Zoo

Extension Task

At the Zoo, each giraffe eats the following amount of food every day.
There are 5 giraffes at the zoo.

Giraffe: (each)

- Herbivore pellets 4 kg
- Alfalfa hay 2.5 kg
- Timothy hay 2.5 kg
- Apples 90 g
- Onions 120 g
- Bananas 30 g
- Yams 100 g
- Carrots 60g
- Red beets 40 g
- Browse (tree leaves) 1 kg

1. How many total kilograms of food does a giraffe eat on any given day?

2. How many kilograms of vegetables will the giraffes eat during the months of April and May?

3. How many kilograms of fruit will the giraffes eat during the months of April and May?

April: Giraffe Food						
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

May: Giraffe Food						
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

SCAFFOLDING TASK: Which Wedge is Right? Return to Task Table

TASK CONTENT: Students will use non-standard units to measure angles.

STANDARDS FOR MATHEMATICAL CONTENT

MGSE4.MD.5. Recognize angles as geometric shapes that are formed wherever two rays share a common endpoint, and understand concepts of angle measurement:

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

STANDARDS FOR MATHEMATICAL PRACTICE TO BE EMPHASIZED

1. Make sense of problems and persevere in solving them.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.

BACKGROUND KNOWLEDGE/COMMON MISCONCEPTIONS

Students have previously developed a conceptual understanding of linear measurement using non-standard units. They should also be able to identify different types of angles, i.e. right, acute, and obtuse.

Students are confused as to which number to use when determining the measure of an angle using a protractor because most protractors have a double set of numbers. Students should decide first if the angle appears to be an angle that is less than the measure of a right angle (90°) or greater than the measure of a right angle (90°). If the angle appears to be less than 90°, it is an acute angle and its measure ranges from 0° to 89°. If the angle appears to be an angle that is greater than 90°, it is an obtuse angle and its measures range from 91° to 179°. Ask questions about the appearance of the angle to help students in deciding which number to use.

ESSENTIAL QUESTIONS

- Why are standard units important?
- How does a circle help with angle measurement?

MATERIALS

- Cardstock circles or circular paper plates (one per student)
- "Which Wedge is Right?, Part 1 – Wedge Measures" student recording sheet

- "Which Wedge is Right?, Part 2 – Equal Wedge Measures" student recording sheet (copy on cardstock)
- Pattern blocks
- Scissors
- Plain paper

GROUPING

Partner Task

NUMBER TALKS

Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. Catherine Fosnot has developed problem "strings" which may be included in number talks to further develop mental math skills. See *Mini lessons for Operations with Fractions, Decimals, and Percents* by Kara Louise Imm, Catherine Twomey Fosnot and Willem Uittenbogaard. (*Mini lessons for Operations with Fractions, Decimals, and Percents*, 2007, Kara Louise Imm, Catherine Twomey Fosnot and Willem Uittenbogaard)

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

In this task, students will use a non-standard measurement for angles and then explore finding the measurement of angles using common-sized wedges.

Comments

Common-sized wedges are an effective way to measure angles, allowing for easy communication about the size of angles. The goal of the lesson is for students to realize the need for developing a standard unit of measurement for angles similar to the standard units of linear measurement and weight.

Task Directions

Part 1

1. Give each student the "Which Wedge is Right? Part 1 - Wedge Measures" student recording sheet. As they are looking at the angles on the sheet, have them discuss the following questions with their partners or as a whole class:
    - Which angle do you think takes up the least amount of space?
    - Which angle do you think is takes up the greatest amount of space?
    - Can you order all of the angles from smallest to largest?
    - How did you decide the order?
    - Which angles were hard to compare? (Angles similar in size might be hard to compare.)

2. Explain to students that being able to compare angles is important. In addition, we need a way to give a numerical measure to angles.
    - Do you think we can use a ruler to measure angles? Why or why not?

3. This is a good place to help students draw the comparison between the type of object being measured and the type of measuring tool we use. We use linear inches and centimeters to measures segments and lengths. We use square units like square inches and square centimeters to measure area.
    - What could we use to measure angles?

4. Allow the students to discuss ideas on angle measurement options. Then give each student a circle. Have each student cut a 'wedge' from his or her circle. The students do not need to worry about cutting the same size wedges. Ask them to describe the wedge they just created.
    - Does it look like a right angle, an acute angle, or an obtuse angle?

5. Tell the students they will be using the wedges they created to measure angles. Ask them to measure the first angle on the student recording sheet using their wedge. Give them a few minutes to determine a method for using the wedge they created to measure the angle.
    - Pay close attention to students who created large wedges because they may not be able to measure the angle they drew. Encourage these students to make their wedges smaller and to try again.

6. Once everyone has figured out how to measure using wedges, each student needs to use their wedge to measure the other angles on the paper. Ask students to record each angle measure in the table chart at the bottom of the page.
    - Encourage students to use the term "wedge" when reporting their measures.

7. Help students do the following as students are measuring the angles with their wedges:
    - They need to line up the point of their wedge with the vertex of the angle.
    - They need to make sure they are not over-lapping the wedges too much as they are measuring.
    - They need to line up the straight side of the wedge with the side of the angle they are measuring.

8. Once students have measured their angles, ask them to compare their angle measures with a partner. Before the students compare measures, ask them to predict if their answers will match their partner's answers. Be sure to ask students to explain their thinking.
    - Have students record their angle measures in the chart at the bottom of their partner's paper.

9. Have students discuss the results of their partner's angle measures. Make sure their discussion addresses the following questions:
    - What did you like about using your wedges to measure angles?
    - What did you not like about using your wedges?
    - Why did you and your partner get different answers for the same angle? Is that reasonable?

- Were your partner's answers always greater than or less than your answers? Why did this happen?
- What could you do to make sure you get the same answers when you are measuring angles?

Part 2

Have students generate ideas about why it may be helpful for everyone to use the same size wedges.

Students will follow the directions below from the "Which Wedge is Right?" student recording sheet.

Get one of each type of pattern block and a pair of scissors, and then complete the directions below.

1. Cut off the bottom of this paper along the dotted line.
2. Cut apart each of the wedges from the section you cut from this paper.
3. Trace one of each type of pattern block on this paper.
4. Measure each angle in the pattern blocks. Note: Each of the wedges has the same measure.
5. Record the measure of each angle in the outline of the each pattern block.

By tracing the pattern blocks, students are given a chance to show how they determined the measure of the angle and to record their answers. Some students may want to measure the physical blocks. However, all students will need to trace the pattern blocks on paper and record their answers on the appropriate shape and angle, or find another way to communicate their measurements to the class.

Watch for errors in measurement caused by students overlapping the wedges or carelessly turning the wedges as they count the number needed to cover the angle.

Make sure the students continue to use the word "wedge" in their measurements. They should not write the measure of the angle as 3; they need to write the angle measure as 3 wedges. As they continue having to re-write the word wedge every time, they may decide it would be easier to have an abbreviation or symbol for "wedge." In this case, students can agree to use a "w," wedge shape, or a different way to represent "wedge."

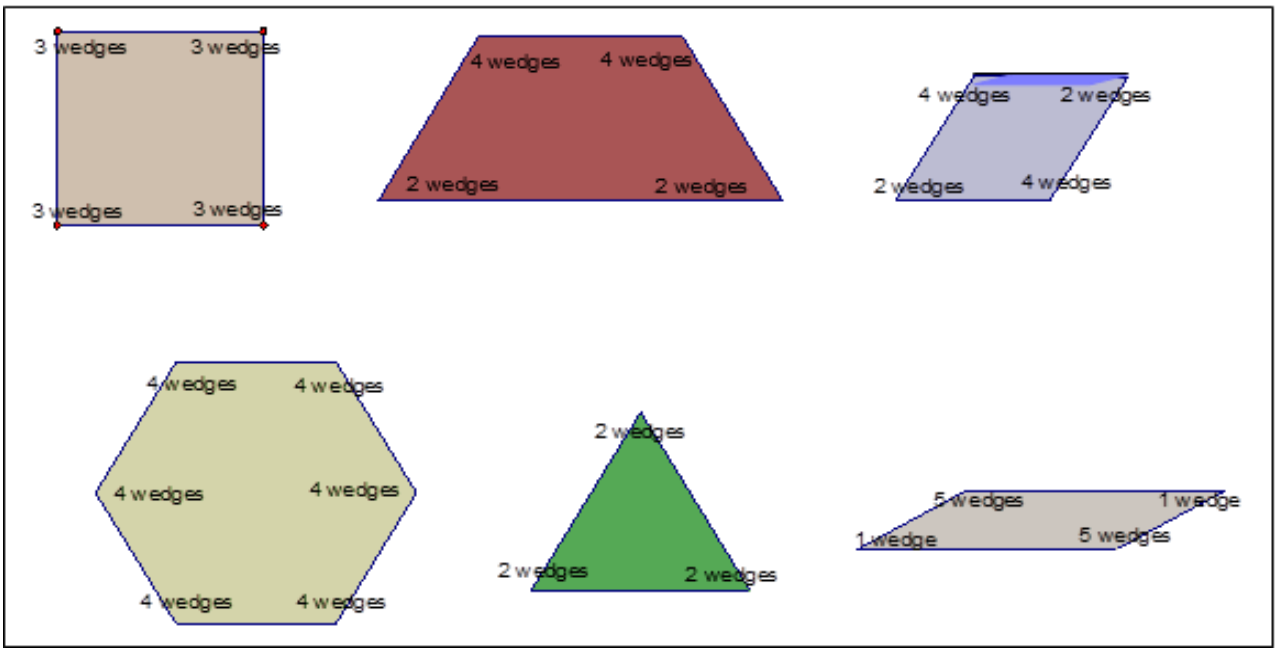
The students should realize the right angles are about 3 wedges and their measures should be more likely to agree with other students' measures because all wedges are the same measure. Allow time for the students to discuss their measures and any discrepancies they notice.

Make sure students have time to discuss the following:

- Were there angles that were difficult to measure? Some of the small angles may be more difficult.
- Were there any angles in the shapes that were the same size? Did you get the same measure for these angles?
- Did everyone get the same measure? If not, why? Should everyone get the same answer?
- What would happen if we all cut our wedges in half? Would that change our answers? Would it be helpful in any way?

Part 2

- **Solutions to pattern blocks:**



FORMATIVE ASSESSMENT QUESTIONS

Part 1

- What did you like about using your wedges to measure angles?
- What did you not like about using your wedges?
- Why did you and your partner get different answers for the same angle? Is that reasonable?
- Were your partner's answers always greater than or less than your answers? Why did this happen?
- What could you do to make sure you get the same answers when you are measuring angles?

Part 2

- Were there angles that were difficult to measure? Some of the small angles may be more difficult.
- Were there any angles in the shapes that were the same size? Did you get the same measure for these angles?
- Did everyone get the same measure? If not, why? Should everyone get the same answer?
- What would happen if we all cut our wedges in half? Would that change our answers? Would it be helpful in any way?

DIFFERENTIATION

Extension

- Use the equal size wedges and cut them each in half. Let students explore using different size equal wedges.

Intervention

- Use larger angles drawn on paper and fraction circles for an easier manipulative.
- For students who struggle to recognize right, acute, and obtuse angles, prepare 12 angle cards. Use cardstock and draw one angle on each card. Make 4 right angles, 4 acute angles, and 4 obtuse angles. Have students move the angle cards into three groups. Continue working until students have correctly grouped them into right, acute, and obtuse angles. Write the name of each type of angle above the cards. Have the students practice reading the names and identifying the characteristics of each.

Intervention Table

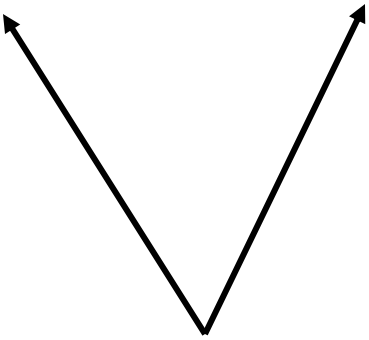
TECHNOLOGY

- http://www.beaconlearningcenter.com/WebLessons/Anglemania/tri2003.htm Anglemania: This tutorial about lines and angles can be used for remediation purposes.
- http://www.crickweb.co.uk/ks2numeracy-tools.html#angle Angles: This resource can be used to demonstrate the use of a protractor and test angle estimation skills. It can be used to extend this task.

Which Wedge is Right?

Part 1 - Wedge Measures

1.



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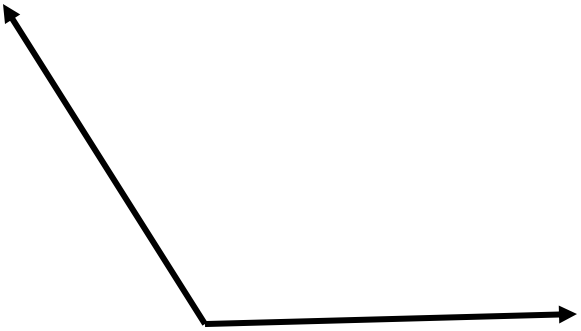

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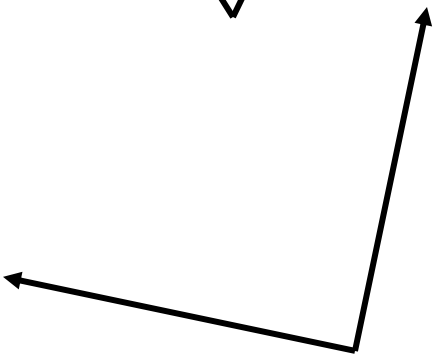

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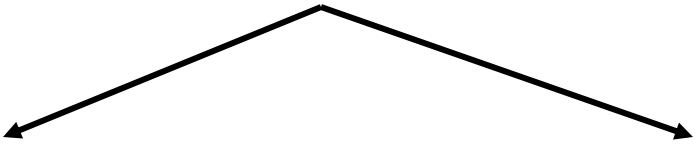

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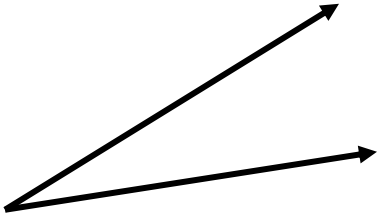

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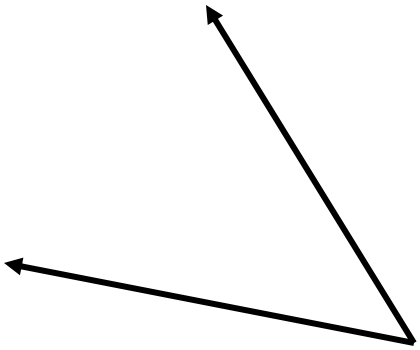
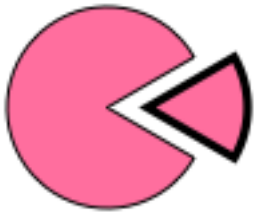


Angle	How large is the angle?	
	Your measure	Partner's measure
1.		
2.		
3.		
4.		
5.		
6.		



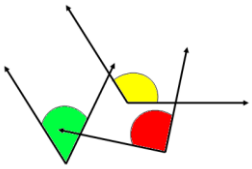
Name _____ Date _____

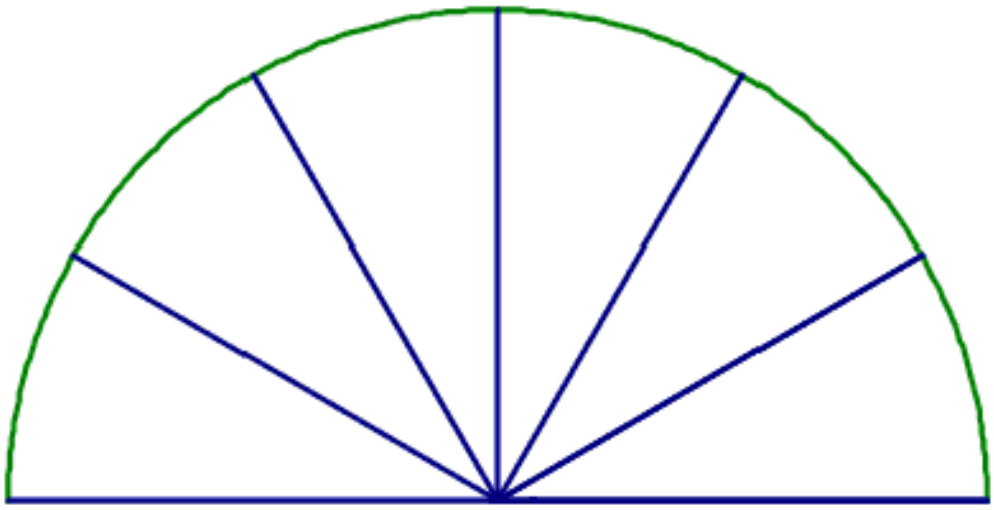
Which Wedge is Right?

Part 2 – Equal Measure Wedges

Get one of each type of pattern block and a pair of scissors, then complete the directions below.

1. Cut off the bottom of this paper along the dotted line.
2. Cut apart each of the wedges from the section you cut from this paper.
3. Trace one of each type of pattern block on this paper. (Use the back of this sheet if needed.)
4. Measure each angle in the pattern blocks. Note: Each of the wedges has the same measure.
5. Record the measure of each angle in the outline of each pattern block.





SCAFFOLDING TASK: Angle Tangle Return to Task Table

TASK CONTENT: Students will use the 360° of a circle to identify and use benchmark angles.

STANDARDS FOR MATHEMATICAL CONTENT

MGSE4.MD.5. Recognize angles as geometric shapes that are formed wherever two rays share a common endpoint, and understand concepts of angle measurement:

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

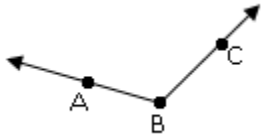
MGSE4.MD.7 Recognize angle measure as additive. When an angle is decomposed into non-overlapping parts, the angle measure of the whole is the sum of the angle measures of the parts. Solve addition and subtraction problems to find unknown angles on a diagram in real world and mathematical problems, e.g., by using an equation with a symbol or letter for the unknown angle measure.

STANDARDS FOR MATHEMATICAL PRACTICE TO BE EMPHASIZED

1. Make sense of problems and persevere in solving them.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.

BACKGROUND KNOWLEDGE

Students should be able to identify right, acute, and obtuse angles. Also, students should know how to name an angle using a point on each side with the vertex in the middle (i.e., ∠ABC, where A and C are a point on each ray, and B is the vertex of the angle.)



Benchmark angles, like benchmark numbers, are angles that are easy to work with and easy to identify. For example, 180° is half of 360°, making it a benchmark angle called a straight angle. Similarly, 90° is half of 180°, making it another benchmark angle called a right angle. Finally, half of 90° is 45°, another benchmark angle. When thinking of thirds of 360°, one third is 120°,

and two thirds of 360° is 240°; two more benchmark angles. Students should recognize how these angles are related to fractions of a circle.

The student sheet with fractions of a circle with measures of 45 degrees, 60 degrees, and 120 degrees should look similar to the ones below.

45 degrees is1/8 of the circle

60 degrees is1/6 of the circle

120 degrees is 1/3 of the circle

Students are confused as to which number to use when determining the measure of an angle using a protractor because most protractors have a double set of numbers. Students should decide first if the angle appears to be an angle that is less than the measure of a right angle (90°) or greater than the measure of a right angle (90°). If the angle appears to be less than 90°, it is an acute angle and its measure ranges from 0° to 89°. If the angle appears to be an angle that is greater than 90°, it is an obtuse angle and its measures range from 91° to 179°. Ask questions about the appearance of the angle to help students in deciding which number to use.

ESSENTIAL QUESTIONS

- How are a circle and an angle related?

MATERIALS

- "Angle Tangle, 360º Circle" student sheet
- "Angle Tangle, Fractions of a Circle" student recording sheet
- 9 x 12 white paper
- Fraction circles
- Crayons or colored paper

GROUPING

Individual/Partner Task

NUMBER TALKS

Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. Catherine Fosnot has developed problem "strings" which may be included in number talks to further develop mental math skills. See *Mini lessons for Operations with Fractions, Decimals, and Percents* by Kara Louise Imm, Catherine Twomey Fosnot and Willem Uittenbogaard. (*Mini lessons for Operations with Fraction, Decimal, and Percents*, 2007, Kara Louise Imm, Catherine Twomey Fosnot and Willem Uittenbogaard)

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

In this task, students will explore angles and their measurements using a 360º circle. Students will also begin to understand the measures of benchmark angles.

Comments

- **360° Circle**

  One way to introduce this task would be to involve students in a discussion about what they already know about angles, especially those that are more familiar to them, such as right angles. Then give each student a copy of the 360-degree circle shown in the directions and discuss how a circle has 360 degrees. One-way students can connect to this idea is by talking about skateboard and snowboard tricks, like the 180 and the 360, and what kind of movements are made in those tricks.

  Looking at their paper, students can begin at 0° and find 180° and 360° on the circle. They may also notice that 0° and 360° are in the same place. Ask students, "If you divide a circle in half how many degrees would that represent?" (180°). Start at 0 degrees on your circle and trace your finger around to 180 degrees. Then have students stand up and jump/spin trying to rotate 180 and 360 degrees.

  Ask students to try to jump 90 degrees. If they take another 90 degree jump where will they land? What about after a third 90-degree jump? And after a fourth 90-degree jump, how many degrees would that be? Looking at their 360 circle, students should be able to identify 90 degrees, 180 degrees, 270 degrees and finally 360 degrees. So, if you could jump all the way around in one jump you would be doing a 360!

- **Angle Tangle, Fractions of a Circle**

  During the task, monitor how students set up their angles. Using a 360° circle, have students orient 0° on a horizontal radius with angles opening counterclockwise, as modeled in the circles in the "Background Knowledge" section. Tell students that the point on the circle indicates where to begin measuring the angle.

  When discussing the angles created with the fractional pieces, be sure to ask about the angle formed when two $\frac{1}{3}$ fractional pieces are put together (240°) or when two $\frac{1}{8}$ fractional pieces are put together (90°).

Task Directions

Students will follow the directions below from the "Angle Tangle" student recording sheet.

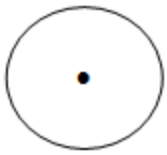
*If **"do a 360"** means to make a complete circle, it makes sense that there are 360 degrees in a circle. You will be exploring the degrees in a circle and how that relates to angle measures. If a circle has 360 degrees, how many degrees are in $\frac{1}{2}$ of a circle? You will explore that and the measures of other benchmark angles in this task.*

Materials:

- A piece of 9 x 12 art paper.
- Fraction circles - a whole, halves, fourths, eighths, sixths, and thirds.
- Crayons or colored pencils

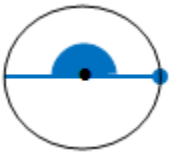
Directions:

1. Fold your 9 x 12 art paper to make four boxes.
2. Trace the whole circle from your circle fractions in each of the boxes on the front and in two boxes on the back.
3. Begin with the first whole circle. Label your circle as shown.



360 degrees is 1 whole circle

4. How much of the circle would have a measure of 180 degrees? Find the fraction piece that would cover half the circle. In the second box, trace the halves onto the circle ($360 \div 2 = 180$ or $\frac{1}{2}\ x\ 360$). Label your circle as shown.



180 degrees is ½ of the circle, also called a straight angle.

5. How much of the circle would have a measure of 90 degrees? (Think about how far you had to jump for a 90-degree turn.) How could you relate 90 degrees to a fraction of your circle? Find the fraction pieces that would make 90-degree angles. Label your circle as shown. ($360 \div 4 = 90°$ or $\frac{1}{4}$ x $360 = 90$)

90 degrees is ¼ of the circle

6. Use the remaining circles to find the angles with measures of 45 degrees, 60 degrees, and 120 degrees.

FORMATIVE ASSESSMENT QUESTIONS

- When would you use benchmark angles in your everyday life?
- How can you use fractions of a circle to help you measure and compare angles?
- Into how many parts is the circle divided? What is 360 divided by 2? 360 ÷ 3? 360 ÷ 4? etc.

DIFFERENTIATION

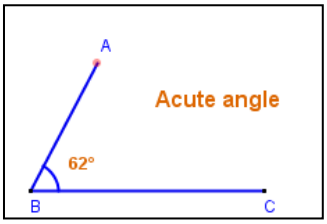
Extension

- Students can work to demonstrate the number of fractional pieces necessary to create reflex angles (angles between 180 and 360 degrees). For example, students can model a 225° angle as 5/8 of a circle with each 1/8 of a circle equaling 45° (45 x 5 = 225).

Intervention

- Before students are asked to complete this task, provide them with a student sheet where one fractional piece is drawn on each circle and the measure of the angle is given. Have students determine the fractional piece that is drawn and trace in the rest of the pieces into the circle. After the student records the measure of each angle, she adds them to determine a sum of 360. Also, through discussion, students can find the number of angles needed to create a 180°, 90°, or 270° angles.

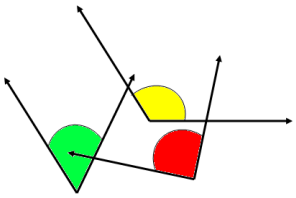
Intervention Table



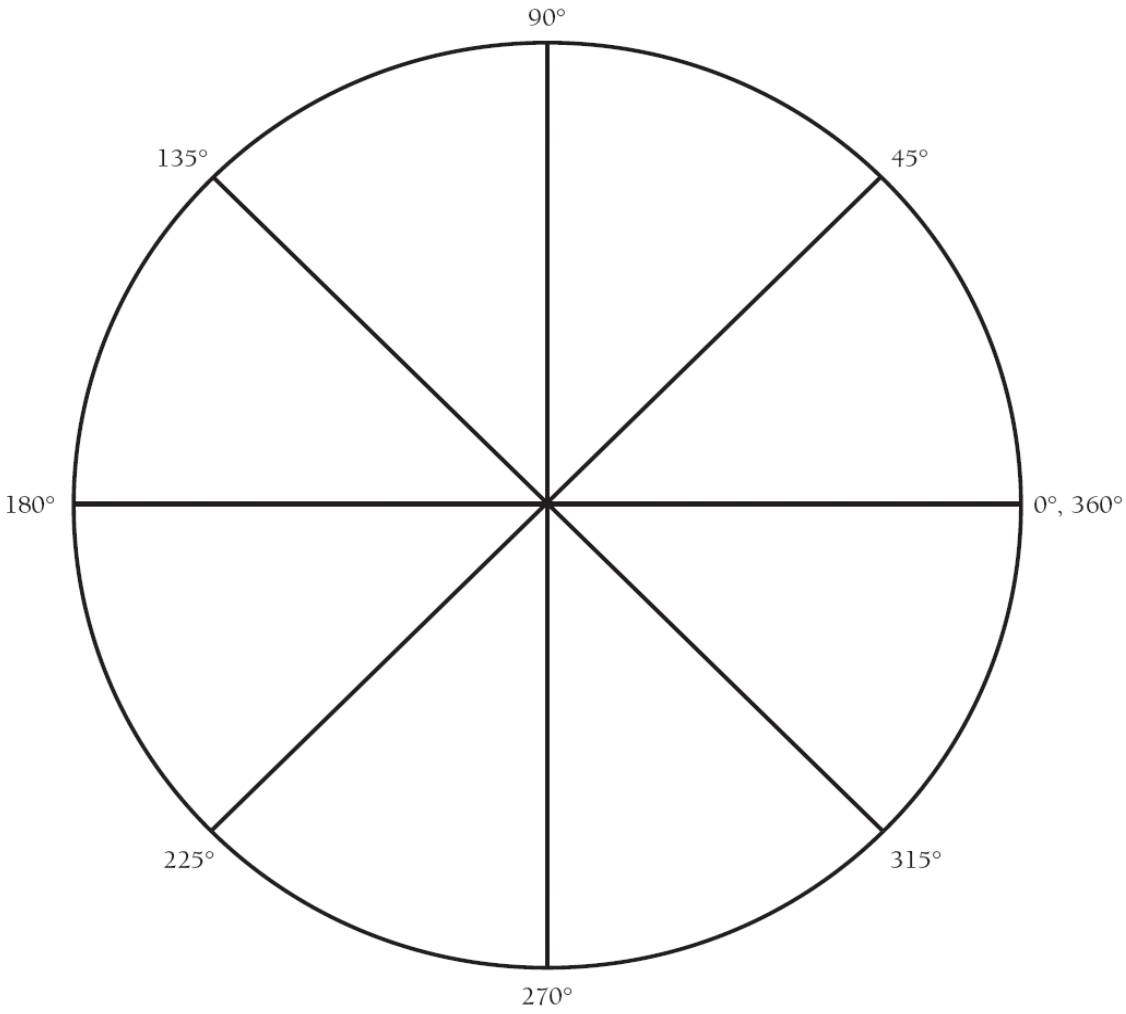
TECHNOLOGY

- http://www.beaconlearningcenter.com/WebLessons/Anglemania/tri2003.htm Anglemania: This tutorial about lines and angles can be used for remediation purposes.
- http://www.crickweb.co.uk/ks2numeracy-tools.html#angle Angles: This resource can be used to demonstrate the use of a protractor and test angle estimation skills. It can be used to extend this task.

Angle Tangle

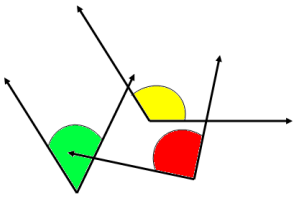


360º Circle



Angle Tangle

Fractions of a Circle



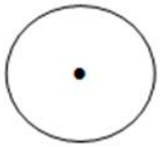
In skateboarding to do a "360" means to make a complete circle. This is because there are 360 degrees in a circle. You will be exploring the degrees in a circle and how that relates to angle measures. If a circle has 360 degrees, how many degrees are in $\frac{1}{2}$ of a circle? You will explore that and the measures of other benchmark angles in this task.

Materials:

- A piece of 9 x 12 art paper.
- Fraction circles - a whole, halves, fourths, eighths, sixths, and thirds.
- Crayons or colored pencils

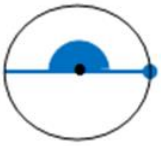
Directions:

1. Fold your 9 x 12 art paper to make four boxes.
2. Trace the whole circle from your circle fraction circles in each of the boxes on the front and in two boxes on the back.
3. Begin with the first whole circle. Label your circle as shown.



360 degrees is 1 whole circle

4. How much of the circle would have a measure of 180 degrees?
   Find the fraction piece that would cover half the circle. In the second box, trace the halves onto the circle (360 ÷ 2 = 180). Label your circle as shown.



180 degrees is ½ of the circle, also called a straight angle.

5. How much of the circle would have a measure of 90 degrees? (Think about how far you had to jump for a 90-degree turn.)
   How could you relate 90 degrees to a fraction of your circle?
   Find the fraction pieces that would make 90-degree angles. Label your circle as shown.

90 degrees is ¼ of the circle

6. Use the remaining circles to find the angles with measures of 45 degrees, 60 degrees, and 120 degrees.

SCAFFOLDING TASK: Build an Angle Ruler

Return to Task Table

TASK CONTENT: Students will build and use an angle ruler.

STANDARDS FOR MATHEMATICAL CONTENT

MGSE4.MD.5. Recognize angles as geometric shapes that are formed wherever two rays share a common endpoint, and understand concepts of angle measurement:

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

MGSE4.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 or letter for the unknown angle measure.

STANDARDS FOR MATHEMATICAL PRACTICE TO BE EMPHASIZED

1. Make sense of problems and persevere in solving them.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.

BACKGROUND KNOWLEDGE

Students should have worked with angles in multiple situations. They should have developed an understanding of the need for standard measurement units and tools.

ESSENTIAL QUESTIONS

- How is a circle like a ruler?
- How can we measure angles using wedges of a circle?

MATERIALS

- Angle ruler copied on transparency, one per student
- "Build an Angle Ruler" student sheet
- "Build an Angle Ruler, Measuring Angles" student recording sheet

GROUPING

Individual/Partner Task

NUMBER TALKS

Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. Catherine Fosnot has developed problem "strings" which may be included in number talks to further develop mental math skills. See *Mini lessons for Operations with Fractions, Decimals, and Percents* by Kara Louise Imm, Catherine Twomey Fosnot and Willem Uittenbogaard. (*Mini lessons for Operations with Fractions, Decimals, and Percents*, 2007, Kara Louise Imm, Catherine Twomey Fosnot and Willem Uittenbogaard)

TASK DESCRIPTION, DEVELOPMENT, AND DISCUSSION

Students will measure the angles in a geometric design using an "angle ruler." This activity builds upon the previous tasks of angle measurement using nonstandard and standard units and introduces the angle ruler which provides more specificity in measurement. This is an introductory task; it prepares students for the introduction of the protractor.

Comments

The discussion part of this task is vital. The goal of the initial questioning is to have students discuss the advantages of using a smaller wedge to measure more accurately. The disadvantage in a wedge this small might be trying to cut it out and turning it repeatedly to measure an angle. The measure of each wedge is 10^{o}.

When students are looking at the angle ruler, they should be able to relate the numbering of the wedges to the numbering on a ruler. Make sure they address the need for 0 to be on the ruler. Have them discuss why this ruler has a zero while their inch ruler does not have a zero.

Pass out student recording sheet and angle rulers to each student. Once you have provided the students with a copy of the transparent angle ruler, they will need to decide how they are going to use it to measure angles. Make sure they have a chance to discuss this with their partner and/or class and give them an opportunity to try different methods.

As students work together to measure angles, be sure they are aware of the following:

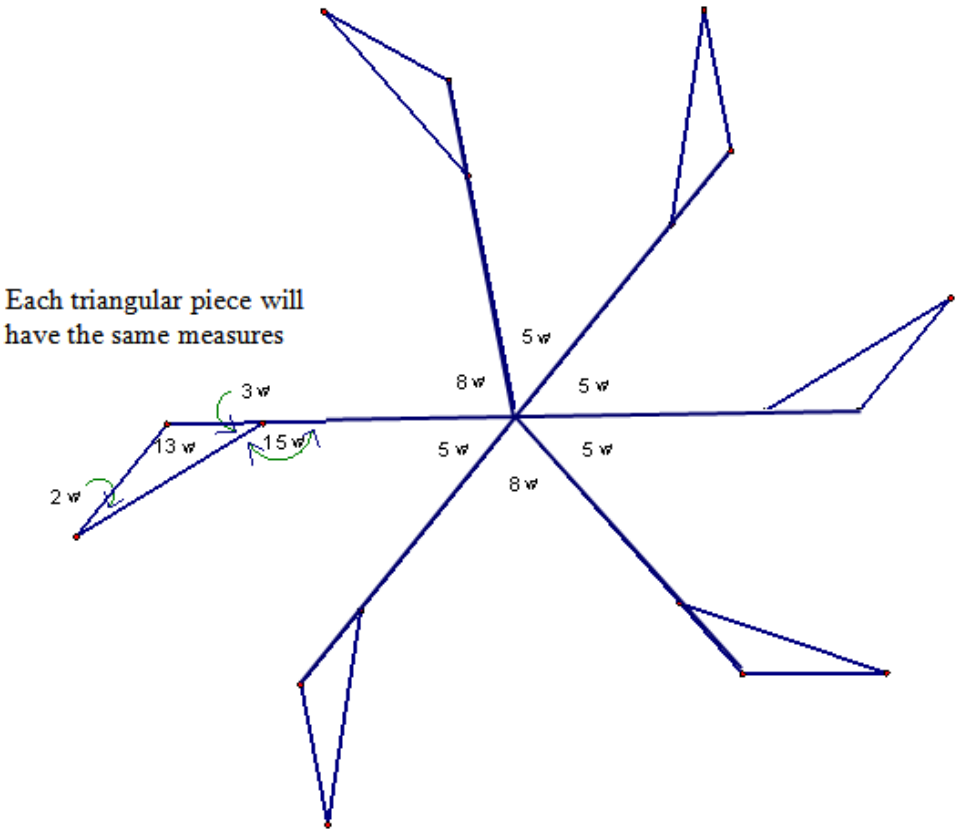
- The center of the circle needs to be lined up with the vertex of the angle.
- The 0 on the circle needs to be lined up with one of the sides of the angle.
- The 'angle ruler' should be rotated in whatever direction makes it easiest to line up the zero on one of the sides of the angle being measured.

Make sure students are recording their angle measures in a way that allows them to communicate which angle has the indicated measure.

There are many different angles that can be measured in Rafe's design. Students may not see all the different angles created in the design. Have them work together to find as many angles as possible.

Possible Solution:

Note: For the sake of abbreviation, "*w*" will represent one wedge. So, "3*w*" represents 3 wedges.

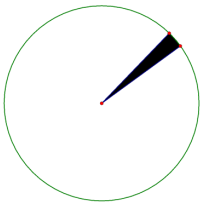


Task Directions

Part 1

Students will follow the directions below from the "Build an Angle Ruler" student sheet.

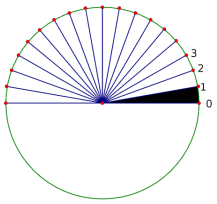
You have been measuring angles using wedges. Look at the wedge below. What do you notice about it?



Discuss the following questions with your partner. Be prepared to share your thoughts with the class.

- Do you think it would be easy to measure an angle with this wedge?
- What would be the advantages of using this wedge?
- What would be the disadvantages of using this wedge?

You are going to use an angle ruler today using the wedge above. Look at the figure below.



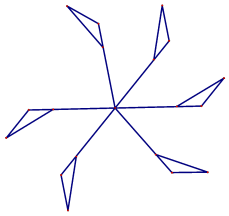
Discuss the following questions with your partner. Be prepared to share your thoughts with the class.

- How do you think it was created?
- What do the numbers represent?
- What are the missing numbers?
- How would this circle be helpful in measuring an angle?
- Why might we call this an angle ruler?

Part 2

Students will follow the directions below from the "Build an Angle Ruler, Measuring Angles" student recording sheet.

Rafe created the design below. What patterns do you notice in his design?



Your teacher has given you a copy of the "angle ruler" printed on a transparency sheet. Work with your partner and decide how to use your angle ruler to measure the different angles in Rafe's design. Try to find as many different angles as possible. Write the angle measure inside the angle.

How do you think Rafe created this design?

FORMATIVE ASSESSMENT QUESTIONS

- How many wedges does it take to go completely around the middle of the design?
- How many wedges does it take to go halfway around the middle of the design?
- How many total wedges are used for the three angles in the triangle? Do you think this is always true? How could you check?
- Can you make a bigger angle by adding two or more smaller angles together? Trace one and then determine its measure in wedges. Do you have to re-measure the angle to determine its size?

DIFFERENTIATION

Extension

- Ask students to create their own design using an angle ruler. Have students share their design and measure the angles contained within the design.

Intervention

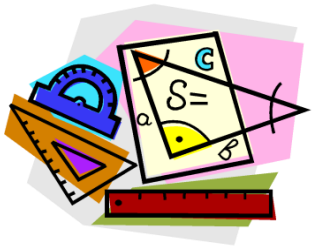
- Discuss possible angles to measure within Rafe's design, being sure students are able to identify the vertex.

Intervention Table

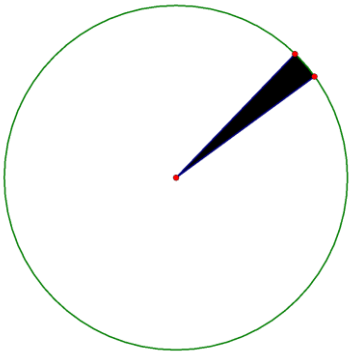
TECHNOLOGY

- http://www.beaconlearningcenter.com/WebLessons/Anglemania/tri2003.htm Anglemania: This tutorial about lines and angles can be used for remediation purposes.
- http://www.crickweb.co.uk/ks2numeracy-tools.html#angle Angles: This resource can be used to demonstrate the use of a protractor and test angle estimation skills. It can be used to extend this task.

Build an Angle Ruler



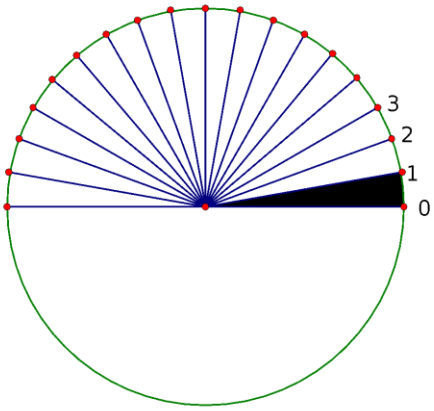
You have been measuring angles using wedges. Look at the wedge below. What do you notice about it?



Discuss the following questions with your partner. Be prepared to share your thoughts with the class.

- What would be the advantages of using this wedge?
- What would be the disadvantages of using this wedge?

You are going to use an angle ruler today using the wedge above. Look at the figure below.

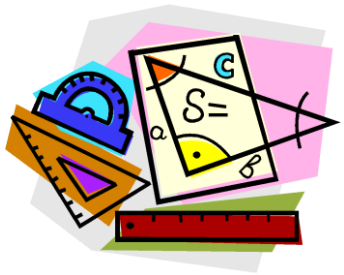


Discuss the following questions with your partner. On the back of this paper, record your answers to the questions. Be prepared to share your thoughts with the class.

- How do you think it was created?
- What do the numbers represent?
- What are all the missing numbers?
- How would this circle be helpful in measuring an angle?
- Why might we call this an angle ruler?

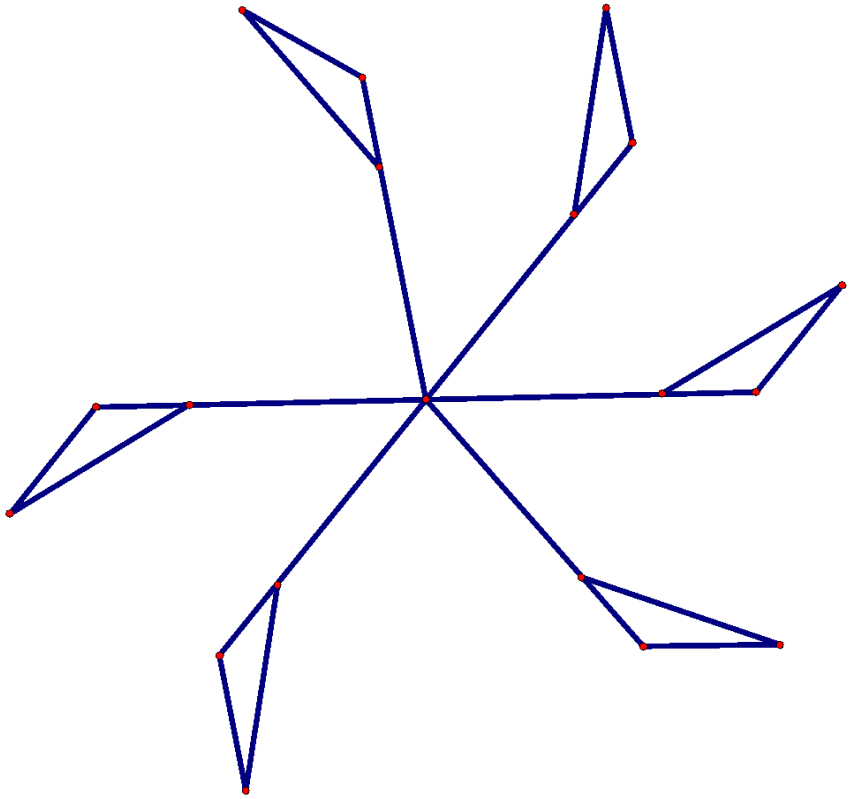
Build an Angle Ruler

Measuring Angles



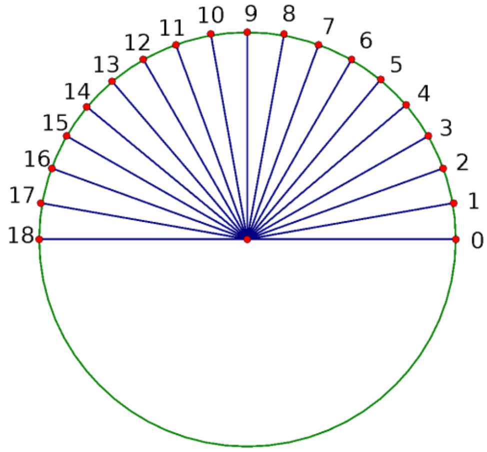
Rafe created the design below. What patterns do you notice in his design?

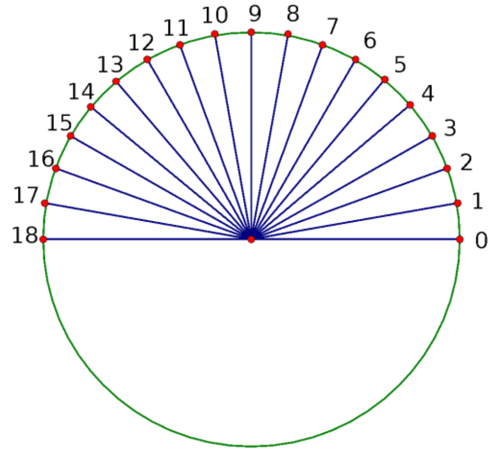
Your teacher has given you a copy of the "angle ruler" printed on a transparency sheet. Work with your partner and decide how to use your angle ruler to measure the different angles in Rafe's design. Try to find as many different angles as possible. Write the angle measure inside the angle.

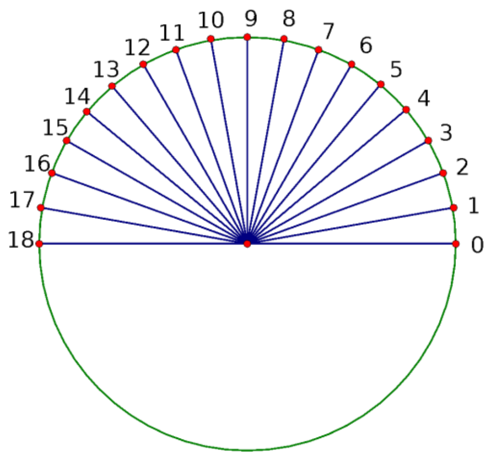


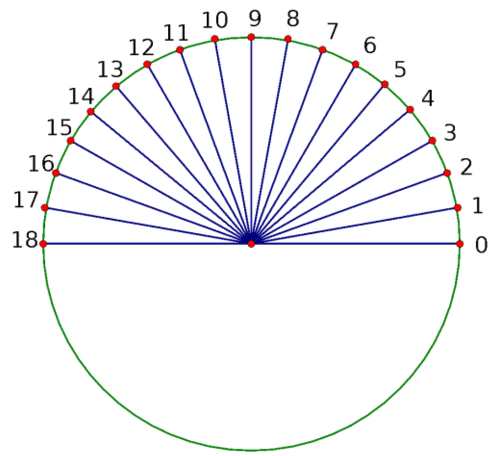
How do you think Rafe created this design?

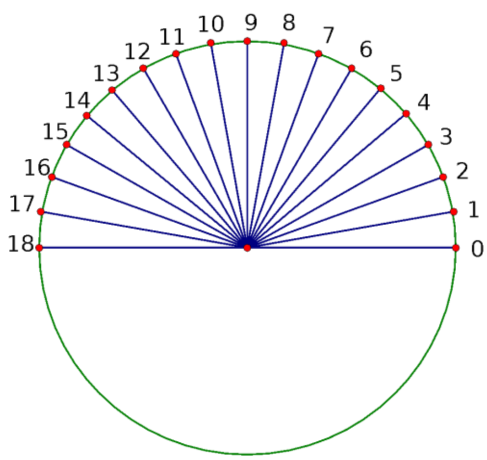
Angle rulers to copy onto transparencies:

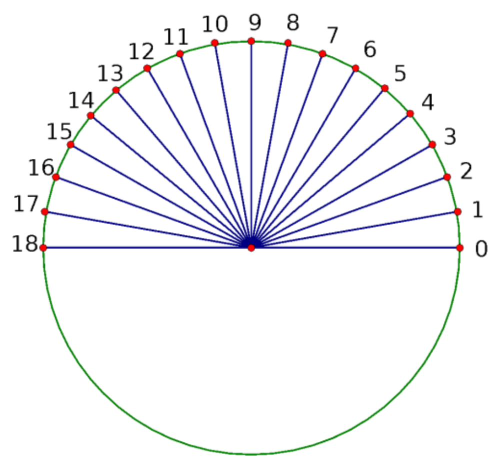












Constructing Task: Guess My Angle! Return to Task Table

TASK CONTENT: Students will measure angles using a protractor.

STANDARDS FOR MATHEMATICAL CONTENT

MGSE4.MD.5. Recognize angles as geometric shapes that are formed wherever two rays share a common endpoint, and understand concepts of angle measurement:

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

MGSE4.MD.6 Measure angles in whole-number degrees using a protractor. Sketch angles of specified measure.

MGSE4.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 or letter for the unknown angle measure.

STANDARDS FOR MATHEMATICAL PRACTICE TO BE EMPHASIZED

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.

BACKGROUND KNOWLEDGE

Students should understand the parts of an angle and be familiar with ways to measure angles (angle ruler, wedges, and comparisons).

Students are confused as to which number to use when determining the measure of an angle using a protractor because most protractors have a double set of numbers. Students should decide first if the angle appears to be an angle that is less than the measure of a right angle (90°) or greater than the measure of a right angle (90°). If the angle appears to be less than 90°, it is an acute angle and its measure ranges from 0° to 89°. If the angle appears to be an angle that is greater than 90°, it is an obtuse angle and its measures range from 91° to 179°. Ask questions about the appearance of the angle to help students in deciding which number to use.

This task requires a deck of angle cards. To use the cards repeatedly, copy onto cardstock and laminate before cutting them apart. There are 16 cards per deck.

ESSENTIAL QUESTIONS

- How do we measure an angle using a protractor?
- Why do we need a standard unit with which to measure angles?
- What are benchmark angles and how can they be useful in estimating angle measures?

MATERIALS

- Angle ruler and completed student recording sheet from "Build an Angle Ruler"
- Protractor, one per student
- "Guess My Angle!" student recording sheet
- Deck of angle cards
- *Hamster Champs,* by Stuart J. Murphy or similar book about angle measurement

GROUPING

Whole Group/Partner Task

NUMBER TALKS

Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. Catherine Fosnot has developed problem "strings" which may be included in number talks to further develop mental math skills. See *Mini lessons for Operations with Fractions, Decimals, and Percents* by Kara Louise Imm, Catherine Twomey Fosnot and Willem Uittenbogaard. (*Mini lessons for Operations with Fractions, Decimals, and Percents*, 2007, Kara Louise Imm, Catherine Twomey Fosnot and Willem Uittenbogaard)

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

In Part 1 of this task, students will transition from using an angle ruler to using a protractor to measure angles. In Part 2, students will practice using a protractor by playing "Guess My Angle!"

Comments

This activity should follow closely behind Rafe's design from the previous task "Build an Angle Ruler." The wedge used in the angle ruler in Rafe's design measures 10º. This allows an easy transition from using the wedges in the ruler to using degrees.

As students learn to use the protractor, watch for the following typical difficulties:

- The 0° mark, not the bottom of the protractor, should be lined up with one of the sides of the angle.

- The hole in the center of the protractor should be lined up with the vertex of the angle.
- The solid black line, or (zero-degree line) on the protractor should be lined up on one side of the angle.
- The protractor should be rotated in whatever direction makes it easiest to line up the zero on one of the sides of the angle being measured.
- Make sure the students look at the angle and decide if it is acute or obtuse when deciding which number to read on the protractor. Also, have them 'read up' from one side of their angle to the other as they are measuring. Tell them it is just like starting at zero on a ruler and counting on to find the final measurement.

As students learn to measure an angle with a protractor, sometimes it is necessary for them to extend the sides of a given angle, so that it will be visibly easier to measure. **Changing the length of the sides of an angle does not change the measure of the angle.** To help students see this, draw an angle on the board and have students measure it. Then have a student come up and extend the lengths of both sides of the angle. Ask if they think the measure of the angle has changed. Next, have the students re-measure the angle. Erase part of one side of the angle, so the two sides are of obviously different lengths. Ask them to discuss the effect this has on the size of the angle. They may need to do this several times to understand that the lengths of the sides do not affect the size of the angle.

Task Directions
Part 1
This task can be introduced by reviewing the features of the angle ruler.

To introduce a protractor, begin by asking students to look at their angle ruler while discussing the following questions.

- How can an angle ruler be changed to measure angles even smaller than 1 wedge?
- What would be the advantage in cutting each wedge into 2 wedges? How many total wedges would we have? (18 x 2 = 36 wedges)
- What would happen if we divided each wedge into 3 wedges? How many total wedges would we have? (18 x 3 = 54 wedges)
- Imagine cutting each wedge into 10 wedges. How big would each wedge be? Would those wedges be easy to cut apart? How many total wedges would we have on our ruler? (18 x 10 = 180)
- If we divided each wedge into 10 wedges, how would that change the numbering on our ruler?

Give students a marker they can use on their transparency. Have them change the numbers on their ruler to reflect dividing each wedge into 10 wedges. (Multiply the wedge measure by 10.) Once students have labeled each wedge as a multiple of ten, discuss with students how their angle ruler is the same and how it is different.

Give each student a protractor. Tell students that the tool they were given is called a protractor and is used to measure angles. Explain that the smallest wedges have a special measure. Each smallest wedge has a measure of one degree. (Teachers might need to explain that each mark for

one degree would need to be extended to the center point to create a one-degree angle. Typically, protractors just use tick marks for one-degree increments.) **A degree is like an inch or a centimeter; it is an agreed upon size**. Ask students how their angle rulers and the protractors are alike. How are they different?

Students should notice there are numbers going in both directions on the protractor but not on the ruler they created. Make sure they discuss why this might be the case. Have them work with a partner to determine how they could use the protractor to measure angles.

Some suggested questions for students to answer while learning to use a protractor include:

- How many degrees would you find in a complete circle? There are 360º in a complete circle. The students can see this by noticing they have half a circle or by putting two of the protractors together to create a whole circle. Another approach would be to add the degrees on each protractor.
- Have students find a right angle on their desks and use their protractor to measure it. How many degrees are in this angle?
    - Based on their understanding that a right-angle measures 90°, ask how many degrees will be in an acute angle. Students should remember an acute angle is smaller than a right angle, so an acute angle would be less than 90 but more than 0. (The idea that an acute angle has more than 0 degrees is important.)
    - How many degrees are in an obtuse angle? Because it is bigger than a right angle, it must have more than 90°, but less than 180°. Students may be unclear about a straight line, so be sure this discussion occurs. An angle that has exactly 180º is a straight angle, not an obtuse angle.
    - If there is time, have students experiment with reflex angles, angles whose measures are greater than 180º and less than 360º.
- Use the protractor to measure the angles of Rafe's Design. How are your answers the same? How are they different? The measure of the angles should be the number of wedges times 10. Some students may take this opportunity to try to be more accurate in measuring their angles. The angles are constructed to be multiples of 10, so their answers should be close.

Part 2

Hamster Champs, by Stuart J. Murphy, or a similar book about measuring angles using a protractor, is one way to introduce the second part of this task.

When students are comfortable using a protractor, let them work in pairs to play "Guess My Angle!" Students will follow the directions below from the "Guess My Angle!" student recording sheet.

Directions

1. Pick up one card at a time; both players use the same card.
2. Estimate the measure of the angle on the card and record it in the chart (right), without letting your partner see your estimate.

3. After you and your partner have written an estimate, use a protractor to measure the angle. Make sure both players measure the angle individually and make sure you both agree on the angle measure.
4. Each round is scored as follows:
    a. 2 points – for the player with the closest estimate.
    b. 4 points – for the player with the exact measure.
    c. If you both players have the same estimate, both players earn 2 points (even if both estimates are exact.)
5. The winner is the player with the most points at the end of five rounds.

FORMATIVE ASSESSMENT QUESTIONS

- How are an angle ruler and a protractor similar/different?
- What steps should be used when measuring an angle with a protractor?

DIFFERENTIATION

Extension

- Have students trace pattern blocks on paper and measure the angles using a protractor. Compare the measures of the angles measured with a protractor with those measured with the angle ruler.
- Play STOP! Using a large angle manipulative (a Judy clock will work for this as one minute is equal to six degrees), give an angle measurement. Move one side of the angle until someone says STOP. If they are within 5 degrees, they win and become the angle manipulator.

Intervention

- Have students work in pairs, one with an angle ruler and one with a protractor. Give each pair an angle to measure and have them use their own tool, then compare and check results. Switch tools and continue.
- To demonstrate using a protractor, use "What's My Angle?"

Intervention Table

TECHNOLOGY

- http://www.crickweb.co.uk/ks2numeracy-tools.html#angle Angles: This resource allows to guess angle measures or type of angles based on measurements. It can be used for additional practice.
- https://prod.classflow.com/classflow/#!/product/itemId=fd838e4b0bcf4ce08202386a56641370 Measure and Draw Angles: This activity can be used with an ActivSlate or Smartboard. It can be used for additional practice or extending this task.
- https://learnzillion.com/lessons/2973-measure-angles-to-the-nearest-degree-with-protractors This LearnZillion tutorial teaches students how to measure to the nearest degree using a protractor.

Guess My Angle!

Materials:

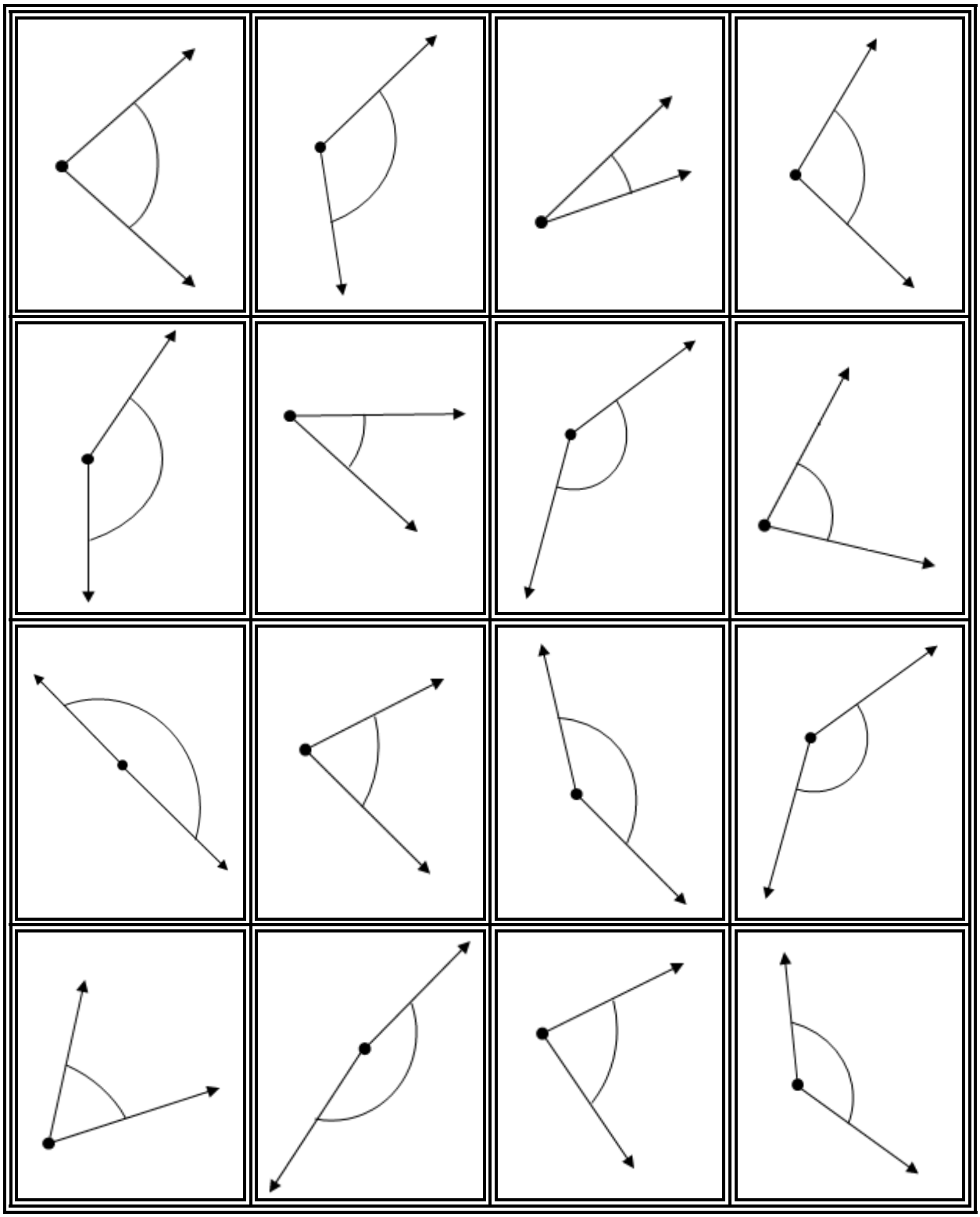
Deck of angle cards
Protractor for each player

Directions:

1. Pick up one card at a time; both players use the same card.
2. Estimate the measure of the angle on the card and record it in the chart below, without letting your partner see your estimate.
3. After you and your partner have written an estimate, use a protractor to measure the angle. Make sure both players measure the angle individually and make sure you both agree on the angle measure.
4. Each round is scored as follows:
    a. 2 points – for the player with the closest estimate.
    b. 4 points – for the player with the exact measure.
    c. If you both players have the same estimate, both players earn 2 points (even if both estimates are exact.)
5. The winner is the player with the most points at the end of five rounds.

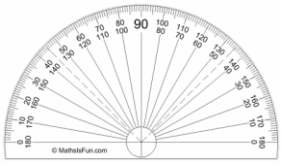
Round	Angle Measure Estimate	Angle Measure Actual	Score
1.			
2.			
3.			
4.			
5.			
		Total Score	

Guess My Angle! – Playing Cards



CONSTRUCTING TASK: Turn, Turn, Turn

Return to Task Table



TASK CONTENT: Students will use rotation to find various types of angles.

STANDARDS FOR MATHEMATICAL CONTENT

MGSE4.MD.5. Recognize angles as geometric shapes that are formed wherever two rays share a common endpoint, and understand concepts of angle measurement:

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

MGSE4.MD.6 Measure angles in whole-number degrees using a protractor. Sketch angles of specified measure.

MGSE4.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 or letter for the unknown angle measure.

STANDARDS FOR MATHEMATICAL PRACTICE TO BE EMPHASIZED

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.

BACKGROUND KNOWLEDGE

Students should be familiar with right, acute, and obtuse angles and half and full rotations.

ESSENTIAL QUESTIONS

- How does a turn relate to an angle?
- What does half rotation and full rotation mean?
- What do we actually measure when we measure an angle?

MATERIALS

- Scissors
- Two circles (see comments)

GROUPING

Whole Group

NUMBER TALKS

Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. Catherine Fosnot has developed problem "strings" which may be included in number talks to further develop mental math skills. See *Mini lessons for Operations with Fractions, Decimals, and Percents* by Kara Louise Imm, Catherine Twomey Fosnot and Willem Uittenbogaard. (*Mini lessons for Operations with Fractions, Decimals, and Percents*, 2007, Kara Louise Imm, Catherine Twomey Fosnot and Willem Uittenbogaard)

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

In this task, students will form various angles by rotating the two inter-connected circles. Each circle must be a different color. Copy half of the required circles on colored cardstock, the rest on white cardstock. Alternatively, different colored paper plates can be used.

Comments
This kinesthetic activity allows students to manipulate paper to form angles. The idea is to help develop the concept of angles as a rotation around a circle.

One way this task can be introduced is to ask students to move their arms to show the rotation that occurs when an angle is created. This strategy will help children develop the sense of an angle as a turn. While doing this, students will need to use both arms, one to indicate their starting location and one to point to how far they have turned. For example, you could go through the following directions and questions with your students:

- Look at the front wall and point to it with your right hand.
- Without moving your right hand, turn your left arm until your left hand is pointing to the wall on your left.
- What angle did you create with your arms?
- How far did you turn?
- If you moved your body 180º, how would that look? Show me.
- Can you turn more than 180º? Can you make three 90° turns? How far did you turn in total?
- What if you turn in a complete circle? 2 circles? 1 and a half circles?

Students can often relate real-world activities to the concept of turning a certain number of degrees. A skateboarder wants to learn to do a 180, a 360, a 720, etc. The same can be said about snowboarders on a half-pipe, X-treme Motocross, etc. Many of these students will have seen this on television even if they have never actually experienced it themselves.

Task Directions

Part 1

Have students cut out two circles. (They should be cut from two different colored pieces of cardstock, or you may use two different colored paper plates.) Cut along the radius drawn on each circle. Slide the circles together and spin to make different angles.

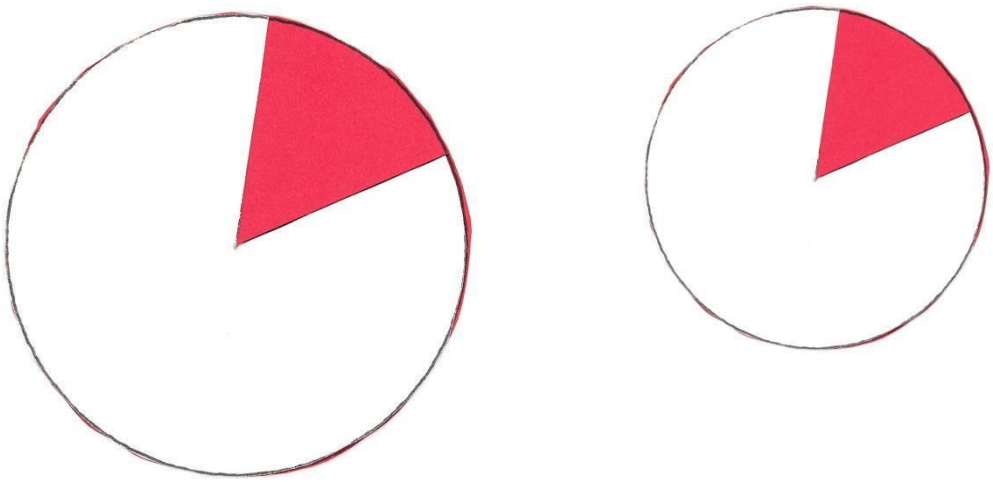
Encourage students to think of an angle as a turn or rotation. Have students make familiar angles (right, acute, obtuse). Then challenge them to make an angle that is the same as 3 right angles, an angle that has a right angle and an acute angle, etc.

Part 2

Students may have some common misconceptions about angle measurement. The activity below gives students another opportunity to understand that the length of the sides of an angle do not affect the size of an angle.

Using two different sized circle sets, made in the same way as the sets formed by the students in this task, create two angles about the same size. Then ask, "Which angle is larger?"

Give the students opportunities to compare the effect of turning angles on the different sized sets.



Another way for children to relate to the fact that the length of sides is irrelevant to the size of an angle is to use clocks of different sizes. No matter how big or small a clock may be, it takes the same amount of time to go from, 12:00 to 12:15, or 1:00 to 2:00. Have students discuss the angles the hands of the clock make as they move around the clock. Note that the motion of each hand should be dealt with separately, since the movement of the hour hand is paced differently from the movement of the minute hand.

FORMATIVE ASSESSMENT QUESTIONS

- How are you using your two circles to create angles?
- What happens on your circles when you start with a smaller angle and create a larger one?
- Is there any place on your two circles that stays the same no matter what size angle you make? (The idea is for students to realize that the center point stays the same and movement occurs around this point.)

DIFFERENTIATION

Extension

- Paste a copy of a protractor onto the back of one of the circles so the angle created by rotating the circle can be measured from the back of the set. Have one student create an angle while another child estimates the size of the angle. The first student can simply turn the circle around so students estimating the angle size can determine if they are correct. They should continue in a back and forth manner allowing both children the opportunity to practice estimating angle measures. This would be easy to keep close by to use as a sponge activity and allows the students to have repeated exposure in estimating angle measures.

Intervention

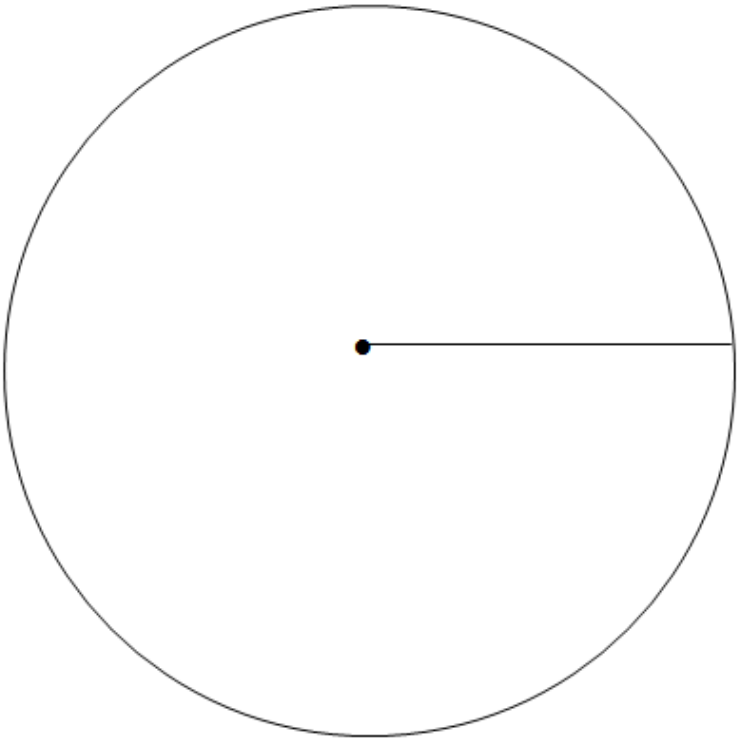
- Allow students to measure angles whose sides are long enough to measure comfortably with a protractor.
- Before students measure an angle, discuss the type of angle (acute, obtuse, right) so that the student uses the correct set of numbers on the protractor when reporting the measure of the angle.

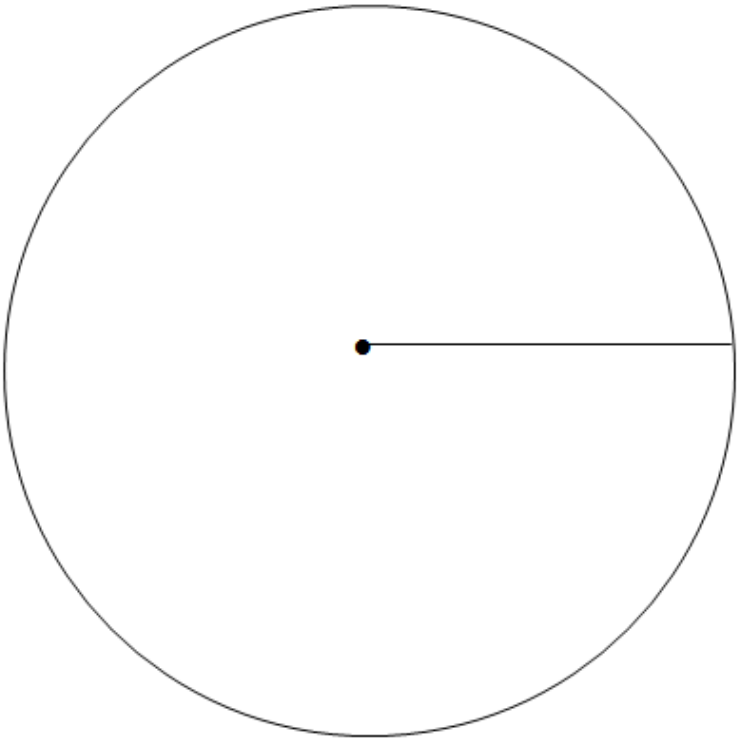
Intervention Table

TECHNOLOGY

- https://prod.classflow.com/classflow/#!/product/itemId=fd838e4b0bcf4ce08202386a56641370 Measure and Draw Angles: This activity can be used with an ActivSlate or Smartboard. It can be used for additional practice or extending this task.
- http://www.oswego.org/ocsd-web/games/bananahunt/bhunt.html Banana Hunt: This game requires monkeys to be place at the proper angle degree in order to collect bananas. It can be used for additional practice.
- http://www.amblesideprimary.com/ambleweb/mentalmaths/protractor.html Protractor: This activity can be used by the student or teacher to review angles and how to use a protractor.

Turn, Turn, Turn
Circles





CONSTRUCTING TASK: Summing It Up Return to Task Table

TASK CONTENT: Students explore the angle measures of a triangle.

STANDARDS FOR MATHEMATICAL CONTENT

MGSE4.MD.5. Recognize angles as geometric shapes that are formed wherever two rays share a common endpoint, and understand concepts of angle measurement:

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

MGSE4.MD.6 Measure angles in whole-number degrees using a protractor. Sketch angles of specified measure.

MGSE4.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 or letter for the unknown angle measure.

STANDARDS FOR MATHEMATICAL PRACTICE TO BE EMPHASIZED

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.

BACKGROUND KNOWLEDGE

Students need to be able to accurately measure an angle with a protractor. Also, students need to be able to recognize a straight angle and know that its measure is 180°.

ESSENTIAL QUESTIONS

- How are the angles of a triangle related?
- What do we know about the measurement of angles in a triangle?

MATERIALS

- "Summing It Up" student recording sheet
- Ruler, Protractor, Scissors
- Piece of plain paper

GROUPING

Individual/Partner Task

NUMBER TALKS

Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. Catherine Fosnot has developed problem "strings" which may be included in number talks to further develop mental math skills. See *Mini lessons for Operations with Fractions, Decimals, and Percents* by Kara Louise Imm, Catherine Twomey Fosnot and Willem Uittenbogaard. (*Mini lessons for Operations with Fractions, Decimals, and Percents*, 2007, Kara Louise Imm, Catherine Twomey Fosnot and Willem Uittenbogaard)

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

In this task, students will explore the angle measures of a triangle and find that the sum of the angles is always 180°. While this is not a requirement of the standards at 4th grade, it is an interesting way to recognize angle measure as additive from a different perspective which might inspire curiosity about summing other polygon angle measures.

Comments

To facilitate this task, provide a poster paper or a location on the board where students can record their angle measure sums. As students are working, comment about how different their triangles are.
Watch the sums students are finding; if they are very different from the expected 180°, encourage (or help) students to re-measure their angles and check their addition.
After completing this task, the websites below may be shared with the students to reinforce what they experienced by doing this task.

Task Directions

Students will follow the directions below from the "Summing It Up" student recording sheet.

You will be exploring the sum of the angle measures of a triangle.

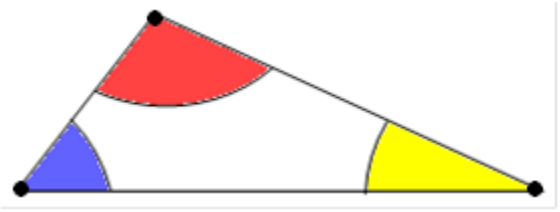
Directions:

Part 1

1. Using a straightedge, make a triangle on a separate piece of paper. Make your triangle big enough to easily measure each angle.
2. Measure each angle of the triangle using a protractor.
3. Write the measure of each angle inside the angle.

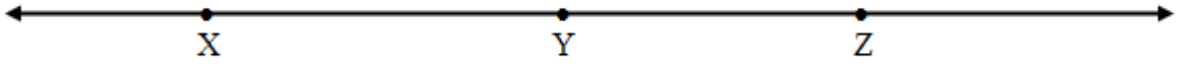
Find the sum of the measures of the angles.

4. Record your sum on your paper and on the white board. **Sum of Angles_____**
5. Look at the class data on the white board. **What do you notice about the sum of the angle measures of triangles?**



Part 2

1. Look at ∠ XYZ below. **What type of angle is ∠ XYZ? What is the measure of ∠ XYZ? How do you know?**
2. Put a point on each vertex of your triangle.
3. Color each angle a different color as shown.
4. Cut out your triangle.
5. Carefully tear off each angle from your triangle.
6. Place the angles along the line below, placing the vertices of the angles on point Y on the line. Angles should not overlap.
   What do you notice? Compare your results with the results of your neighbors. On the back of this paper, write a conjecture about the sum of the angle measures of any triangle.



FORMATIVE ASSESSMENT QUESTIONS

- Is your triangle different from your elbow partner's triangle? How is it different?
- What did you find for the sum of the angle measures? Show how you measured one of the angles.
- What do you notice about the sums you and your classmates are finding?
- What do you know about a straight angle?
- How do the angles fit on ∠ XYZ?
- Can you take any three angles whose sum is 180 degrees and create a triangle with them, or do you have to start with a triangle, tear it apart, and find that the angles sum is 180 degrees? Will this idea work both ways, or just one? Start tearing up those triangles!

DIFFERENTIATION

Extension

- Have students explore quadrilaterals in a manner similar to the way students explored triangles.
- To explore other shapes besides triangles and quadrilaterals, allow students to explore the activity Angle Sums. http://illuminations.nctm.org/ActivityDetail.aspx?ID=9.

Intervention

- This task may be more manageable if done with a partner or in a small group with explicit teacher direction.

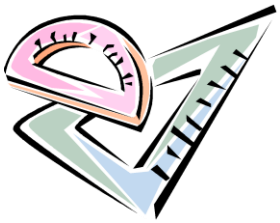
Intervention Table

TECHNOLOGY

- https://prod.classflow.com/classflow/#!/product/itemId=fd838e4b0bcf4ce08202386a56641370 This activity can be used with an ActivSlate or Smartboard. It can be used for additional practice or extending this task.
- https://www.primarygames.co.uk/pg2/bhunt/bhunt.html Banana Hunt: This game requires monkeys to be place at the proper angle degree in order to collect bananas. It can be used for additional practice.
- http://www.amblesideprimary.com/ambleweb/mentalmaths/protractor.html Angles: This activity can be used by the student or teacher to review angles and how to use a protractor.

Name _____ Date _____

Summing It Up



You will be exploring the sum of the angle measures of a triangle.
Directions:

Part 1

1. Using a straightedge, make a triangle on a separate piece of paper. Make your triangle big enough to easily measure each angle.
2. Measure each angle of the triangle using a protractor.
3. Write the measure of each angle inside the angle.
4. Find the sum of the measures of the angles.
5. Record your sum on your paper and on the white board. **Sum of Angles _____**
6. Look at the class data on the white board. **What do you notice about the sum of the angle measures of triangles?**

_____

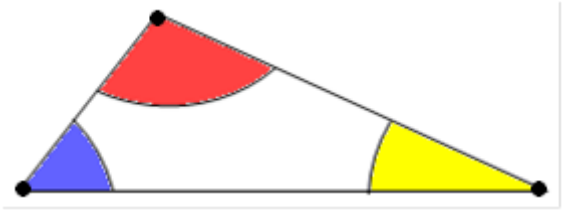
_____

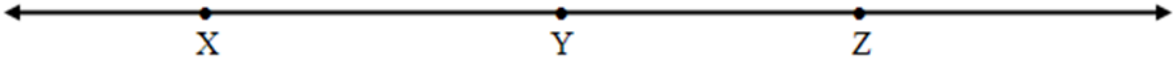
Part 2

7. Look at ∠ XYZ below. **What type of angle is ∠ XYZ? _____**

   What is the measure of ∠ XYZ? How do you know? _____

   _____
8. Put a point on each vertex of your triangle.
9. Color each angle a different color as shown.
10. Cut out your triangle.
11. Carefully tear off each angle from your triangle.
12. Place the angles along the line below, placing the vertices of the angles on point Y on the line. Angles should not overlap.
    What do you notice? Compare your results with the results of your neighbors. On the back of this paper, write a conjecture about the sum of the angle measures of any triangle.





Unit 7 Culminating Task- Part 2

PERFORMANCE TASK: Angles of Set Squares

Return to Task Table

TASK CONTENT: Students will combine shapes to make angles and find measures of unknown angles in a triangle.

STANDARDS FOR MATHEMATICAL CONTENT

MGSE4.MD.5. Recognize angles as geometric shapes that are formed wherever two rays share a common endpoint, and understand concepts of angle measurement:

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

MGSE4.MD.6 Measure angles in whole-number degrees using a protractor. Sketch angles of specified measure.

MGSE4.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 or letter for the unknown angle measure.

STANDARDS FOR MATHEMATICAL PRACTICE TO BE EMPHASIZED

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.

BACKGROUND KNOWLEDGE

Students should have had experience with exploring and measuring angles. Also, students need to know the sum of the angle measures of a triangle is 180°

Students are confused as to which number to use when determining the measure of an angle using a protractor because most protractors have a double set of numbers. Students should decide first if the angle appears to be an angle that is less than the measure of a right angle (90°) or greater than the measure of a right angle (90°). If the angle appears to be less than 90°, it is an

acute angle and its measure ranges from 0° to 89°. If the angle appears to be an angle that is greater than 90°, it is an obtuse angle and its measures range from 91° to 179°. Ask questions about the appearance of the angle to help students in deciding which number to use.

ESSENTIAL QUESTIONS

- How can we use the relationship of angle measures in a triangle to solve problems?
- How can angles be combined to create other angles?
- How can we use angle measures to draw reflex angles?

MATERIALS

- "Angles of Set Squares, Angle Measures" student sheet
- "Angles of Set Squares" student recording sheet
- "Angles of Set Squares, One Angle" student recording sheet (intervention)

GROUPING

Individual/Partner Task

NUMBER TALKS

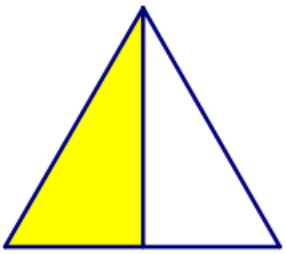
Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. Catherine Fosnot has developed problem "strings" which may be included in number talks to further develop mental math skills. See *Mini lessons for Operations with Fractions, Decimals, and Percents* by Kara Louise Imm, Catherine Twomey Fosnot and Willem Uittenbogaard. (*Mini lessons for Operations with Fractions, Decimals, and Percents,* 2007, Kara Louise Imm, Catherine Twomey Fosnot and Willem Uittenbogaard)

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

In this task, students will combine shapes to make angles and explore angle measures of triangles.

Comments
While this task may serve as a summative assessment, it also may be used for teaching and learning. It is important that all elements of the task be addressed throughout the learning process so that students understand what is expected of them.
A set square is not an actual square; it is a pair of triangular-shaped tools that are used in technical drawing. The set square typically contains two triangles, one with 30-60-90 degree angles, and the other 45-45-90 degree angles. The 30-60-90 triangle is half of an equilateral triangle, and the 45-45-90 triangle is half of a square. This lesson utilizes both types of set squares.

To introduce this task, students can be given a square and an equilateral triangle cut from paper. Students can fold the two shapes in order to create the two triangles used for this task. The shapes should be folded as shown and then cut along the fold.



Students should be able to determine that the diagonal of the square cuts the right angle into two equal angles of 45°. Also, the altitude of the triangle cuts the angle at the "top" into two equal angles. If each angle of an equilateral triangle is 60°, then two equal angles of 30° are formed. Students may recognize that one angle in each triangle is a right angle. (All angles of a square are right angles, and the altitude of a triangle forms a right angle where it intersects the side.) Therefore, students know the measures of two of the angles of each of the "set squares" triangles. They will need to use what they know about triangles (previous task) to find the measure of the third angle.

> 90° + 30° = 120°, 180° - 120° = 60°; therefore, the measure of the third angle of the first triangle is 60°.
>
> 90° + 45° = 135°, 180° - 135°= 45°; therefore, the measure of the third angle of the first triangle is 45°.

The angles that can be created using the set squares are 30, 45, 60, 75, 90, 105, 120, 135, and 150 degrees and their reflex angles 330, 315, 300, 285, 270, 255, 240, 225, and 210 degrees.
Note that angle measures are multiples of 15 degrees, but we are missing angles with measures of 15 and 165 degrees. Challenge students to determine a method for drawing an angle of 15 degrees and then 165 degrees. (You can make a 15-degree angle by looking at the difference between 45- and 30-degree angles. Once you create a 15-degree angle, you can use it to create a 165-degree angle.)

Task Directions
Part 1

Give students a square and an equilateral triangle cut from paper. Students will follow the directions below from the "Angles of Set Squares, Angle Measures" student recording sheet.

> You will use "set squares" during this task.

Directions:

1. Measure the angles of each triangle using a protractor.
2. Write the measure inside each angle.
3. Use what you know about the angle measures of a triangle to check to be sure you measured correctly. Show your work below.
4. Cut out the triangles carefully.

Part 2

Next, students will follow the directions below from the "Angles of Set Squares" student recording sheet.

Using the set squares you cut out, find all possible angles you can make with any angle or combination of two angles in the pair of set squares. Draw and label the measure of the different angles you find.

Here are some hints:

- There are at least 20 angles that can be found.
- Don't forget reflex angles!
- Think about comparing angles to find new angle measures.

Organize your work in a way that makes it easy for others to understand.

FORMATIVE ASSESSMENT QUESTIONS

- How could you make your own set squares?
- How do you know the angle measures are correct? Can you tell me two ways?
- How can you combine angles to create new angles?
- How can you compare angles to create new angles?
- How do you know you have found all of the possible angles?
- What is a reflex angle?
- How are you organizing your work so that you are sure you have found all possible angles?

DIFFERENTIATION

Extension

- Have students use the angles of two different pattern blocks to create a new angle. For example, use an orange square (90^o angles) and a tan rhombus (30^o and 150^o).

Intervention

- Have students work with one of the set squares to determine the angles and make observations before introducing the second one. Use the "Angles of Set Squares, One Angle" student recording sheet for the 30-60-90-triangle.

Intervention Table

TECHNOLOGY

- http://www.ictgames.com/weight.html Interactive games to explore the concept of weight and scales
- http://www.primarygames.co.uk/pg2/bhunt/bhunt.html Banana Hunt: This game requires monkeys to be placed at the proper angle degree in order to collect bananas. It can be used for additional practice.
- https://apps.mathlearningcenter.org/pattern-shapes/ Angle Measurements: This tool can be used by the student or teacher to review angles and how to use a protractor to measure.
- https://www.mathplayground.com/measuringangles.html Measuring angles
- https://www.funbrain.com/games/shape-surveyor A fun, interactive game to practice area and perimeter of shapes
- http://www.sheppardsoftware.com/mathgames/geometry/shapeshoot/PerimeterShapesShoot.htm Perimeter shape game
- https://www.turtlediary.com/games/area-and-perimeter.html Area and Perimeter games

Name _____ Date _____

Angles of Set Squares

Angle Measures

You will use "set squares" during this task.

Directions:

1. Measure the angles of each triangle using a protractor.
2. Write the measure inside each angle.
3. Use what you know about the angle measures of a triangle to check to be sure you measured correctly. Show your work below.

Name _____ Date _____

Angles of Set Squares

Using the set squares you cut out, find all possible angles you can make with any angle or combination of two angles in the pair of set squares. Draw and label the measure of the different angles you find.

Here are some hints:

- There are at least 20 angles that can be found.
- Don't forget reflex angles!
- Think about comparing angles to find new angle measures.

Organize your work in a way that makes it easy for others to understand.

Name _____ Date _____

Angles of Set Squares

One Angle

Complete the chart by tracing angles of your "set squares" with the given measures.

30°	60°
90°	270°
300°	330°